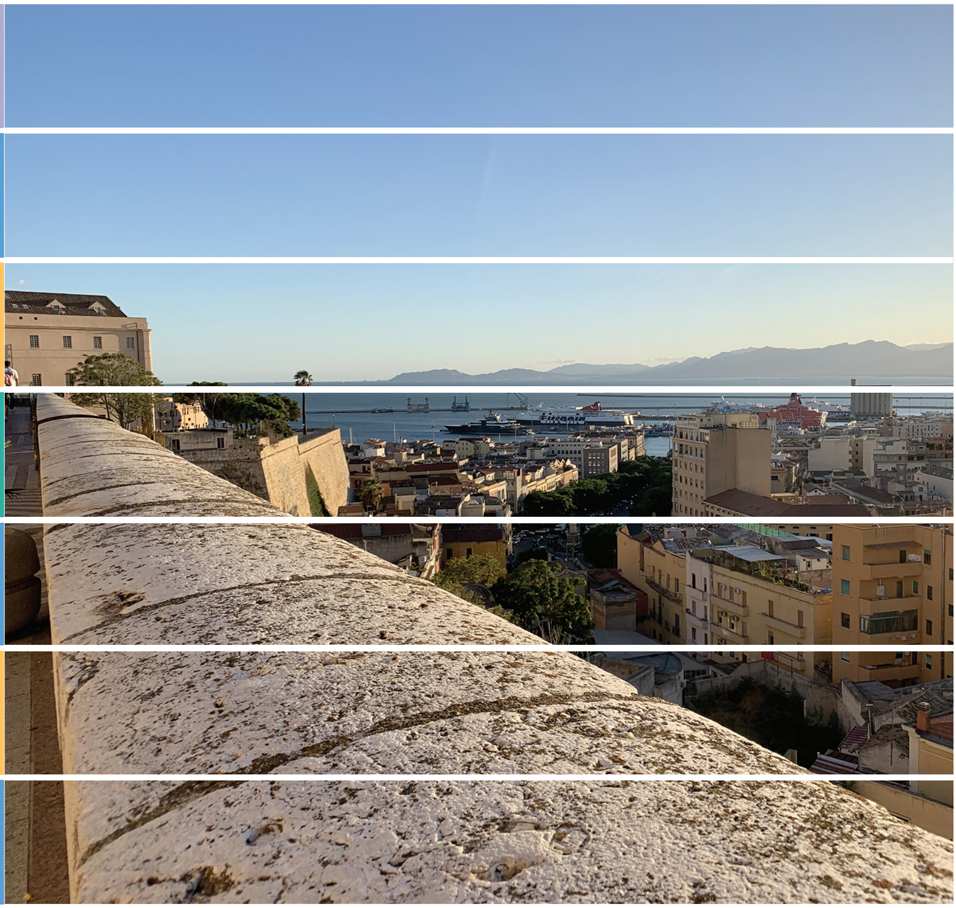
Carmela Gargiulo Corrado Zoppi
Editors

Planning, Nature and Ecosystem Services



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Carmela Gargiulo Corrado Zoppi

Editors

Planning, Nature and Ecosystem Services

INPUT aCAdemy 2019

Conference proceedings

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INPUT aCAdemy 2019

This book collects the papers presented at INPUT aCAdemy 2019, a special edition of the INPUT Conference hosted by the Department of Civil and Environmental Engineering, and Architecture (DICAAR) of the University of Cagliari.

INPUT aCAdemy Conference will focus on contemporary planning issues with particular attention to ecosystem services, green and blue infrastructure and governance and management of Natura 2000 sites and coastal marine areas.

INPUT aCAdemy 2019 is organized within the GIREPAM Project (Integrated Management of Ecological Networks through Parks and Marine Areas), co-funded by the European Regional Development Fund (ERDF) in relation to the 2014-2020 Interreg Italy – France (Maritime) Programme.

INPUT aCAdemy 2019 is supported by Società Italiana degli Urbanisti (SIU, the Italian Society of Spatial Planners), Istituto Nazionale di Urbanistica (INU, the Italian National Institute of Urban Planning), UrbIng Ricerca Scientifica (the Association of Spatial Planning Scholars of the Italian Schools of Engineering) and Ordine degli Ingegneri di Cagliari (OIC, Professional Association of Engineers of Cagliari).

This book is the most recent scientific contribution of the "Smart City, Urban Planning for a Sustainable Future" Book Series, dedicated to the collection of research e-books, published by FedOAPress - Federico II Open Access University Press. The volume contains the scientific contributions presented at the INPUT aCAdemy 2019 Conference. In detail, this publication, including 92 papers grouped in 11 sessions, for a total of 1056 pages, has been edited by some members of the Editorial Staff of "TeMA Journal", here listed in alphabetical order:

- Rosaria Battarra;
- Gerardo Carpentieri;
- Federica Gaglione;
- Carmen Guida;
- Rosa Morosini;
- Floriana Zucaro.

The most heartfelt thanks go to these young and more experienced colleagues for the hard work done in these months. A final word of thanks goes to Professor Roberto Delle Donne, Director of the CAB - Center for Libraries "Roberto Pettorino" of the University of Naples Federico II, for his active availability and the constant support also shown in this last publication.

Rocco Papa
Editor of the Smart City, Urban Planning for a Sustainable Future" Book Series
Published by FedOAPress - Federico II Open Access University Press

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INTRODUCTION

This e-book contains the Proceedings of the INPUT aCAdemy 2019 Conference held at the University of Cagliari on 24-26 June 2019, titled "Planning, nature and ecosystem services."

Input aCAdemy follows the tenth INPUT Conference, held in September 2018 at Tuscia University, in Viterbo and, in some way, it breaks the biennial tradition of the INPUT Conferences. The reason for the frequency increase of the INPUT Conferences is that the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari is involved in a project funded by the Programme INTERREG Marittimo–Italia France–Maritime 2014–2020, Axis 2.

In the context of the project, entitled "GIREPAM–Integrated Management of Ecological Networks through Parks and Marine Areas", the Department and the Office for Nature Protection and forest policies of the Regional Autonomous Administration of Sardinia are studying and defining an experimental methodology to integrate conservation measures concerning Natura 2000 Sites into marine protected areas regulations. The methodology is implemented to build the new regulations of two marine protected areas of Sardinia, namely the Island of Asinara and of the Island of Tavolara and Cape Coda Cavallo.

Since GIREPAM allocates a considerable amount of funds to the organization of an international conference on protection of nature and natural resources, ecosystem services and their relationship with spatial planning processes and practices, green infrastructure, and integrated management of protected areas and Natura 2000 Sites, and these funds must be spent by December 2019, the research group at the Department proposed to the INPUT Community, during the 2018 Viterbo Conference, a 2019 INPUT Conference focussing on these themes. The INPUT Community responded enthusiastically and, that being so, the research group has made every effort to make the event come true.

The Conference develops through plenary sessions and parallel tracks. The scope of the plenary sessions is to propose distinguished points of view concerning research and implied planning ideas and policies on important and significant issues which feature the ongoing scientific and technical debate on nature and natural resources.

The questions proposed and discussed in the Conference are three central topics which are characterized by several studies available in contemporary literature, and by vibrant debates as well, both from the theoretical and technical points of view. These questions are presented and discussed in the three plenary sessions which are the starting points of the three days of the Conference. Each plenary session is organized as follows: first, a speaker, a distinguished scholar, proposes the findings of his theoretical and/or applied research work and derived implications for spatial policy; secondly, a discussant, a distinguished

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scholar as well, critically analyzes the positions expressed in the first place and identifies open or unresolved questions and outstanding issues; thirdly, the public enters the discussion, through questions, observations, critical positions. Finally, the speaker replies to the discussant's and to the public's statements.

The first plenary session is on "Valuing ecosystem services in money: A necessary evil for protecting biodiversity?"; the speaker is Erik Gomez-Baggethun (Faculty of Landscape and Society, Norwegian University of Life Sciences); the discussant is Andrea Arcidiacono (Department of Architecture and Urban Studies, Polytechnic University of Milan).

The second plenary session concerns "Managing urban ecosystems for goods and services"; the speaker is Kevin Gaston (Environment and Sustainability Institute, University of Exeter); the discussant is Bernardino Romano (Department of Civil, Building-Architecture and Environmental Engineering, University of L'Aquila).

The third plenary session is related to "Mapping and modeling ecosystem services: A cascade ES modeling approach applied to the Flemish Natura 2000 Network"; the speaker is Jan Staes (Department of Biology, University of Antwerp); the discussant is Beniamino Murgante (School of Engineering, University of Basilicata at Potenza).

The topics presented in the plenary sessions are the background of the discussions which characterize the parallel tracks. These tracks are featured by studies which consider protection of nature and natural resources, ecosystem services and their relationship with spatial planning processes and practices, as regards the following topics:

1. Ecosystem services and spatial planning;
2. Integrated management of marine protected areas and Natura 2000 sites;
3. Rural development and conservation of nature and natural resources;
4. Geodesign, planning and urban regeneration;
5. Green and blue infrastructure;
6. Smart city planning;
7. Water resources planning, ecosystem services and nature-based solutions in spatial planning;
8. Conservation and valorisation of architectural and cultural heritage;
9. Accessibility, mobility and spatial planning;
10. Tourism and sustainability in the Sulcis area;
11. Ecological networks and landscape planning.

The closing plenary session of the Conference proposes a roundtable discussion on "Planning Nature 2000 Network and protected areas: The integration of conservation measures into regulations." The roundtable will involve panelists from several institutions who participate in the GIREPAM Project.

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THE DANUBE RIVERSIDE DEVELOPMENT IN THE IRON GATES GORGE, SERBIA, BETWEEN SOCIO-ECONOMIC NEEDS AND PROTECTED ECOSYSTEM

BRANISLAV ANTONIĆ[a], ALEKSANDRA DJUKIĆ[a], MILICA CVETANOVIĆ[b]

[a] Department of Urbanism
University of Belgrade, Serbia
e-mail: antonic83@gmail.com
adjukic@afrodita.rcub.bg.ac.rs
URL: http://www.arh.bg.ac.rs/

[b] Department of Regional Geography
University of Belgrade, Serbia
e-mail: mimacvetanovic@gmail.com

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ABSTRACT

The Iron Gates are the longest gorge of the Danube, a major waterway in Europe. For Serbia, the Danube is both important as a transport corridor and tourist route, which is also applied for the Iron Gates part. In the other side, the Iron Gates are the largest national park in Serbia, with protected river and mountain ecosystems, plus many cultural heritage sites, which significantly restricts riverside development. Third, it is also a region with its local population, settlements, and economy. This overlapping makes any future planning perspective for the Iron Gates Region very complex and with expected compromises. The current spatial plans for the Iron Gates recognise this complexity. This is particularly visible along the Danube riverside. The river is certainly the main access to the gorge and the main driver of desirable socioeconomic development for local communities thereof. However, the development along the river is impossible in many parts due to protected riverside areas or rough terrain. Remaining parts have the other problems with inadequate plot organisation. Therefore, the implementation of the plans carries many challenges at lower levels. The aim of this paper is to present this discrepancy and offer new ways for concrete solutions. It compares the main planning actions to facilitate local socio-economic development and the newest efforts of local authorities to implement them for riverside as a critical resource for the region. The final highlights are dedicated to the actions that are unorthodox and thereby innovative for riverside development in unique ecosystems.

KEYWORDS
Water Infrastructure; Riverfront Development; Tourism; Protected Ecosystem; the Danube; the Iron Gates

1 INTRODUCTION – DEVELOPMENTIN PROTECTED ECOSYSTEMS

Ecosystems and their sustainable use are always an 'old-new' topic for scholars. One of its simpler definitions explains that ecosystems are the specific systems formed in correlation between living organisms and their non-living surrounding in a particular area (CDO, 2019). In the other words, the meaning of a community instead of an individual (species) is in focus (Smith, 2013). Interestingly, this meaning can be expanded to some, at first very different systems, such as urban areas. Considering the structure of cities as a system created in interaction between humans and their built environment (Lynch, 1960), both systems show noticeable similarities in their functioning (Steinitz & Rogers, 1970; Stremke & Koh, 2010).

Completely natural and urban ecosystems are extremes in the meaning of an ecosystem. An academically more researched type is the natural ecosystems that require protection due to challenging natural-human relations. In their essence, all ecosystems are under the influence of different external and internal factors (Chapin, Matson & Vitousek, 2002). These factors can be purely natural, such as topography or climate, or from anthropogenic activities, such as settlements and economy. The ecosystems seen as protected areas are also a subject of international concern. The International Union for Conservation of Nature (IUCN) defines a protected area as a "clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). This definition undoubtedly links ecosystems and protected areas.

The "hotspot" about protected ecosystems in the last decades is how properly managing them to meet protection needs and their viable utilization (Lackey, 1998; McDonald, 2018). Therefore, the IUCN (2010) prioritizes several types of protected areas in its current operative program. One of them is transboundary protection areas. In the case of Serbia, the most important example is the Iron Gates (Serb. Ђердап/Đerdap) protected area, halved between Romania to the north and Serbia to the south (Fig. 1). The Iron Gates are actually the greatest gorge on the Danube River, the second longest in Europe, which implies that this location had significance through history. The gorge with mountainous landscapes at both backsides is a large protected ecosystem. The protection encompasses numerous smaller sites of natural and cultural heritage, as well as the whole gorge as an entity. Hence, the Iron Gates are a sensitive area in which any kind of development must be carefully planned. In the recent years, this has been especially noticeable in the case of booming cultural tourism, because protected areas have preserved the particular character that attracts tourists (Adams, 2008).

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An expected answer to the previous situation is to set adequate planning actions for an ecosystem, which must make a right balance between its ecological protection and spatial utilization (Steiner, 2002). A proper planning, including both functional and physical design, is a paramount task for the viability of protected ecosystems today (Stremke & Koh, 2010). This dichotomy can be applied for the national parks in Serbia (Jovičić & Ivanović, 2004). The current spatial plans for the Iron Gates Region also recognize this complexity. This is particularly visible along the riverside of the Danube, which is certainly the main access to the gorge and the main driver of desirable socio-economic development for local communities thereof. However, this type of development is forbidden or very limited in many parts due to protected riverside areas or rough terrain. Remaining parts have the other problems with inadequate plot organization. Therefore, the implementation of capital projects by plans carries many challenges at municipal and urban/settlement levels.

The aim of this paper is to present this discrepancy and offer new ways for concrete solutions. It compares the main planning actions to facilitate local socio-economic development and the newest efforts of local authorities to implement them for riverside as a critical resource for the region. For many of them, it can be easily concluded that “ordinary” planning actions cannot enable the capital projects in the Iron Gates. Hence, final highlights refer to the actions that are unorthodox and thereby innovative for riverside development in this unique ecosystem.

2 METHODOLOGY

The concrete subject of this research is the western third of the Serbian Iron Gates, around Golubac Town. The research is developed as a case study, followed by structure and used material. It combines three methods as separate analyses. Before them, the key elements of relevant theory are given.

The analyses are organised by three respective levels:

- the first analysis is the research of the main policy documents for investigated area, e.g. three spatial plans of regional and municipal levels. A special focus is on the capital projects in the Danube Riverside. The plans are: (i) spatial plan of the special-purpose area of the international waterway E80 –the Danube (Pan-European Corridor VII)[Serb. Просторни план подручја посебне намене међународног водног пута E80 – Дунав (Паневропски коридор VII)], (ii) spatial plan of the special-purpose area of “Đerdap” National Park [Serb.Просторни план подручја посебне намене Националног парка “Ђердап”], and (iii) spatial plan of Golubac Municipality (Serb.Просторни план Општине Голубац].

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- the second analysis is a field research, including the communication with local experts and representatives from Golubac, regarding the implementation of the capital projects. It links municipal and urban/settlement levels (Golubac Municipality and Golubac Town as its seat);
- the third analysis pertains to plot organisation in the riverside part of Golubac Town, with the emphasis on its (in)compatibility with the capital projects planned for this area.

All three analyses are a matter for a mutual discussion after their explanation. The main findings from this discussion lead to the introduction of the aforementioned "unorthodox" approach proposed by Golubac Municipality, which deals with resolving the implementation of capital projects at the local level.

3 CASE STUDY –THE IRON GATES GORGE IN SERBIA

A case study is the area around Golubac Town, which also administratively concurs with the eastern half of Golubac Municipality. Golubac Town itself is located at the western entrance of the Iron Gates gorge – it has strategic position between Pannonian Plain (west) and the Iron Gates Gorge (east). Nearby Golubac Fortress marks the unique position of the dramatic landscapes change (Fig. 1a).

The Iron Gates are a large transboundary protection area, protected separately by both countries; it is a "Đerdap" National Park in Serbia and "Porțile de Fier" Natural Park in Romania. Serbian park is older, established in 1974, and it is the largest national park in country (Stanković, 2002). Romanian park was established in 1990 and it is the second largest natural park in country (Toniuc et al., 1992). The total surface of both areas is 1,794 km2. This coverage roughly corresponds to the Iron Gates Region.

The entire region presents a huge and rich ecosystem. First, the gorge is not uniform; it contains of four inner gorges ("narrows" or canyons) and three inter-valleys. This allows the change of the elements of natural and cultural landscape with many specific segments of the scenery (Fig. 1b). Geologically, "the Danube [in the gorge] offers a rare, unique glimpse in the geology of the South Carpathians, as it crosses transversally the folded structures of this alpine chain" (Popa et al., 2004, p. 7).). Unique flora and fauna, mostly emphasised in the deciduous forests follow this (Niculae, 2002). On the other side, human-made parts of landscape are visible, but with a different impact across the gorge. The most important change by humans is certainly the formation of large Iron Gates artificial lake in the early 1970s. This led to the flooding the lowest part of the gorge with all previous islands and the reallocation of several settlements (Orşova, Donji Milanovac) and the most valuable heritage

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sites (Tabula Traiana, "Lepenski Vir" archaeological site), leaving old settlements to be flooded. The destiny of "Lepenski Vir" with the remnants of the oldest permanent settlement along the Danube is particularly interesting (Fig. 1c). Its site is dislocated by 100 meters away from its original location, with the intention to preserve the previous ambient in ecosystem (Pavlović, 2017). The artificial lake is thereby a prominent new element of landscape (Stanković, 2002). Accordingly, formation of the lake formed a new riverside, too. These lower parts of the gorge, next to the Danube are more under human influence, which mirrors through settlement formation and agriculture, especially orchards and pastures (Niculae, 2002). At the end, the historic remoteness and contemporary socio-economic problems have made the region more attached to tradition and with preserved tradition and local customs (Antonić & Đukić, 2018). Therefore, human influence in the Iron Gates can be considered as mixed – both positive and negative (Popa et al., 2004).

Fig. 1 The Đerdap (Iron Gates) National Park: its position in Serbia and the location of the main heritage sites in it, including the most prominent ones: Golubac Fortress (a), Kazani Narrows (b) and "Lepenski Vir" archaeological site (c) (Author: B. Antonić; Author of photos: B. Antonić; Supplementary maps: Google Maps).

4 ANALYSES AND RESULTS

4.1 ANALYSIS 1: THE INPUTS ABOUT CAPITAL PROJECTS FROM STRATEGICPLANS

The first analysis considers Golubac area from national perspective, because all three mentioned plans are developed at national level.

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Spatial plan of the special-purpose area of the international waterway E80 – the Danube (Pan-European Corridor VII) (Hereinafter: the Danube Plan): In this spatial plan from 2013, it was mentioned that a passenger dock at Golubac Fortress will be built (as it was done). Within this area, there is already cargo dock in Golubac (in bad state, for reconstruction). It was also planned to build a nautical centre in the central part of the Danube Riverside in the Iron Gates gorge (Serbia), but this has not yet been implemented. Several minor projects, such as marinas and new border crossings for ferry transfers, are also mentioned and mapped. The Danube plan also underlines the direct positive effects of the corridor development of the Danube waterway and its surroundings are expected from tourism. For the development of sustainable tourism, it is necessary to provide the marking of directions of movement through the forest complex, to build the necessary infrastructure facilities, to present the tourist offer and to monitor the visit (NASP, 2010).

Spatial plan of the special-purpose area of "Đerdap" National Park (Hereinafter: Đerdap Plan): This plan was purposely created and enacted for the park in 2012. It foresees several capital projects for the area. One visitor centre was built (more is planned), the Golubac Fortress is reconstructed, with new road bypass. Priority is given to the development of conservation conditions and projects for the preservation, improvement and sustainable use of immovable cultural assets and their protected environments in the context of tourism development. The construction and modernization of the road network, the development of river passenger traffic, the promotion and development of cycling traffic within EuroVelo 6 corridors is planned (and partly implemented). In terms of tourism, the realisation of nautical-tourist infrastructure (marinas, docks and nautical centres) is planned and this is accomplished with a minor part. Five tourist spots are planned on the "Road of the Roman Emperors" section in the gorge. One of the priorities is the construction of tourist facilities with respect to ecological criteria, bio-climatic architecture, the use of renewable energy sources, and compliance with the landscape (NASP, 2009).

Spatial plan of Golubac Municipality (hereinafter: Municipal Plan): This spatial plan (2011) prioritise the improvement of Golubac Town as a municipal seat, primarily with public services and tourist facilities. Priority activities in rural settlements along the Danube are: increase of traffic accessibility, development of eco-agriculture, start of development of capacities in the field of rural tourism (renovation, arrangement and equipping of villages suitable for the development of eco, ethno and gastronomic tourism). These types of tourism would play a major role in the development of cultural tourism by learning about the local tradition and cuisine of this region. Rural tourism in the Iron Gates is still underrepresented, but incentives for Dobra village are mentioned. The main projects are: the town marina, new border crossing, new tourist pier for the fortress, and the

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modernisation of the town beach in its western outskirts (Arhiplan, 2011). The summary map of the capital projects in Golubac area (Fig. 2) distinctly presents where national level should control the development of the area. It is obvious that most of these projects are located on the Danube Riverside and that they are functionally dependent of the river. Nevertheless, the prioritisation of the projects varies between the plans. Finally, some collisions about the location or character of intervention (new/renewal) are also noticeable in these plans. For illustration, it is questionable by the plans should the pier of Golubac Fortress be new or renewed or where is an exact location for a new marina in Golubac Town – in the existing western of eastern small ports.

Fig. 2 The summary map of capital projects in Golubac area from strategic plans (Author: B. Antonić).

2.2 ANALYSIS 2: FIELD RESEARCH

Field research was conducted in 2017 and 2018, integrating two types of research: fieldwork with data collecting and professional communication with local representatives and experts. The topic was the general development of the Danube Riverside in Golubac Municipality. The outcomes of this research show a stance from local/municipal tier. One of the main observations is the distinction of the development potential regarding the areas inside and outside the national park (Fig. 2 – green area), due to the regulation of a protected ecosystem.

The main goal of local representatives and experts is certainly the development of tourism, with a special emphasis on cultural tourism. The reconstruction of Golubac Fortress is in progress but has already fuelled tourism; according to a local tourist guide, about 50 cruisers docked in front of the fortress and about 80,000 tourists visited the fortress in 2018. However, the main problem in local tourism is that the majority of tourists just pass through the town to reach the fortress, where they spend maximum 2-3 hours. They rarely spend more time in this area due to still weak supportive tourist service and infrastructure. Thus, local revenues are still low comparing the attractiveness of Golubac Fortress and the

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Iron Gates in its background, which is an issue for this shrinking community. The main local observations regarding new capital projects for Golubac urban zone are:

- the reconstruction of Golubac Fortress with the construction of supplementary visitor centre with parking and cruiser pier is almost completed. The last step is the revitalisation of the fortress vicinity, including an apartment village ("fishermen village" project);
- new big-format tourist facilities in Golubac Town are a very challenging issue for a municipality. "Golubački Grad" Hotel on the main town square from the 1980s was privatised after 2000. However, new owners are not capable to modernise it, so the hotel offer is substandard. Public sector has a limited influence in the private ownership. Hence, municipal authorities estimate that the construction of a completely new hotel in a different location in Golubac is a more probable solution;
- the proposed project for the main road bypass around the town is contested, too. The town is currently under the pressure of dense traffic because the Iron Gates Main Road (National Road No 34) passes through the centre of Golubac. However, this road also brings travellers and tourists and support local retail;
- a new 7-km long quay with pedestrian and cyclist path along the Danube Riverside in Golubac is 70% done. The path is a part of "EuroVelo 6" Route. The remaining part between the town and the fortress, which is technically the most complex due to cliff terrain, is left for the future;
- a project for a new marina is the first stage of preparation. After long negotiation, western port was chosen for this facility, but available land is too small for the format of a modern marina;
- a new border crossing by ferryboat is almost completed in the western outskirts of the urban zone (Usije). Serbian part was completed, but Romanian border crossing is still in preparation;
- the upgrading of the town beach in Vinci weekend-house zone at the north-western edge of the urban area is a long-waiting project. The existing beach is used, but mostly by the local population. This upgrading for tourism purposes request a complex technical intervention, to secure the beach facilities from strong winds and waves during winter months.

2.3 ANALYSIS 3: MAPPING OF LAND ORGANISATION

The previous section scrutinises local view on the capital projects in Golubac area. Capital projects, such as a new marina or a hotel, certainly require large land plots. The problem is

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the current land organisation (Fig. 3). In the town centre, all available plots are small and individually inadequate for any capital project thereof. The process of land consolidation among many owners is very complicated in Serbia, so it is always the last option. Several larger plots along the riverside are suitable by size, but they are in public ownership and in public use (town park, local education centre). Outside Golubac centre, the only large land plots are at its eastern outskirts. Nevertheless, these plots are in state ownership and belong to "Đerdap" National Park, which defines them as the part of a protected ecosystem and restricts their future use and development without any construction.

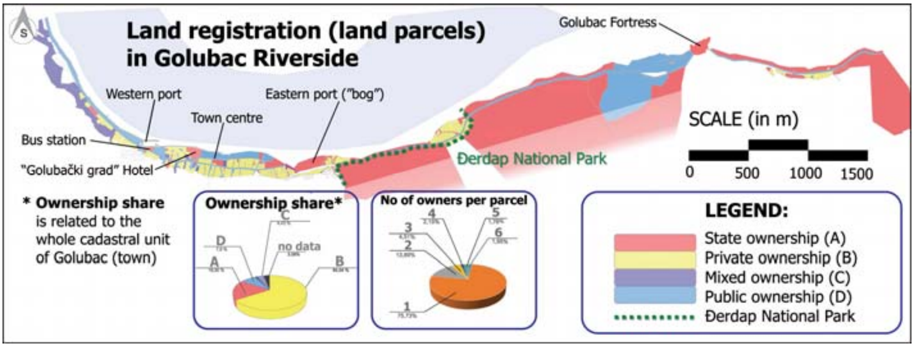

Fig. 3 The map of land registration (land parcels) in Golubac Riverside / Resource: Municipal cadastre (Authors: N. Mandić, M. Kostadinović & S. Mićanović /Customised by B. Antonić).

5 INSTEAD OF AN ORDINARY CONCLUSION. INNOVATIVE APPROACHES TO ACQUARE A LAND FOR THE NEW RIVERSIDE DEVELOPMENT

A general notion from three elaborated analyses presents a sharp dichotomy between national and local levels. To summarize, the capital projects in analyzed spatial plans are generally greeted by national level as a key element to the foster long-awaited socio-economic development of Golubac. In the other side, their implementation faces big obstacles at urban level, considering the current land organisation in Golubac. Knowing that small municipal government, such as Golubac, has limited resources, possible ways for land consolidation are even more questionable. This situation demonstrates significant discrepancies between different vertical levels of "classic" territorial planning. Golubac municipality thereby aspires to find some "unorthodox" solutions for its capital projects. This is related to a unique position at the end of artificial Iron Gates Lake, where the current Danube Riverside is also new, from the 1970s.Without this limit, land reclamation is proposed as a model to fully or partly obtain land plots for capital projects from the lakebed. This is also an innovative approach for Serbia. Some on-going projects have already used

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land reclamation; the new visitor centre of Golubac Fortress was built on reclaimed land. Local authorities are planning the following land-reclamation interventions:

- the land for a new big-format hotel with more exclusive facilities should be developed on the land reclaimed from the town eastern 'port', which is actually a bog and without any use today. The position of this new land is excellent for this type of a hotel, because it is next to the main road and between the town centre with historic fabric (western) and the national park and the fortress (eastern);
- in the case of the town road bypass, a middle solution is backed by local level. This refers to the new bypass road just for the most problematic transport (heavy vehicles like regional buses and lorries), while the other vehicles will use the current route, to support local economy;
- the last and the technically most contested eastern part of the Danube quay with pedestrian-cyclist path is to be resolved by the construction of a bracket-structured path, inclined in the cliffs along the river;
- a project for a new marina is already in preparation. The location is the existing (western) port, which will be further enlarged and upgraded with the new technical and leisure facilities. A part of the future complex will be built on the land reclaimed from the riverbed;
- the new border crossing is intentionally built at the western part of Golubac area – Usije Settlement, to make balance in the spatial development of the Danube Riverside. The municipality dedicated a bigger plot for the border crossing, as a reserve for the future needs;
- similarly, the existing beach in Vinci northwest area is to be resolved through land reclamation. This is less drastic, in the form of a several-meters wide "belt" with concrete sand boxes that will gradually descend to water and preserve the sand from strong winds and waves.

Many of explained interventions are still in the form of proposals. It is also evident that most of them are financially, technically, and professionally demanding due to compromise with the protected ecosystem of the gorge. This means that local level cannot implement them without external influence. Therefore, the next step for local authorities is to promote these projects and related interventions externally, but not just to national government. New approaches should be made to access to the private incentive, which will bring a new energy in local development.

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AUTHOR'S PROFILE

Branislav Antonić is a teaching assistant at the Department of Urbanism, University of Belgrade – Faculty of Architecture, Serbia. His scientific and pedagogical interests are urban and spatial planning, with a special focus on the planning of medium-size and small communities, as well as the spatial aspect of housing and tourism. He is an active participant in scientific conferences and exhibitions. He is also a licensed urban and spatial planner with professional involvement in more than 30 spatial and urban plans and urban design projects.

Aleksandra Djukić is an associate professor at the Department of Urbanism, University of Belgrade – Faculty of Architecture, Serbia. Her scientific and pedagogical interests are urban planning and design, with a special respect on urban morphology and urban renewal and regeneration. She is an active participant in scientific conferences and exhibitions. She is also a licensed urbanist, planner and architectural designer – she was the leader of member of working team in numerous documents in urban planning and design, as well as in architectural design and spatial planning.

Milica Cvetanović is a PhD student of geography, narrower scientific field regional geography, at University of Belgrade – Faculty of Geography, Serbia. Her scientific interests are regional geography, tourism and sustainable development, with a focus on researching the importance of tourism in the sustainable development of the regions. She is primarily involved in the research of the regions in Serbia. She participated with scientific papers at national and international conferences and published several papers in journas of national importance.

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FROM A SPECIES-CENTRED TO AN ECOSYSTEM-BASED MANAGEMENT APPROACH

A CASE STUDY OF THE SALTMARSHES OF HYÈRES (PROVENCE, FRANCE)

***PATRICK ASTRUCH[a]**
CHARLES-FRANÇOIS BOUDOURESQUE[b]
THOMAS CHANGEUX[b]

[a] GIS Posidonie, Mediterranean Institute of Oceanography (MIO)
Aix-Marseille University, France
e-mail: patrick.astruch@univ-amu.fr

[b] Aix-Marseille University and Toulon University
CNRS, IRD, MIO (Mediterranean Institute of Oceanography), France
e-mail: charles.boudouresque@mio.osupytheas.fr

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ABSTRACT
The management of the complex saltmarshes-wetlands-coastal lagoons (hereafter: saltmarsh ecosystem – SME) is often centred on the so-called 'heritage-value species' (rare, threatened and/or charismatic species). In addition, managers, stakeholders and the public at large, generally favour certain visible higher-level taxa, such as birds and magnoliophyta, rather than the 'ordinary biodiversity'. This 'species-centred' or 'taxon-centred' approach, a legacy from the 20th century, is fully understandable in areas where species identified as critically endangered occur. However, an ecosystem-based approach, of course including heritage value species and higher taxa, but based upon the whole functioning of the ecosystem, would present advantages of paramount importance. The ecosystem-based approach involves the management of the interactions between functional boxes, the search for an equilibrium according to the supposed baseline, ecosystem services and management goals; it can also involve man within a social-ecosystem-based approach. This approach offers a basis for taking into account the current global change. A conceptual model of the SME has been established. Considering the high diversity of saltmarsh environments, both physically and biologically, this model is a framework that can be adapted to each case study. Here, the authors focused on case studies of Hyères saltmarshes. In the light of historical data running over several centuries (opening and closure of connexions with the sea, fisheries, salt production), the management during the last decades, mainly based upon waterfowl conservation and enhancement, the weaknesses of the traditional species-centred approach and the advantages of an ecosystem-based approach are highlighted.

KEYWORDS
Coastal Lagoons; Saltmarshes; Ecosystem-based Approach; Management; Conservation; Mediterranean

* The other authors are: Daniel Fagetc, Matthieu Lascèved, Laurence Le Diréacha, Laura Massinellia, Flore Moussya.

1 INTRODUCTION

Saltmarshes are a worldwide ecosystem of which the origin and structure vary according to climate, precipitation rate and variability over years. Nevertheless, high functional similarity can be observed worldwide between saltmarsh ecosystems (SME) (Adam, 1990). In temperate microtidal areas such as the Mediterranean Sea, saltmarshes are a complex of both wetland and coastal lagoon or estuarian system. Hereafter, we will use the term saltmarshes with this comprehensive meaning. Saltmarshes play an important role at the interface between terrestrial and marine realms and provide numerous ecosystem services (Costanza et al., 1997; Himes-Cornell et al., 2018). They are often more or less artificialized, and harbour threatened habitats (Gedan et al., 2009; Mollema et al., 2013).
Saltmarshes are therefore ecosystems of high heritage value and concern; many international agreements are aimed at protecting and sustainably managing them (e.g. Ramsar, Habitats Directive Natura 2000, 92/43/EEC) (Evans, 2012). Management plans for SMEs with conservation issues are based on a species-centred approach; goals focus on the maintenance or the enhancement of 'biodiversity' and 'high-value' taxa, namely emblematic, rare, aesthetically attractive and/or threatened species, to the detriment of 'ordinary biodiversity' and species considered as harmful (Boudouresque, 2014; De la Blanchère, 1875). Biodiversity is often seen by managers as the number of species, which is considered as a health index of the ecosystem (Boudouresque, 2014; Wilson, 1988). In reality, disturbances and stress usually increase the number of species (Hastwell & Huston, 2001). Although this species-centred approach has allowed the protection and conservation of key species, the failure to take into account the whole ecosystem functioning has often resulted in artificialized ecosystems and even in failures in species conservation.
The aim of the present work is to apply an Ecosystem-based Approach (EA) to SMEs, in a Mediterranean context. We propose a conceptual model of the SME to understand its functioning and provide a tool to improve the management efficiency. Here, we focus on the case of the Hyères saltmarshes.

2 METHODOLOGY

Coastal wetlands and lagoons around the bays of Hyères and Giens (Hyères, Provence, North-western Mediterranean Sea, France) have been profoundly transformed by human activities. Since the Middle Ages, two distinct areas have been delineated, Salin des Pesquiers and Vieux Salins (Fig. 1). The first was a coastal lagoon surrounded by wetland where an important local fishery was established, generating considerable revenue

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(Réveillon, 2018). The second, smaller one was exploited for salt production since Antiquity. From 1848 to 1995, these two areas were converted into an intensive salt production zone. In 2001, the whole site became the property of the Conservatoire du Littoral (a public agency dedicated to the protection of littoral land) and managed by the Toulon Provence Méditerranée (TPM) local authority. Since then, the management goals were mainly focused on the historical heritage (salt production) and the conservation of waterfowl and wintering birds (Audevard, 2017). Managers already highlighted the low connectivity between the open sea and the saltmarshes, with important consequences for the fish assemblage.

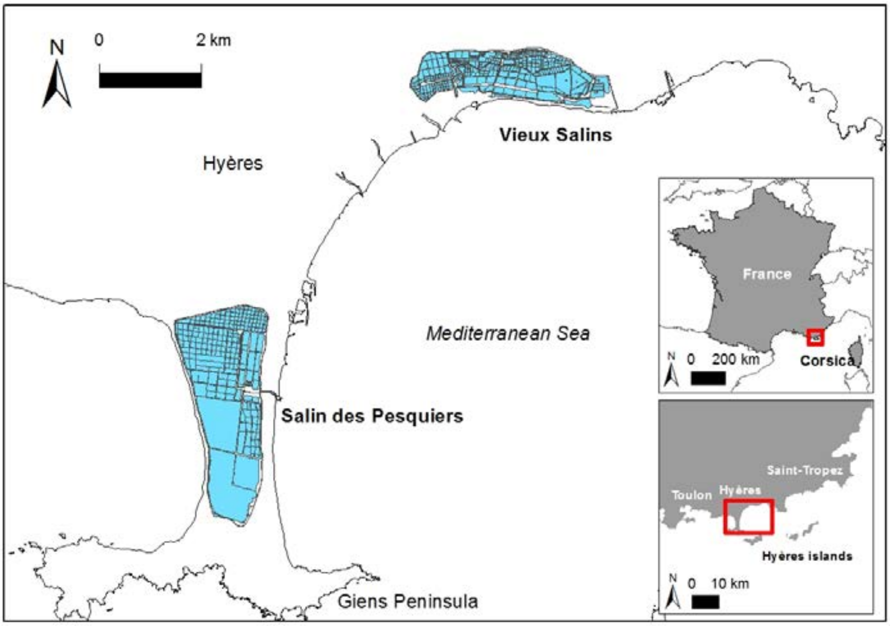

Fig. 1 Location of the saltmarshes of Hyères (Salin des Pesquiers and Vieux Salins).

Since the seminal work of Teal (1962), several studies have considered the food web and interactions between functional compartments within SMEs (De Wit, 2011). The need for an EA is stressed by the Marine Strategy Framework Directive (MSFD, 2008/56/EC) of the European Union (EU) (Laffoley et al., 2004), applied to fisheries management worldwide (Rice, 2005). In the framework of the MSFD, an EA has been applied to Mediterranean marine ecosystems to assess their quality (e.g. Posidonia oceanica seagrass meadow: Personnic et al., 2014). The Ecosystem-based Quality Index (EBQI) has been developed to provide a standard tool for managers and stakeholders (Ruitton et al., 2017).

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The conceptual model of the SME proposed here is based on taxa from the north-western Mediterranean. However, it is designed to be also used in other areas. This model was based on the expert judgement of the authors, the literature and original data. Original data were collected within the saltmarshes of Hyères on submerged macrophytes, fish and plankton to complete the available information.

3 RESULTS AND DISCUSSION

3.1 CONCEPTUAL MODEL AND HABITATS OF THE HYÈRES SALTMARSHES

In the conceptual model we propose (Fig. 2), there is only one width of arrows: the goal of this model is not to assess the carbon flows but to understand the links between compartments. The taxa vary according to the site location and the connection with the open sea. For example, submerged Magnoliophyta (boxes 1 and 2) are represented by (i) Ruppia spiralis in low connected, euryhaline and hyperhaline conditions, (ii) Zostera spp. or Cymodocea nodosa in well-connected and euryhaline or marine conditions and (iii) Stuckenia pectinata in low-connected and oligohaline conditions (Guélorget & Pertuisot, 1992; Shili et al., 2007; Tamisier & Boudouresque, 1994).

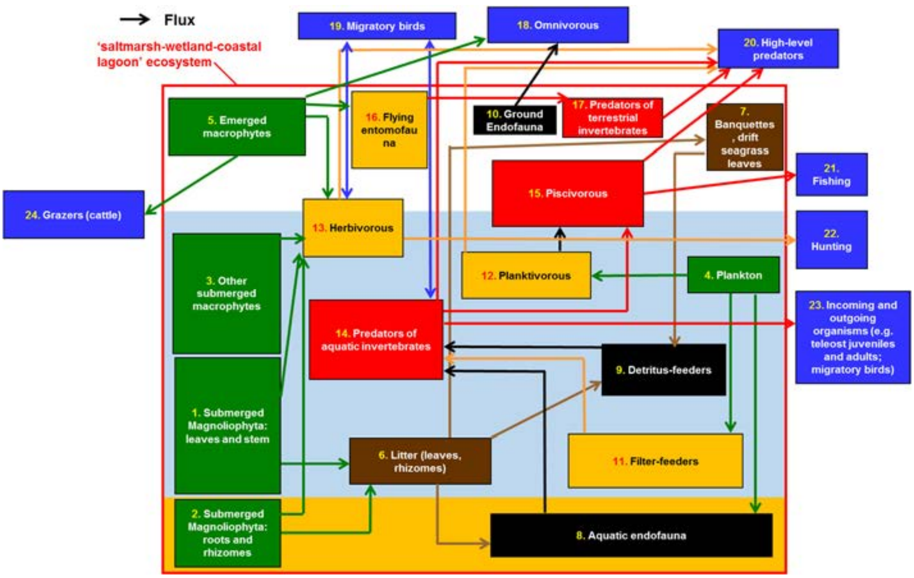

Fig. 2 Conceptual model of Saltmarsh-wetland-coastal lagoon ecosystem (SME). Arrows correspond to the carbon flux between boxes. Box colours: Green: primary producers, Yellow: primary consumers; Red: predators; Brown: litter (dead vegetal material); Black: endofauna and detritus-feeders; blue: box outside the ecosystem but with significant interactions.

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In the Hyères SMEs, the Ruppia spiralis meadow is present, with a high biomass and cover; R. spiralis is a halophilous species, the only seagrass that can thrive in such a range of salinity (i.e. 0-108 g kg-1). The absence of other expected taxa such as Zostera noltei can be explained by e.g. low connectivity with the open sea, high salinity and eutrophication).

Plankton can react very fast after shifts in water conditions. Sites well-connected with the open sea present a low abundance of both phyto- and zooplankton, bigger individuals and relative stability over time (i.e. older populations). Salinity is the main driver of phytoplankton and zooplankton (Quintana et al., 1998). In less connected and stable areas, abrupt fluctuations occur, the abundance is higher, particularly for phytoplankton, mainly represented by small individuals corresponding to a young population.

Fish assemblages (which contribute to several boxes) are dominated by sedentary taxa adapted to oligohaline, euryhaline or hyperhaline conditions: e.g. Atherina spp., Gambusia affinis, Pomatoschistus spp., etc. When the connection with open sea is better established, a higher species diversity is observed (e.g. Chelon spp., Sparus aurata, Diplodus spp., Dicentrarchus labrax, Anguilla Anguilla). The abundance of juveniles of these taxa can be considered as indicative of this connectivity. The physico-chemical conditions (salinity, dissolved oxygen) of the different parts of the lagoon depend upon the degree of confinement (sensu Perthuisot & Guelorget, 1983) and are the main drivers of fish assemblages (Bodinier et al., 2010). The management of the saltmarshes of Hyères, mainly focused on birds since its implementation in 2004, has led, as might be expected, to a conspicuous increase in the number of bird species and their abundance; in addition, the overall reproduction success improved (Audevard, 2017). The saltmarsh vegetation encompasses several habitats (Noble & Michaud, 2016), e.g. pioneer stands of Salicornia patula and Suaeda, stands of Sarcocornia fruticosa, Juncus subulatus and Arthrocnemum macrostachium, ephemeral and small extension lawns, stands of J. maritimus, and dense stands of the invasive Spartina patens. Aside from the birds, the macrofauna of the saltmarshes of Hyères includes the fox Vulpes vulpes, the wild boar Sus scrofa and the domestic cat, Felis silvestris catus. The frog Hyla meridionalis, sensitive to high salinity, only survives in a freshwater stretch of the 'canal de ceinture' of the Salin des Pesquiers; the toad Pelobates cultripes is no longer present, due to increased salinity in the area where it once dwelt; the lizards Lacerta bilineata and Podarcis muralis are not uncommon in the outer parts of the saltmarshes. In contrast, the lizard Psammodromus hispanicus, once relatively common, is nearly extinct in the area, maybe because of restoration work on the tombolo, with large bulldozers moving the sand (Orsini et al., 1993). The European pond turtle Emys orbicularis is relatively common at Les Vieux Salins, despite competition with the invasive red-eared slider Trachemys scripta (Joyeux, 2005; Lascève, 2014).

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3.2 AN ALTERNATIVE SOCIAL-ECOSYSTEM-BASED MODEL OF MANAGEMENT

Historical data regarding the use of the Salin des Pesquiers lagoon as an active fishery show that the site's functioning was totally different before the middle of the 19th century, from that of today (Réveillon, 2018). The Salin des Pesquiers was an open Mediterranean lagoon, with a permanent connection with the Bay of Hyères, and sometimes also with the Gulf of Giens. Taking into account global warming, the sea level rise and the increase in submersion events, a new marinization of the SME is expected.

Between the current management approach, which is clearly bird-centred, and the restoration of totally natural functioning of the SME (socially and ecologically unrealistic), an intermediate path could be a mix of bird conservation, more wilderness and, as a result, an improvement of the fish nursery role of the lagoon in order to foster coastal fishery. These three facets should be aggregated in the context of a social-ecosystem-based approach. (i) The water circulation in those ponds where high salinity and low connectivity prohibit the use by teleost fish could continue without major change, in order to avoid the trapping of juvenile fishes that cannot escape to join a suitable habitat for adult populations, inside or outside the lagoon (Bruslé & Carbony, 1992). (ii) The initial objectives of the first management plan of the saltmarshes of Hyères, established in 2004, was centred on waterfowl and saltmarsh landscapes conservation. The new management plan, based on a social-ecosystem-based approach, would not be inconsistent with the traditional goals of managers, but would also consider the improvement of the ecosystem functioning (based on water circulation and connection with the open sea), the unavoidable future marinization of the SME, and the improvement of access to the sites for visitors.

The social-ecosystem-based approach applied to SME management presented here must be considered as a logical progression of management approaches within the scope of current guidelines such as the MSFD. Worldwide, the species-centred approach applied during the 20th and early 21st centuries has allowed the conservation of heritage, threatened and rare taxa and the maintenance of large surface areas of well-functioning SME. The present approach also considers those high-value taxa but associated with the 'ordinary biodiversity' for an improved assessment of the functioning of the ecosystem. The consideration of human activities within the SME is consistent with management objectives taking into account conservation of both fauna and flora, and the preservation of sustainable economic activities. This approach deals with the social-ecosystem concept, where Man is considered as part of the system and contributes to its functioning with an impact that is not 'negative by definition', and that can even be positive (Boudouresque et al., in press). Ecosystem services provided by SME (Himes-Cornell et al., 2018) must be taken into account to highlight the benefits offered by a well-functioning SME. A species-centred approach, based

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on an unreachable baseline state of the ecosystem (e.g. before the Industrial Revolution), cannot be considered as a suitable management approach in the context of global change issues. In contrast, the EA can assess and monitor the functioning of SME, taking into account the expected changes (rise of the sea level), more connections with open sea, marinization, 'positive' consequences for teleost fish species of halieutic interest with juveniles which settle in brackish water, and 'negative' decrease in nesting and breeding of some species of waterfowl.

4 PERSPECTIVES AND CONCLUSIONS

The species-by-species approach is essential for species that are critically endangered throughout their range, such as the monk seal Monachus monachus, or in part of their range, such as the osprey Pandion haliaetus in the Mediterranean Sea. But this approach, if it does not fit into an ecosystem approach, is often ineffective, or leads to an artificialized environment, closer to an animal park or a botanical garden than to a natural environment.

The goal of the ecosystem-based approach (EA) for the saltmarsh ecosystems (SMEs) is not to quantify the carbon fluxes between each functional compartment, but to understand the functioning of the ecosystem in order to support the management choices. The goal of the EA is not to restore a natural ecosystem (SMEs are never natural ecosystems), but to find a reasonable balance between different management choices, in relation to humans (e.g. historical heritage, tourism, environmental education, the role of nursery, artisanal fishing), different functional compartments (e.g. macrophyte vegetation, herbivores, invertivores, infauna) and different taxa (e.g. teleosts, birds, insects). In addition, such a balanced approach is likely to optimize ecosystem services while more efficiently protecting the taxa that really require protection.

Finally, the conceptual model that serves as the basis for the EA, once adapted to each SME and its management objectives, can serve as a basis for the establishment of an Ecosystem-based Quality Index (EBQI), a powerful tool for assessing the quality of the SME and the efficiency of its management.

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IMAGES SOURCES

Saltmarshes of Hyères (Vieux Salins, Provence, France)

AUTHOR'S PROFILE

Patrick Astruch*.* Research engineer at GIS Posidonie (Marseille, France; NGO working on applied research on marine ecology), he is focused on the monitoring and the understanding of the functioning of marine and coastal ecosystems within the Mediterranean. GIS Posidonie is defined as a link between fundamental research in ecology and management.

Charles-François Boudouresque. Professor emeritus at the Mediterranean Institute of Oceanography (Marseille, France, Aix-Marseille University), teaching and working at Aix-Marseille University since more than 50 years, he is an international expert in phycology and marine and coastal ecosystems functioning.

Thomas Changeux*.* Research engineer at the French Research Institute for Development, based at the Mediterranean Institute of Oceanography (Marseille, France, Aix-Marseille University), he is an expert in fish ecology in brackish and freshwater ecosystems.

Daniel Faget*.* Lecturer at Aix-Marseille University (UMR TELEMME), he's working on the history of fisheries, particularly within the Mediterranean context.

Matthieu Lascève*.* Biologist naturalist working in Toulon Provence Méditerranée management team of the saltmarshes of Hyères, he's involved in the monitoring of birds, reptiles and mammals' populations.

Laurence Le Diréach*.* Doctor in Oceanography and researcher at GIS Posidonie, she is specialized in fish ecology and monitoring in brackish and sea water, particularly on fish juveniles and larvae.

Laura Massinelli. Master degree in Oceanography from the University of Aix-Marseille, she has contributed to the project during an internship at GIS Posidonie, particularly on macrophytes community mapping.

Flore Moussy*.* Master degree in Environmental Sciences from the University of Montpellier (France), she has contributed to the project during an internship at GIS Posidonie, working on the Ecosystem-based approach applied to saltmarshes. She also participates to experimental fishing and plankton community monitoring.

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SPATIAL EVOLUTIONS BETWEEN IDENTITY VALUES AND SETTLEMENTS CHANGES

TERRITORIAL ANALYSES ORIENTED TO THE LANDSCAPE REGENERATION

DONATELLA CIALDEA

L.a.co.s.t.a. Laboratory, University of Molise
e-mail: lab.lacosta@unirmol.it
URL https://www.lacosta.unimol.it

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ABSTRACT

The coastal landscape is, by definition, the environment where main contradictions and major conflicts develop. This paper is focused on the variations that have defined the layout of the settlement system especially in relation to the presence of the sea and the naturalistic values of coastal environments. The research, carried out during the preparation of the studies for the Landscape Plan of the Molise Region, is the result of the elaboration of the interdisciplinary research group of the l.a.co.s.t.a. Laboratory, University of Molise in Italy, involved in territorial investigation and in the elaboration of analysis and project maps, as a part of the work carried out, under the Agreement with the Molise Region. It is a large-scale project for the New Landscape Plan for the Molise Region, as an experimental model of application of the recent Italian Code for Cultural and Landscape Heritage, belonging to the European Landscape Convention. The two components, included in the title, identity values and settlements changes, aim to underline the landscape peculiarities and the settlements features, strictly connected to the natural environment. The case-study concerns the coastal area of the Molise region. In fact the presence of the sea also intervenes and therefore in this paper we analyze a methodology used to compare the levels of values, connecting the identifying factors, linked to the settlement system with the need to safeguard or in some cases restore environmental values.

KEYWORDS
Landscape Regeneration; Urban Built Environment; Identity Values; Smart and Resilient Land

1 INTRODUCTION

This paper concerns the coast but also the urban centres, where the size of the urban settlement linked to the second houses along the coast, assumes even greater dimensions than the historical centres, far away from the coast. In dealing with the study of literature, the cases of small-sized regions were analyzed, which in the course of drawing up their own Landscape Plan dealt with the theme of recovering identity values, in some cases giving priority to the aspect of landscape enhancement and in others the local identity of small historic centres. The literature on this topic very often faces problems in a sector-specific way. The slow pace with Italian Regions is preparing their own Landscape Plan (in terms of adapting the old landscape plans or in terms of drafting the new landscape plans) does not yet allow us to get a clear picture of their different attitudes. From the theoretical point of view, many studies were made, with several interesting finding. They concern various aspects: in some cases they regard the identification of indicators useful for assessing the landscape quality (Cassatella & Peano, 2011; Clementi, 2012; De Marco & Mattiucci, 2015; Gambino & Peano, 2015; Voghera, 2011); in other cases they provide the construction of the cognitive framework of the territory (Magnaghi, 2007, 2012) or a normative apparatus useful for planning choices (Barbanente, 2011, 2015, 2017).

The present work adds a contribution to the discussion of the topic: there is a reciprocal influence between the “naturalness” aggression and the development of the urban settlements, whose loss of harmony results in great problems for both. In specificity of case study, the work attention was focused on physical and environmental factors, in a spatial view, with emphasis in potentiality of the strategic planning issues. In our case it is necessary to highlight some peculiarities: the particular condition is that we are in an urban environment, but within a small city. Our study also contemplated the consideration of similar cases in other regions that have centres with similar urban features. For example, the Sardinia Region, although it is an island, presents characteristics of the urban areas, small and medium-sized, very similar to the Molise Region. In fact, even in Sardinia specific urban policies have been activated. The construction of the new model of "urbanity", with respect to which some generating elements are precisely the historical centres and, more generally, the nucleuses of urbanity present in the territory, requires that the infrastructural systems are generating new values (Regione Sardegna, 2003). Even the Basilicata Region does not have large cities. The research also shows that the territorial structure of the Basilicata Region is common, in large part, to the Mediterranean area characterized mainly by the presence of small settlements under 10,000 inhabitants. In such a structured system, with a low population density, without significant social and economic dynamics, the

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network of small centres represents an extraordinary identity wealth, witness to the relationship between man and the environment (Abate, 2012). Also in the Umbria Region, even if it doesn't overlook the coast, there are a lot of small size cities. The Region has drawn up the "Strategic Territorial Plan" that outlines a strategic vision of the regional territory starting from the settlement dynamics. The urbanization process has however taken on specific features that differentiate it from that which has affected most of the Italian regions; the absence of metropolitan areas or large conurbations, is in fact accompanied by the presence of small and medium-sized cities of great quality, located in a largely intact and well preserved territory. From this, the need to develop an all-Umbrian model to face the redevelopment of the building able to solve the main problems: the resettlement of new activities and the maintenance of inhabitants, accessibility and urban mobility, the recovery of heritage historical-artistic or unused to be allocated to new functions" (Regione Umbria, 2013).

The attention of our research was mainly focused on the study of methodologies concerning the values of the landscape and the values of urban and extra-urban settlements. Regarding the Landscape Values, we analyzed some documents produced in Italy for the preparation of the different Regional Landscape Plans. In particular, the Puglia Region has produced an in interesting document for the Landscape Districts identification, that allows the integration of the "Cultural Heritage Map" with all different historical civilizations data (Regione Puglia, 2015). Also the Tuscany Region has drawn up the Landscape Schedules, with the identification of the quality objectives, including the description of the structural features identifying territories in question, noting that "the use made by the early Italian Landscape Plans has defined a custom that recalls very closely (perhaps too) the cultural heritage schedules (Regione Toscana, 2010). The link between cultural heritage and landscape induces an 'object' evaluation of the landscape, leaving out the aspects linked to the sensitive, relational, cultural, perceptive dimension" (Poli, 2012). Also interesting is the work of the Lombardy Region that researches the "Landscape Traces" that also proceeds to the identification of the still existing and travelable road fragments, to the presumptive or documentary recognition of the missing ones, to the relative artefacts as well as to the travel support buildings, to connections between itineraries, and to their reciprocal functional hierarchy. The data collected in survey schedules should be transferred in the Geographical Information System of the Lombardy Region in which it will be possible to outline the whole catalogued network (Regione Lombardia, 2010). Moreover, in the Molise region numerous studies have been carried out in recent years concerning the landscape values of the territory, performed by experts in the various disciplinary sectors (Cialdea & Privitera, 2007; Cialdea & Mastronardi, 2014; Privitera, 2005, 2006; Rosskopf et al., 2016). Furthermore, in relation to Urban and Extra-urban Settlements several European-level

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documents on integrated sustainable urban development were consulted on the implementation of sustainable urban development related to the delegation to urban Municipalities, designing integrated strategies useful for the monitoring and evaluation of urban projects (in particular see European Commission, 2015). Subsequently were consulted documents of local Authorities that have addressed the issue of cataloguing of goods located within historic centres that had similarities with the region under study, i.e. of regions mainly in central and southern Italy with small and medium-sized (Regione Calabria, 2004; Regione Sicilia, 2008; Regione Umbria, 2013; Napoli, 2014). Finally, some recent works edited recently by the L.a.co.s.t.a. Laboratory Research Group were taken into account (Cialdea, 2007; Cialdea, 2009).

2 METHODOLOGY

The observation and study of the landscape requires more and more of an evaluation in terms of both methodology and content, because it is necessary to critically interpret the complex system in which the landscape itself is articulated. This work involved three different steps: the analysis phase; the in-situ data verification phase and the synthesis phase with the results. Our analysis has two main purposes: on the one hand, it strives to identify the peculiarities of the landscape, in many cases linked to the physical characteristics of the places (which often also mean difficulties - hydrogeological instability, imperviousness of places). On the other hand, the article proposes a reflection on policy intervention tools with potential to tackle and to solve problems related to the urban expansion, especially along the seacoast. These two components are included in the title that aims to correlate identity values and settlements changes.

The methodology for deepening the territory transformations focuses on the evolution of settlement systems. In this phase of the work we focused on the variations that influenced the settlement system especially in relation to the presence of the sea. Therefore, we describe the Model of Analysis (Cialdea, 2013) tested for a comparative analysis of cross-border coastal environments and now refined during the preparation of studies for the Landscape Plan of the Molise Region. The ongoing research was developed starting from a portion of the sample area for which a fair amount of territorial data was collected. The data were carefully selected and classified using a model scheme, and they were merged into an organic and structured spatial database, from the elementary data useful for the construction of complex evaluation indicators. The identification of the indicators was carried out using a two-dimensional model in which the static territorial component, classified according to the five Resources Systems, was taken into consideration (S1 physical-environmental resource, S2 landscape-visual resource, S3 historic-cultural resource, S4

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productive-agricultural resource, S5 demographic-tourism resource). The data for each system is processed in three chosen states, these are: actual state; state evolved over time; previsional state, that is with reference to the formulation of urban planning tools currently in use. Therefore, three basic *grids* were created, which serve as a reference for the reading of each resource system. They were constructed starting from several primary documents. The term basic grid defines the layers constituting the information base of the management system for the territorial data which is useful for landscape analysis. Comparisons between the basic grids of each resource system will create the information and evaluations which will form the research conclusions. The basic grids will be described below and several images are shown of those created for a municipality, that is Campomarino, along the coast of the Molise Regione (see Fig. 1).

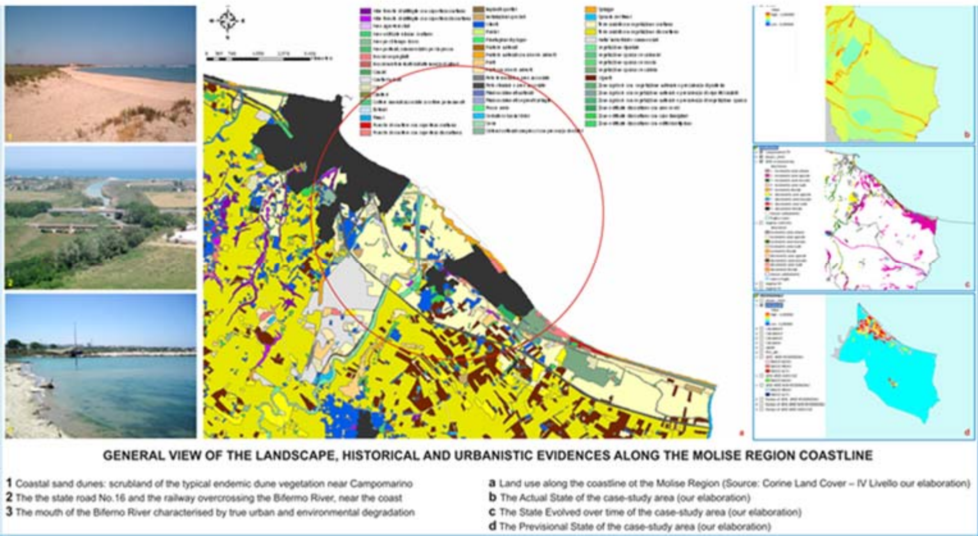

Fig. 1 General view of the landscape, historical and urbanistic evidences along the Molise Region coastline (Source: l.a.co.s.t.a. elaboration 2018)

To create the grids the raster data model was applied; precisely because the data derives from various sources and is unhomogeneous (from traditional map data to that in GIS format, with different levels of geo-referencing from the lowest level to data shape points), the raster model is the least approximate for this type of application. As is known the two main systems for modelling the real world in GIS are the raster model and the vector model. An extremely concise description of the specifications of each model in relation to the type of data to be processed is that the vector model suits discrete data, for example administrative boundaries, the limits of an urban planning zone, the electricity lines, data shape points, but is not good for representing data of a continuous nature such as the

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altimetrical model of a territory, the influence of a data shape point on the surrounding territory and distribution models in general because such phenomena do not have precise boundaries without any breaks. Moreover, the raster model facilitates intersection analysis with data of diverse accuracy because the accuracy is defined (knowingly by whoever conducts the analysis) by the size of the data cell used (and therefore by the accuracy established for the model) and not by the accuracy of the data collection. In this case in particular, the accuracy level is that typical of 1:25.000 maps which conventionally equals the intrinsic error in graphics (such is considered the margin of error deriving from the pen mark equal to 0.35 mm which is the equivalent of just under 10 metres in the nominal scale 1:25.000) which it is not possible to go below in traditional maps. However, it must be stressed that the choice of the 10 metre pixel does not degrade the information to a level that is any lower than the least accurate data and as such results as being widely usable for territorial analyses where even 10 metres are below a significant threshold from the moment that they represent only 100 m^2.

The first *grid,* called A, that is the reference for the analysis of *the present state*, was developed from the present PTPAAV (Vast Area Landscape Environmental Physical Plan). The elements were divided by category in accordance with the diverse categories of *interest*: Elements of historic, urban, archaeological, architectural interest; Agricultural-productive elements of interest for natural characteristics; Naturalistic elements of interest for physical-biological characteristics; Areal elements that are geologically unstable; Elements and environments of visual interest.

An evaluation was assigned regarding the importance of each single element for each of the above mentioned categories; this evaluation is known as a value and may vary in a domain given by the following scale of ordinal type points: Low; Medium; High; Exceptional.

In this form the synthesised maps were digitalised for the purposes of the project thus obtaining layers of vector information divided into the above categories and by different primitive graphic representations (point, line or polygon). It was chosen to use the numbers 1 to 4 establishing the following correlations (Tab. 1).

VALUE	RANGE
1	low
2	medium
3	high
4	exceptional

Tab. 1 Values attributed to elements of interest in the PTPAAV n. 1

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However, the interesting lies in being able to correlate these four distinct fields of evaluation in an overall picture. To this end a particular type of *visual overlay* was used, based on the RGB (Red, Green, Blue) model used in the digital sphere for visualising coloured images (Tab. 2). The grid relative to the evolved state (E) was created on the basis of land use in the area examined in the period of time between the 1950s and nowaday: this grid highlights the main variations with particular attention to wooded areas (highlighting the areas corresponding to reforestation and deforestation), dunal areas (with the aim of defining the zones that have disappeared and those that remain), urban areas (and related progressive expansion), areas under cultivation (with particular attention for the zones affected by the land reforms).

BAND	RASTER
overlay	Visual
R – RED	Historic [1]
G – GREEN	Agricultural
B – BLUE	Naturalistic

Tab. 2 Association between the raster and the bands selected for visualisation

Therefore, the evolved state is described using the comparison between two representations of the state of the territory that are 40 years apart. The categories attributed to the polygons for this map have been streamlined and simplified so as to obtain the following key that is valid for both periods: urban areas; agricultural areas (including meadows and meadow-pastureland and arboriculture); grasslands and wastelands (shrub cover <40% and tree cover <20%); shrub and bushland (shrub cover >40%); chestnut plantations; broadleaf forests; coniferous forests; mixed forests of conifers and broadleaf; reforestation (forestry formation of conifers and broadleaf with h<5m); bare ground areas (mountains, coasts etc.); water bodies and wetlands. From a comparison between the two it is evident that the land cover (vegetation) and use for which the terrain is destined changed significantly in about 40 years. In order to better assess the changes and evolution it was deemed necessary to create a comparative information layer (which analyses the decrease or increase of the land with respect to the sea). Therefore, the key was structured in the following way: increase in urban areas; increase in agricultural areas; increases in woodland areas; increase in bare ground; increase in shoreline; decrease in agricultural areas; decrease in woodland areas; decrease in bare ground; decrease in shoreline; no change.

[1] For historic interest both data points and lines were selected and given a value. The points were identified with a 50 m radius circle and the lines buffered to a total width of 210 m, corresponding to the maximum width of a drove-road of 110 m with a buffer of 50 m on either side.

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Finally, the grid for the *previsional state* (P) has been derived from the current urban plan and consists in the identification of the various designated zones with their relative attributes (building and land use characteristic). As regards the municipality of Campomarino, the previsional state was created using the forecast suggested by the Master Plan (P.R.G.). This zoning (available in .dwg format) was imported into a GIS and then georeferenced, obtaining a .shp file which identifies the zones using polygons as the primitive graphic.

3 DISCUSSION AND RESULTS

The Molise's circa 35 km of coastline is characterised by notable environmental diversity with an alternating presence of coastal marshes, delta systems, sandy shorelines and dunal systems. The inland area, which is mainly hilly and today under intense cultivation, is characterised by water courses with respective flood plains and banks which still conserve their particular natural characteristics, constituting a series of important ecological corridors which from the delta develop towards the inland areas. The main environmental characteristic of the coastal area comes from the alternation of stretches of sandy shoreline interrupted by the delta systems of the main water courses. Not by chance three Site of Community Importance (SCI) exist: they include circa two thirds of the entire Molisan coastline. Some analyses were carried out for these territories, for which it is still possible to think of "soft" forms of development (i.e through the creation *greenways* parallel to the coast or *blueways* parallel to the rivers, where eco-tourism and low impact eco-tourism can be promoted which will consent both sustainable fruition and habitat maintenance). Meanwhile, some specific problems exist. For the SCI named "Foce Trigno – Marina di Petacciato" (IT7228221): the dunes are in quite natural condition but in order to achieve their effective stabilization it would to be opportune to undertake series of environmental restoration operations, (planting of autoctonous species, re-naturalisation, realization of trellises etc.). For the SCI "Foce Biferno - Litorale di Campomarino" (IT7222216): the realization of an access road to the building site and the construction work have completely flattened the dunes and obliterated them for ever. For the SCI "Foce Saccione – Bonifica Ramitelli" (IT7222217): the great problem of illegal construction emerged.

An analysis has also been made of existing built on areas: the substance of *urban and rural construction* was examined, divided into urban areas and important rural agglomerates. According to the methodology already described these elements were examined in the three states Actual, Evolutional and Previsional, extracting the information from the following layers (Tab. 3):

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STATE	LAYER
A	Information layer derived from photo-interpretation of the ortho-photos in colour
E	Information layer derived from the comparison between the state in 1954 and nowaday (vegetation map)
P	Information layer derived from the zoning of the Campomarino Municipality Master Plan

Tab. 3 Information layers for each state

As an example, the analyse undertaken for the municipality of Campomarino are given (see Fig. 1): according to ISTAT the following inhabited localities resulted: Campomarino, Lido Campomarino, Nuova Cliternia, Buccaro, Cianaluca, Ramitelli, Santa Monica. The presence of *Scattered houses* is also mentioned, corresponding to 345 buildings. Therefore the corresponding polygons were identified. Moreover, it was though opportune to note the presence of a built up area half way between Campomarino and the Lido of Campomarino. This area was therefore delimited and the polygon was given as its locality the toponym "Sotto le case" (from the I.G.M.), as it is situated at the foot of the cliffs of Campomarino.

The subsequent operation was that of overlaying the urban_CGR.shp layer on the information layers of the Synthesis Map S1 of the PTPAAV n. 1, that is the elements of exceptional, high, medium and low value in the ambits of interest: Visual; Historical; Agricultural; Naturalistic. The aim is evident: to show how there are built up areas in zones considered by the project group of value and to be protected using methods of restrictive transformability. In the first place the *overlay* was made on the Perceived ambit (Tab. 4).

LEVEL	LOCALITY
Exceptional	Buccaro
Exceptional	Campomarino – Historic Centre
Exceptional	Campomarino – Urban Expansion;
Exceptional	Campomarino Lido;
Exceptional	Sotto Le Case
High	Buccaro
High	Campomarino – Historic Centre
High	Campomarino – Urban Expansion
High	Cianaluca
High	Campomarino Lido
High	Nuova Cliternia
High	Ramitelli
High	Santa Monica
High	Sotto Le Case

Tab. 4 The Perceived layer

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It is obvious that the case involving Campomarino - historic centre cannot be taken into account as it is a zone which certainly pre-dates the approval of the PTPAAV (in 1991). In the locality of Buccaro most of the built-on area is in an area of high perceived interest; however, to the north is a built up area in an ambit of exceptional perceived interest. At the Lido there are no built up areas in ambits of exceptional perceived interest, with the exception of a single building on the edge of the is the same as that for naturalistic interest, strip of pine wood which protects the coast and obviously omitting the presence of campsites and bathing establishments. On the contrary, the locality "Sotto le case" results as being almost entirely within an ambit of exceptional perceived interest. It should be noted that the presence in this area of Campomarino railway station has been deliberately omitted as it is not considered pertinent (and is however earlier than 1991). Even part of the built-on area present in the urban expansion zone of Campomarino results as being in an ambit of exceptional perceived interest. The *overlay* on the historical layer presents nothing of interest, thus we pass to the analyses of the *overlay* on the layer of Naturalistic interest, as an overlay between the built-up urban areas and the productive-agricultural zones would not be coherent. Only two cases were obtained: High, for Buccaro and Medium for Campomarino Lido. The areas involved in these two cases are the same as mentioned previously, as each time the polygon generated for perceived interest, as the perception, in these cases, is of elements of natural beauty. However, it should be noted that for this ambit of interest we are not faced with intersections with ambits of exceptional value. From the analysis of the overlays between the information layer of the present urban areas in Campomarino and the information based on the Actual state at least one situation of territorial transformation emerges that is contrary to the dictates of the Landscape Plan. What also emerged in this case was the particular state of the expansion of the lidos and thus the heavy presence of built on areas along the coast.
In conclusion, from the planning point of view, it opened space for proposals that generate actions to improve the quality of the landscape. The choice was made to verify the actual state and the proposed state of things in the areas under examination, the actual state intends the reality of restrictions currently existing on the territory in question. Ample space has been dedicated to the overall picture of the restrictions, landscape and historical-archaeological which have been defined as positive elements. In reality other types of restriction also exist on the territory, linked the difficulties caused by the nature of the territory itself; for example the hydro-geological restriction which in the Molise covers almost the entire regional territory, or the seismic restrictions which also covers the majority of the regional territory. These are, however, restriction of an environmental type - which will also be taken into consideration - but we concentrated on the so-called positive restrictions, defined as such in that they are useful for the definition of quality landscape

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objectives. In fact, they contribute to the information systems of landscape-visual and historical-cultural nature in the areas under examination. On the contrary, proposed state indicates what can be deduced regarding the intentions of a plan. The case of the Molise is emblematic for the total absence of planning tools above municipal level. Therefore, an examination has been made of individual planning tool proposals at municipal level, with the aim of putting together the various plans in order to seek out possible - and inevitable - incongruities in the border zones between one municipality and another. Moreover, our attention was dedicated to the identification of the geographic and geo-morphological characteristics of the coast, with particular attention to the phenomenon of erosion and therefore includes a careful study of variations in the coastline, also regarding the continual interventions carried out for coastal protection. Moreover, within the project area exist some SCI areas, which as is known are still without a management tool and least of all a planning tool. Therefore, three an examination is undertaken of these areas in search of the most evident conflicting situations. Finally, the initial hypothesis was tested in the case-study in order to highlight the possibility to re-generate local increase through the new landscape planning tool as an element able to include the resources safeguard and the economic development.

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AUTHOR'S PROFILE

Donatella Cialdea. Full Professor (Urban Planning) at the University of Molise since 1988. She is the Director of the Laboratory L.A.Co.S.T.A. (Laboratory for activities relating to Territorial and Environmental Development) at the University of Molise in order to prepare students and operators in the Geographical Information Systems field. Dean of the Faculty of Engineering from 2009 to 2012 and the Coordinator of the PhD Course in "Landscape Analysis and Valorisation" at the University of Molise and the University of Sassari based consortium. She was the Scientific Coordinator of the International Master Level I Pro.D.U.C.T.I.V.E. Coast (Proposal for the Development of Urban and Coastal Territory in relation to the Value of the Environment), aimed at the technical-scientific training of a specific professional figure - the Selective Interpreter of Territorial Data. At present she is a Member of the National Landscape Committee of the Italian Ministry of Cultural Heritage.

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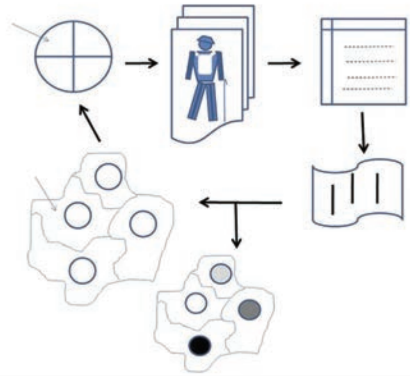
ANALYZING SENIOR TOURISM

THE ROLE OF ECOSYSTEM SERVICES TO IMPROVE SUSTAINABLE TOURISM DESTINATIONS



ROMANO FISTOLA[a], ROSA ANNA LA ROCCA[b]

a Department of Engineerin
University of Sannio, Italy
e-mail: rfistola@unisannio.it

b Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Italy
e-mail: larocca@unina.it

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ABSTRACT

This study focuses on two emerging and growing phenomena that occur in today's cities and will have impacts on the future organization of urban systems, affecting all their components (physical, functional and social). On the one side, population aging, as the principal effect of the "baby boom" generation, but not the only one; on the other side, the tourism phenomenon, as one of the economic sectors relentlessly growing worldwide also according to the United Nations World Tourism Organization forecasts. Senior tourism, thus, has been considered as an urban phenomenon to be investigated as one of the occurrences giving rise to new demands of use of the cities. As these new demands request for good quality and variety of services and facilities, this paper considers the issue of Ecosystem Services (ES), meant as one of the peculiarities able to increase the attractiveness of a tourism destination and enhance its physical quality. ESs contribute to augmenting the well-being of city populations (residents and tourists), improving the efficiency of its services and, overall, assuring the outliving of the whole complex urban and/or territorial system. In other words, the study considers the ecosystem services as a background condition for a territorial context, trying to identify which of them act as polarizing factors for senior travelers. Starting from the characteristics of senior tourism, the study works out a first characterization of a senior-friendly destination in which ecosystem services play a strategic role in improving the general quality of the supply systems' facilities and amenities, in order to assure a high-quality level of life both for residential and temporary urban populations.

KEYWORDS

Senior Tourism; Senior Friendly Destination; Ecosystem Services

1 INTRODUCTION: MOTIVATION OF THE STUDY

The paper aims to investigate two emerging phenomena that affect the evolution and the future of today's cities and, therefore, the governance of urban and territorial transformations. On the one hand, the phenomenon of population aging requires a reconsideration of the urban services supply dedicated to this specific segment of users; on the other hand, the steady growth of tourism is considered not only as an undisputed economic factor, but also as an urban phenomenon that involves various sectors related to the acts of urban transformation governance (La Rocca, 2014).

In the light of the reflections above, and considering the theme of ecosystem services (ESs) as a background panorama for the research, the study aims to define which of the ESs available in a territorial context can have a polarizing effect on tourist flows, with particular reference to the segment of senior travelers. It’s clear that the study deals with different levels of research that intersect each other and should be deepened, in order to support the actors of territory governance towards the ESs which, besides having a strategic role for the safeguarding of local communities, need particular attention as they can incentivize the beneficial effects deriving from a well-planned tourism development.

Therefore, in a first phase, the study was aimed at identifying the essential conditions for a senior-friendly urban system, that is, a system capable of responding to the needs of a specific demand segment, in compliance with the objectives of sustainability and urban resilience. A potential profile of senior travelers is defined in the first part of the work, while recognizing that, at present, there is no single agreed scientific definition. However, what appears to be generally recognized is that this segment of users is particularly interested in high quality services, favors cultural tourism and is extremely flexible with regard to the travel period, due to a greater availability of time not strictly connected to periods off work (Tourage project, 2014).

In the second part, the work examines the issue of ESs in relation to tourism-oriented urban systems. This type of urban systems can be particularly significant for their need to respond to a tourist load which, albeit temporarily, adds up to the people who live in them year-round. The relationship between ecosystem services and tourist activity can be an interesting research path, given that it is based on the relationship between natural environment and man-made environment. In fact, tourism can be analyzed as one of the few (probably the only) urban activity capable of combining the two aspects of this relationship, which would deserve greater attention from the scientific community dealing with urban studies.

Therefore, the study focuses on the definition of a clear methodological-theoretical framework to support subsequent research developments oriented towards the definition of indicators able to “measure” the capacity of a “city/tourist destination” to meet the needs of a new and

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growing demand of use, which, for this purpose, must have adequate facilities, ancillary services and amenities to ensure a proper balance between daily and tourist uses of the city.

2 SILVER-HAIR TOURISTS: A METHODOLOGY FOR TRACING THE PROFILE OF A GROWING TOURIST SEGMENT

The definition of the senior tourist's profile took place through the analysis of the scientific literature produced in the last five years (2013-2018), available on the main online databases that collect scientific articles, conference presentations and books related to the subject matter of this paper. In particular, we examined the following bibliographic platforms:

- Science Direct, Elsevier (SD).
- Web of Science, ISI Thompson Reuters (WoS).
- the Directory of Open Access Journals (DOAJ).

Science Direct is the platform of the Elsevier publishing group which collects scientific articles, books and essays related to 27 scientific categories. The products in the database have different levels of accessibility depending on whether or not the full text is available. This availability may depend both on the relationship between the publisher and the author and on the authorization of access to the database by the registered user. For the purposes of the research, we accessed the database by using the registered allowed University of Naples "Federico II" user, due to the greater flexibility of access guaranteed to the university. Furthermore, the choice to use the Science Direct platform is related to the wide availability of and access to the full texts of all articles in the database. The platform was then consulted by introducing the keywords indicated in Tab. 1 in the "Search" box. The first results obtained were subsequently selected by time period (last 5 years), scientific area of interest and finally by product type. In the database, in fact, 24 different product types can be selected; among them, we selected the following 4 significant categories for the purposes of our study: research article; book chapters; case reports; conference info.

The Web of Science platform is the multidisciplinary bibliographical/citation database of the Thomson Reuters publisher, which acquired the ISI (Institute for Scientific Information) – the academic publishing service that devised the Impact Factor and other citation indexes. The repository allows the simultaneous querying of the three databases: Science Citation Index (SCI), Social Sciences Citation Index (SSCI) and Arts and Humanities Citation index (AHCI). Unlike the previous one, this platform allows a first processing of the query results and consequently makes it possible to select these results within the scientific areas of interest. In particular, among all categories, those closest to the regional science field for content, aims and objectives were selected.

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The Directory of Open Access Journals (DOAJ) is a community-curated list of open access journals which aims to be the starting point for all information searches, providing access to high quality and peer-reviewed resources. We chose to query this database to have the Open Access scientific production as an exclusive reference, which is, in some way, "not subject" to the strictness of academic publishing. This database differs from the previous ones for its specific query results, due to the much smaller number of products listed.

KEYWORD	SD	WoS	DOAJ	TOTAL
Ecosystem services and tourism	46	53	3	102
Ecotourism	179	683	264	1126
Senior tourism	63	133	7	203
Smart tourism	72	185	36	293
Sustainable tourism	1603	781	226	2610
Tourism and accessibility	156	406	235	797
Tourism attractiveness	115	423	9	547
TOTAL	2234	2664	780	5678

Tab. 1 Results of the first round of queries of the three databases examined (authors' elaboration)

Tab. 1 shows the results of the first round of queries carried out on the basis of seven categories of keywords mentioned in the title or in the abstracts. The second round of queries was carried out to obtain better results, in light of the following criteria:

- overlapping of results (same results in different databases);
- repetition of results for two different queries.

By applying these criteria, the number of representative papers considerably decreased, thus allowing for an easier analysis of their contents and coherence with the objectives of the study. In particular, the third round of acquired products verification referred to the application of the following criteria for the selection of results:

- mismatch between the content of the publication and the objective of our study, which, in this phase, was particularly focused on the definition of a possible profile;
- poor correlation between the presence of the keyword in the title and the content of the paper, in relation to the object and objectives of our study.

The overview of the results is shown in Tab. 2.

The table above highlights the clusters defined in view of the whole selection process (rounds 1-3) and a first definition of contents matching on a qualitative basis.

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CLUSTERS	PAPERS	LEVEL OF ATTINENCE
ANALYTICS	2	-
CASE STUDIES	4	-
CHARACTERISTICS	20	++
GENERAL	3	+
MOTIVATION	2	+
SUPPLY SIDE	1	-
TYPOLOGIES	4	+
TOTAL	36	
- Low; + medium; ++ high		

Tab. 2 Overview of the materials selected and identification of the clusters (authors' elaboration)

This means that the greater significance of the "Characteristics" cluster is due to the specific objective of this research phase, aimed at the construction of a reliable profile of the senior user. Similarly, the clusters relating to studies dedicated to specific types of tourist use and the reasons behind the choices of travel were considered significant for the purposes of this specific phase of the work. However, some of them were rejected on the basis of the following criteria: a) no significant mention of senior tourism behaviors; b) unavailability of full texts; c) focus on not relevant specific aspects (health, psychological aspects, dementia, handicap, etc.); d) publication date not in the fixed period.

In particular, the "c" criterion highlights that, in the scientific literature on this subject, the topic of senior tourism (despite having enjoyed a discreet attention and being recognized as capable of activating a tourist flow) has been almost exclusively addressed in terms of perceived "weakness" of the elderly population (particularly from the point of view of health), as closely linked to the need for medical assistance: a sort of "geriatric tourism".

However, the aspect that we seek to point out in this study concerns the transformation of the "senior" population, for which it is reductive to talk about "elderly population"; it is a "new" generation that refers to a cultural model not yet clearly defined, identified as "active aging" (Benberin & Tanbayeva, 2017; Boudiny & Mortelmans, 2011; Boudiny, 2013; Walker, 2010; Zaidi et al., 2013).

After filtering out all data available, we selected 13 documents considered to be the most significant for the objectives of our study (Tab. 3).

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CLUSTER	YEAR	REFERENCES
DEMAND ANALYSIS	2015	Nikitina, O., & Vorontsova, G. (2015). Aging population and tourism: socially determined model of consumer behavior in the "senior tourism" segment. Procedia-Social and Behavioral Sciences, 214, 845-851.
	2016	Alén, E., Losada, N., & Domínguez, T. (2016). The impact of ageing on the tourism industry: an approach to the senior tourist profile. Social Indicators Research, 127(1), 303-322.
	2016	Nella, A., & Christou, E. (2016). Extending tourism marketing: Implications for targeting the senior tourists' segment.
	2016	Tiago, M. T. P. M. B., de Almeida Couto, J. P., Tiago, F. G. B., & Faria, S. M. C. D. (2016). Baby boomers turning grey: European profiles. Tourism Management, 54, 13-22.
	2017	Zsarnoczky, M. (2017). Developing Senior Tourism in Europe. Pannon Management Review, 6(3-4), 201-214.
	2018	Sánchez, N. L., Alén, G., & Dominguez, V. (2018). Determinants of senior's perceived barriers to travel. PASOS: Revista de Turismo y Patrimonio Cultural, 16(2), 387-399.
	2018	Mélon, M., Agrigoroaei, S., Diekmann, A., & Luminet, O. (2018). The holiday-related predictors of wellbeing in seniors. Journal of Policy Research in Tourism, Leisure and Events, 10(3), 221-240.
SUPPLY ANALYSIS	2017	Losada, N., Alén, E., Nicolau, J. L., & Domínguez, T. (2017). Senior tourists' accommodation choices. International Journal of Hospitality Management, 66, 24-34.
	2018	Huber, D., Milne, S., & Hyde, K. F. (2018). Constraints and facilitators for senior tourism. Tourism Management Perspectives, 27, 55-67.
	2019	Lee, C. F., & King, B. (2019). Determinants of attractiveness for a seniors-friendly destination: a hierarchical approach. Current Issues in Tourism, 22(1), 71-90.
CASE STUDY	2018	Klimova, B. (2018). Senior Tourism in Europe: Current State and Prospects for Future. Advanced Science Letters, 24(7), 4778-4781.
	2019	Losada, N., Alen, E., Cotos-Yanez, T. R., & Dominguez, T. (2019). Spatial heterogeneity in Spain for senior travel behavior. Tourism Management, 70, 444-452.
	2018	La Rocca, R., & Fistola, R. (2018). The tourist-religious mobility of the "silver-haired people". The case of Pietrelcina (BN). TeMA Journal of Land Use, Mobility and Environment, SP, 67-84. doi:http://dx.doi.org/10.6092/1970-9870/5767

Tab. 3 Final selection of the analyzed documents

The selected documents use the questionnaire as method of analysis to identify users' preferences and features. The investigations, in particular, are aimed at collecting data concerning:

- socio-demographic aspects: age, economic status, autonomy, social status, level of education, sex, etc.;

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- motivation of the trip: visit family or friends, leisure, culture, events, festivals, nature, etc.;
- length of the trip: short, medium, long stay;
- travel arrangements: package tour, self-arranged tour;
- means of transport: plane, train, bus, car;
- reasonable distance of the destination.

The most widespread measuring method is the Likert scale (Losada et al., 2017) which allows both one-dimensional and multidimensional analyses. In some cases, the analyses use multidimensional methods that refer to main components (Klimova, 2018), or factor analysis (Nikitina and Vorontsova, 2015; Zsarnoczky, 2017); other studies (Tiago et al., 2016) focus on the description of this segment of the population by analyzing behaviors and dividing them into "behavioral groups" according to their different habits and needs. By examining the selected documents, we were able to trace a first profile of users, though further appropriate and direct investigations will be carried out providing for a subsequent deepening of the research. In this phase, the main characteristics that contribute to defining the senior travelers' segment have been defined (Tab. 4). As highlighted in literature (Alén, Losada, & Domínguez, 2016), a particularly important aspect concerns the preferences of this specific category of users, with respect to the organization of the trip, in relation to:

- accommodations: they mostly prefer hotels and resorts if they travel in groups, while they prefer to stay with relatives or friends if they travel alone;
- type of trip: they prefer organized trips, "package holidays", guided tours, mainly for reasons of convenience, security and companions to travel with; this choice is often due to their marital status (single, widowed, divorced), whilst the younger seniors prefer self-organized tours;
- time spent in planning the trip: it is different according to the age classes; the younger seniors usually prepare their trip closer to the travelling date than older seniors;
- source of information: senior tourists prefer interpersonal sources (word of mouth, friends and neighbors) rather than the web or other informatics tools to look for travel information;
- seasonality: they are willing to travel during a period other than the high seasonality period, both for low prices and no overcrowded conditions;
- length of trip: they are generally willing to spend long holidays as they have a lot of free time available, but this condition may vary for personal reasons;
- means of transport: they generally prefer tourist buses, as they love sharing the trip with others.

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VARIABLES	
AGE CLASSES	55-59 seniors 59-69 elderly 69-79 old people 79 + very old
SEX	Prevalence of women in the old people age class; Prevalence of men in the senior age class mainly for the nature-based tourism
STATUS	Married Widowed
LEVEL OF EDUCATION	High school degree University degree
EMPLOYMENT	Retired Housewives Employers
HEALTH CONDITION	Good High
MOTIVATIONS (PUSH FACTORS)	Rest and relaxation Visit new places Learn and experience new things Get away from stress Improve health and well-being Take challenge/experience an adventure Seek intellectual enrichment Exercise physically Visit family and friends
ATTRACTIONS (PULL FACTORS)	Natural attractions Historical attractions Cultural attractions Special events and festivals Leisure activities Good weather Commercial facilities for shopping
AMENITIES (PULL FACTORS)	Safety of the destination Availability of medical facilities Infrastructure Service quality of travel agents Service quality of tour leaders and tour guides Hotel accessibility and disability features Cleanliness and Hygiene
ACCESSIBILITY (PULL FACTORS)	Easy accessibility of destinations Quality of the Public Local Transportation
AVAILABILITY (PULL FACTORS)	Price of inclusive packages/hotels Suitable costs

Tab. 4 Profile of senior tourists: characteristics, push and pull factors

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The review of the literature shed light, on the one hand, on the factors that characterize the senior tourists' profile, on the other, on the peculiarities of a senior tourist-friendly destination. It should also be pointed out that, although there is no officially shared definition, senior tourists are almost unanimously considered as a sub-category of social tourism or, rather, of accessible tourism, since disability is almost automatically identified with old age. Indeed, in developing the definition of accessible tourism, Darcy and Dickinson (2009) do not provide any juxtaposition of these two conditions (old age = movement disabilities), except for equating the elderly with the so-called "weak" categories: Accessible tourism enables people with access requirements, including mobility, vision, hearing and cognitive dimensions of access, to function independently and with equity and dignity through the delivery of universally designed tourism products, services and environments. This definition is inclusive of all people including those travelling with children in prams, people with disabilities and seniors (pag.34).

Although an autonomous (and further) definition of senior tourism has not yet been put forward in this work, it was assumed that this kind of tourism was primarily made up of people with:

- good physical and mental health;
- autonomy of movement
- aptitude for travel and leisure, cultural and physical well-being, socialization reasons;
- propensity to spend part of their assets on journeys.

Therefore, if, on the one hand, it is possible to define a reliable profile for a tourist population made up of "seniors", on the basis of these characteristics, on the other, the definition of the specific features of a theoretical tourist destination suitable for senior tourism is reasonably achievable (Tab. 5). At a later stage, the study involves the development of direct surveys through the use of questionnaires, as well as the consultation of experts who can validate the results achieved so far. A particular aspect of tourism activity, that is especially relevant with regard to the objectives of this study, concerns the evolution of tourism demand towards a more sustainable fruition (from mass tourism to sustainable tourism) that currently characterizes the various tourist segments (young people, adults, the elderly). Analysts of the tourism industry, in fact, highlight the predisposition of these types of users to spend more on services that are "environmentally sustainable" (eco-labelled hotels, energy savings, zero km supply, etc.). On the basis of this consideration, the next part of the research work was oriented towards the study of the relationship between the tourist demand in a senior-friendly destination and the supply of services that could fall into the category of ecosystem services. In other words, in the following part the paper focuses on the relationship between the tourist load and the urban ecosystem concerned, with the aim of defining conditions that can

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guarantee system balance, even when an additional load represented by the transient population of tourists is present. In addition, it is important to highlight how a second key to reading (no less important but far less investigated both in the literature and in development policies) concerns the possibility that senior tourism could represent a way to improve the quality of life of the tourists themselves, who are not just an additional tourist typology to which "pre-packaged" trips that respond exclusively to the logic of the economic market of international tourism are offered (Dann, 2002). This second key of lecture is much more respondent to the objectives of the present research even though less explored in literature. In this regard, the contribution of the present study could be framed as a new line for the research oriented to investigate the perspectives of the relation between the tourist activity and the territorial transformations.

PROFILE OF THE DEMAND (FACTORS INFLUENCING SENIOR TRAVELERS)	OUTLINE OF DESTINATION
age income health curiosity knowledge of languages other than mother tongues cultural level enjoy visiting countries different from residence propensity to travel in low-season period	*Physical condition* Easy reachability Accessibility to local resources Safety Good level of mobility infrastructures Physical accessibility Temperate Climate Availability of parking areas for coach Nature-based resources Cultural attractions *Functional conditions* Quality of the supply of services Hospitality Variety of the supply of services Urban propriety Accessible Medical facilities Accessibility Quality of the Local Public Transport Network *Sociopolitical condition* Security condition Quality and variety of local food Expertise

Tab. 5 Demand profile and destination outline

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3 ECOLOGICAL SERVICES AND SENIOR TRAVELLERS: A METHODOLOGICAL APPROACH

The theme of ecosystem services has started attracting scholars' interest since 2005 thanks to the Millennium Ecosystem Assessment (MEA) which defines the ESs as benefits obtained by the population from ecosystems as "providers" of essential services for achieving the man-environment balance. Among these services, cultural services are deemed necessary to improve the mental and intellectual well-being of the resident population as well as of the transiently hosted one (Altunkasa et al., 2017). They probably represent the most important category for the study, for which the preferences of senior travelers must be formalized.

In this sense, a first relationship between tourism activity (understood as an experience capable of increasing culture and knowledge) and ESs is established. The demand component of tourism can be interpreted as the expression of the needs required by a transient population that needs food, water, energy, produces waste and represents a load for the destination chosen, also on the basis of its physical-geographical features (climate, beauty and uniqueness of places and landscapes, cultural heritage, etc.).

The above considerations highlight the need to formalize which ESs are most relevant in determining the choices of a tourist destination for senior travelers, as indicated in the steps below. In this regard, we drew up an online questionnaire – to be easier to administer to the sample of interest - structured in three main parts. The first one serves to identify the general characteristics of the respondent, who is requested to fill in the sections about age segment, sex and geographical origin. The second part is the most important as it elaborates, in the form of questions, the interest in the various ecosystem functions supplied by a potential tourist destination. With the conclusive question, we try to validate the set of answers given previously. While the first and third parts provide text responses, the central part asks the interviewee to assign, on a scale of 0-5, numeric scores for relevance.

The methodology summarized below must be considered as a first definition of the process of identifying which ESs are capable (as a side effect) of polarizing tourism of people over 55. In this sense, it is possible to identify the following 10 steps referring to a perimeterized administrative/territorial area, which provides a sufficient set of data relating to the local ESs. The presence, quantity and relevance of ESs can be detected through different procedures, including the use of remote sensing techniques for the ESs supporting our survival and well-being, in order to quantify the specific presence of ecosystem components within the territorial region of reference (Longato et al., 2018).

- Identification of the urban center and the surrounding area as the reference territorial unit (RTU);

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- detection of the ESs present in the RTU;
- consideration of the polarizing ESs for the senior tourists (ST) (questionnaire);
- extraction of polarizing ESs within the RTU;
- definition of polarizing ecosystem factors (PEF) through specific multivariate statistical techniques;
- verification of the presence and relevance of PEFs in the RTU;
- identification of the characterizing PEFs;
- indications of territorial governance oriented to the development and specific promotion of PEFs.

Fig. 1 shows the different steps of the proposed sequence.

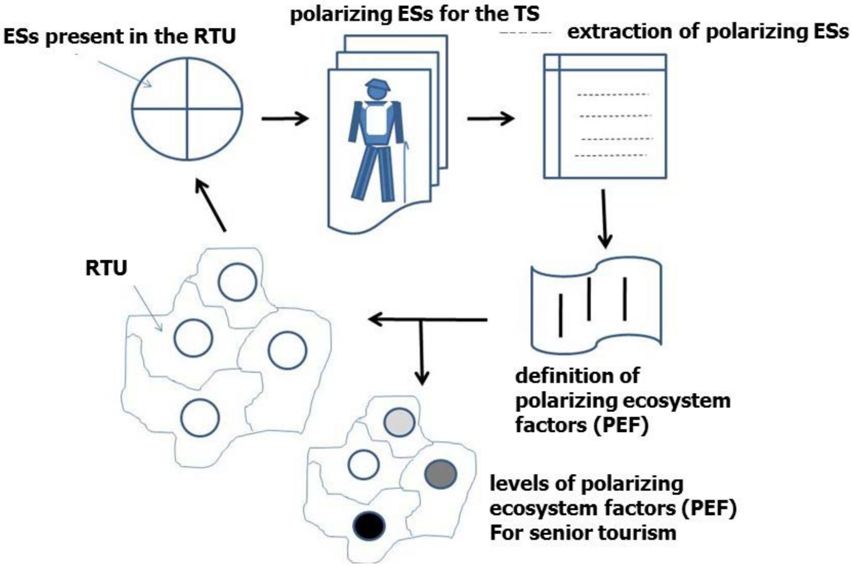

Fig. 1 Steps towards the identification of tourism polarizing ecosystem factors (PEFs)

4 CONCLUSIONS

This study proposes a reflection on the subject of population aging and the growth of this phenomenon worldwide, which is involving another global and constantly growing phenomenon as tourism.

The consideration mainly concerns the need to provide our urban systems with efficient quality services able to meet the needs of the different "populations" living in today's cities as well as in the tourist destinations. In this regard, senior tourism is no longer exclusively an additional tourist segment to comply with the need of preventing the "seasonalization"

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phenomenon (dependence of a destination on tourism flows that concentrate in specific periods of time). It, instead, represents a segment of urban users able to convey the efficiency and quality of urban services and, in particular, of those connected to a sustainable use of the territory. However, thanks to advances in medicine and technology, and to the large amount of free time available, senior travelers will more and more represent a segment of the tourist population to which cities and regions that base their economy on tourism should be devoted, by adapting their spaces and ESs to the needs of the elderly, in order to improve the quality of the destination.

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AUTHOR'S PROFILE

Romano Fistola is associate professor of urban planning at the University of Sannio. His researches mainly deal with topics such as the relationship between technological innovation and urban transformations, urban and territorial risks, the systemic interpretation of the city, the relation between land use and mobility, the sustainability of urban functions, and the comprehension of digital environments for the prefiguration of urban assets.

Rosa Anna La Rocca, PhD in Urban and Regional Planning, associate professor in Urban Planning at University of Naples Federico II. Her research activities refer to the analysis of phenomena that can change urban organization and they are focused on the study of three main relationships: tourism and town planning; land use and mobility, innovation technologies and urban transformations.

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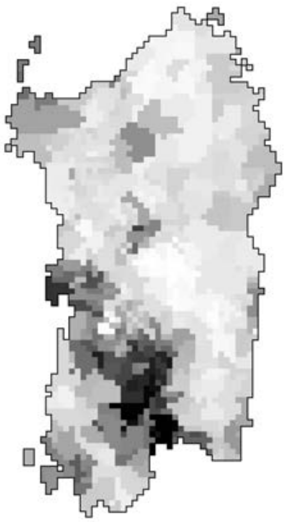

CARBON SEQUESTRATION AND LAND-TAKING PROCESSES

A STUDY CONCERNING SARDINIA (ITALY)

MADDALENA FLORIS, CORRADO ZOPPI

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: maddalena.floris@unica.it; zoppi@unica.it
URL: www.unica.it

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ABSTRACT
According to the European Commission's "Roadmap to a Resource Efficient Europe," the annual land take in the countries of the European Union should amount at most to zero by 2050. This entails that planning practices should focus on ecological objectives, which should be prioritized over other current issues, such as land values' and uses' regulations, spatial market processes and real estate. Land take and related urban development not only implies decline in the availability of land able to sequestrate carbon, but also an increase in emissions. That being so, innovative ecological policies are necessary in order to mitigate or eliminate land-taking processes. This study analyzes the interdependence between land take and carbon capture and storage, identified as an ecosystem service, and proposes an interpretive approach, which is implemented into the Sardinian regional context, that is, a spatial context concerning one of the two insular regions of Italy. CORINE Land Cover nomenclature is used to identify the land cover characteristics. The European Environment Agency makes data available as regards the time series of land cover types. Carbon capture and storage is defined through the NDVI (normalized difference vegetation index) concerning semi-natural and natural zones. By means of the NDVI, an approximation of carbon sequestration distribution and a spatial relation between carbon capture and storage capacity and land-taking processes are detected. The outcomes imply relevant consequences with reference to the implementation of planning measures concerning mitigation of land take and preservation and improvement of carbon capture and storage.

KEYWORDS
Land Take; Ecosystem Services; Carbon Sequestration; Normalized Difference Vegetation Index (NDVI)

1 INTRODUCTION

This study analyzes the interdependence between land take and carbon capture and storage. The research goal is to assess the evidence of a relationship between carbon sequestration by the soil and land-taking processes, and to estimate the quantitative profile of this relationship. The assessment is implemented as regards a spatial context concerning Sardinia, one of the two insular regions of Italy. The results are relevant in terms of further research developments. Carbon capture and storage is a phenomenon, based on photosynthesis, which characterizes peat swamps, forests and grasslands, and other similar ecological systems and consists in carbon dioxide removal from the air by its sequestration by soil and plants (Lal, 2008). The interaction involving air composition and soil has a strong influence on climate regulation (Jobbagy & Jackson, 2000) and is strictly correlated to changes in land cover. Moreover, land condition and green areas play an important role in regulating the carbon cycle since they provide carbon capture and storage as an ecosystem service (European Commission, 2012; Millennium Ecosystem Assessment, 2005). The EEA (European Environment Agency, 2013a) provides the following definition of land take: "Change of the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development." This is a relevant reference for the ongoing discussion on spatial planning since, according to the European Commission's "Roadmap to a Resource Efficient Europe" (Communication COM(2011) 571 of 20 September 2011), the annual land take in the countries of the European Union should amount at most to zero by 2050. Furthermore, a medium-term goal is established by 2020 with reference to the 2014-2020 cohesion policy, which states that direct and indirect impacts of this policy on land cover have to be carefully monitored and assessed. The structure of this study consists of three sections. The next section discusses the methodology concerning the definition of the taxonomies of normalized difference vegetation index (NDVI) and carbon sequestration related to the Sardinian regional context. The results of a multiple linear regression used to assess the relation between carbon storage and capture and land-taking processes are described in the third section. In the conclusions, a discussion related to the outcomes is proposed as regards implications and suggestions concerning planning measures and further research developments.

2 METHODOLOGY

The relation between carbon capture and storage and land-taking processes is studied on the basis of spatial units represented by the 377 municipal administrations of Sardinia,

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which are the lowest layer of the regional public administration framework. A linear regression is estimated according to specification shown in Tab. 1. Carbon sequestration is the dependent variable, whereas the explanatory variables are the level of land take and the land take change occurred between 1990 and 2018, the most recent data concerning the number of residents and the area of the land administered by a municipality. The last two variables are used as control variables to check for: i. the presence of a concentration factor, namely, the lower the number of residents the highest the capacity of capturing and storing carbon dioxide (Sklenicka et al., 2013; Zoppi & Lai, 2015); and, ii. the effect on carbon capture and storage capacity caused by the size of the municipal area, which, ceteris paribus, can possibly positively influence carbon sequestration.

VARIABLE	DEFINITION; SOURCE	UNIT	MEAN	ST. DEVIATION
C_SEQ	Carbon capture and storage capacity; estimated through the NDVI, see Subsection 2.1	Stored carbon dioxide per ha of municipal land, Mg/ha	89.40	22.00
L_TAKE	Size of uptaken land; Copernicus Database	Percentage ratio of land uptaken per km^2 of municipal land, km^2/km^2, %	3.41	5.29
ΔL_TAKE	Change in uptaken land; Copernicus Database	Percentage ratio of the 2018-1990 change in land uptaken per km^2 of municipal land, %	0.99	1.29
RESIDS	Resident people in 2016; the *Comuni Italiani* (Italian municipal administrations)	Number of resident people	4,385.01	12,199.99
ML_AREA	Area of the land administered by a municipality; the Region Sardinia's Geoportal	km^2	63.92	61.76

Tab. 1 Statistics of the variables included in regression model C_SEQ = β0 + β1 L_TAKE + β2 ΔL_TAKE + β3 RESIDS + β4 ML_AREA

The next subsection presents the methodological approach implemented to define the spatial taxonomy of carbon sequestration, whereas a discussion proposed in a previous study (Zoppi & Lai, 2014, Section "What is land take?") is assumed as reference for characterizing the spatial distribution of land take. As per Zoppi and Lai (2014), the spatial taxonomy of land take implemented in this study is based on the land cover classification of the COoRdination de l'INformation sur l'Environnement (CORINE) Land Cover vector map

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(CLC) of the European Environment Agency (EEA) of the EU (European Environment Agency, 2013a). In the CLC classification, non-artificial surfaces are classified into four classes (at Level 1): i. agricultural areas; ii. forests and semi-natural areas; iii. wetlands; and, iv. Waterbodies. The land-taking process is identified in this study as the change of status of areas from non-artificial classes to the artificial land-cover class. Sardinia has experienced an increase in artificial land from 2.26% in 1990 (54,443 hectares) to 3.14% in 2018 (75,718 hectares).

2.1 CARBON CAPTURE AND STORAGE

A number of studies propose combinations of carbon dioxide- and remote sensing-related data to represent spatial taxonomies of carbon pools (Lee et al., 2016; Sun et al., 2019; Rao et al., 2013; Raciti et al., 2014). NDVI indexes biomes' levels of greenness, on the basis of their reflectance spectrum. Late in the 1970s, it was discovered that the quantity of radiation active in photosynthetic terms absorbed by the plants is positively correlated to net photosynthesis. The remote sensors of satellites provide quantitative information concerning the absorbed radiation active in photosynthetic terms. The NDVI is computed through the following formula:

$$\mathrm{NDVI} = \frac{(\mathrm{NR}-\mathrm{RD})}{(\mathrm{NR}+\mathrm{RD})}, \qquad (1)$$

where NR is the near-infrared reflectance and RD is the red reflectance. The spatial distribution of the NDVI taxonomy reveals values included in the interval -0.60 - 0.96, as shown in Tab. 2.

Based on the NDVI distribution, a spatial taxonomy is mapped which associates groups of types of land cover, featured by similar characteristics, to NDVI intervals. This is implemented on the basis of the authors' expertise and of on site survey.

Carbon capture and storage capacity associated to land cover types as regards the pools of carbon is determined on the basis of the spatial data provided by a project funded by the Autonomous Region of Sardinia[1].

[1] The spatial database is based on the surveys implemented in the Project "Charter of the land units and land use capability of Sardinia – First part (2011-2013)." The Project was funded by the Department of Local public administrations, Finance and Spatial planning of the Autonomous Region of Sardinia (ARS). The surveys were implemented by the following public bodies: (i) AGRIS (the Agency of the ARS for theoretical and experimental research concerning agriculture, agri-industrial production and forestry) for the Muravera-Castiadas area (South-eastern Sardinia); (ii) LAORE (the Agency of the ARS for the implementation of the regional projects concerning agriculture and rural development), and the University of Sassari, for the Arzana and Nurra areas (Central and North-western Sardinia); and, (iii) the University of Cagliari for the Pula-Capoterra area (Southern Sardinia).

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The InVEST[2] model uses the carbon pools provided by the Project quoted above to estimate the carbon capture and storage capacity for each land cover type (Nelson et al., 2008).
Three NDVI-related intervals are determined in this study with reference to the Sardinian region, which are characterized by soil features and by the estimated mean carbon capture and storage capacity defined through InVEST (Tab. 2).

NDVI INTERVAL	CLASSIFICATION	CARBON SEQUESTRATION CAPACITY (Mg/ha)
-0.5981 – 0.2659	Soils with no vegetation, bare rocks, built areas, water bodies	0
0.2659 – 0.4890	Soils with sparse vegetation, grass or medium-density vegetation	104.50
0.4890 – 0.9597	Soils with dense vegetation; forests	117.39

Tab. 2 Stored carbon and land uses

3 FINDINGS

The findings concerning the implementation of the proposed methodology are proposed in the following paragraphs. The first two subsections describe the spatial distributions of carbon capture and storage and land-taking processes, whereas the last shows the results of the multiple regression model defined by the variables reported in Tab. 2.

3.1 SPATIAL DISTRIBUTION OF CARBON CAPTURE AND STORAGE

The spatial taxonomy of carbon sequestration belongs to the interval 4.30-115 Mg/ha. The carbon sequestration capacity of about 37% of the municipalities is below 90 Mg/ha. The towns of South Sardinia reveal values comparatively lower than the others. Municipalities located around the SE-NW line which connects Cagliari to Oristano (from South to Central Sardinia) are particularly characterized by a low sequestration capacity. About 4% of the towns, mostly located in the central and northern areas of the Island, show values belonging to the interval 109-116 Mg/ha.
The Metropolitan City of Cagliari, whose administration extends over seventeen municipalities, shows a relevant decrease in carbon capture and storage capacity caused by

[2] InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a free of cost software product, licensed under the BSD open source licence. InVEST is developed by the Natural Capital Project (NCP), whose partners are: the Woods Institute for the Environment and Department of Biology of Stanford University; the Institute on the Environment of Minnesota University; the Nature Conservancy; and, the World Wildlife Fund (WWF). http://data.naturalcapitalproject.org/nightly-build/investusers- guide/html/index.html.

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intensive land artificialization generated by heavy urban expansion, which is as high as 10,700 Mg. This outcome implies that the density of carbon sequestration capacity decreases as urban transformation increases (Sun et al., 2019).
Even higher is the loss in carbon sequestration which is shown by the coastal towns, whose a share of about 35.5% reveals an increase in land take in the interval 0.96-10.80 km2 as a consequence of pressures generated by tourist enterprises, which put at risk coastal and marine environments and their provision of ecosystem services (Lai, Zoppi, 2010). A share of around 38% of the coastal municipalities shows a carbon sequestration capacity ranging between 4.3 and 70.6 Mg/ha.
Fig. 1 reports the spatial distribution of carbon capture and storage in the Sardinian Island.

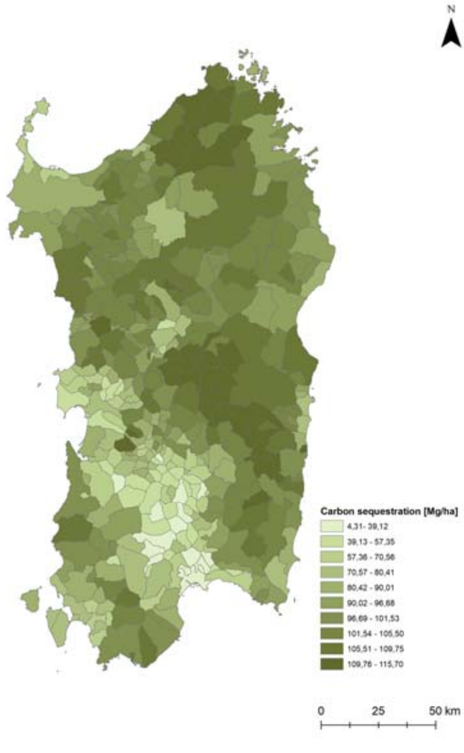

Fig. 1. Taxonomy of carbon sequestration

3.2 SPATIAL DISTRIBUTION OF LAND TAKE

The regional land which changed its status from non-artificial to artificial amounts to about 215 km2 in the period 1990-2018. Its spatial distribution is not homogeneous, and it shows the highest values in the most populous cities, such as the Metropolitan City of Cagliari (5.6

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km2) and the urban areas of Olbia (9.4 km2), Sassari (10.8 km2) and their surroundings, and in the costal tourist settlements.

Nevertheless, more than 33% of the municipal administrations reveal an increase in land take less than 0.09 km2, whereas less than 18% reveal an increase in land take more than 0.98 km2. The towns which are included in the Cagliari metropolitan administration, Olbia, Sassari and a small number of costal settlements belong to this set.

The highly populated and urbanized consolidated tissues of Sassari and Cagliari reveal values of land take which amount to 5% and 2.5%. The two contexts are examples of two different types of urban expansion, namely land sharing and land sparing (Soga et al., 2014).

Cagliari shows a density of 1,801 residents/km2, and, that being so, a compact tissue[3] and a relevant concentration of green spaces within it, which makes the Sardinia's capital city a land sparing urban context, while Sassari, which shows a density of 234 residents/km2, characterized by less concentrated green spaces within the compact tissue, can be identified as a land sharing urban context (Lin & Fuller, 2013). The density of green areas within the compact urban fabrics is positively correlated to protection of biodiversity and supply of ecosystem services and, as a consequence, planning and decision-making processes should focus on land sparing-based policies (Soga et al., 2014), whose Cagliari is an important point of reference. Tab. 3 reports the comparison of the cities of Cagliari and Sassari in terms of their land-sparing and land-sharing attitudes.

CITY	GREEN SPACES (km^2)	COMPACT TISSUE (km^2)	GREEN AREAS IN THE COMPACT URBAN TISSUE (km^2/km^2; percentage of green spaces within the compact urban tissue to the area of the compact tissue)
Sassari	0.5	15.7	2.8%
Cagliari	2.8	54.7	4.9%

Tab. 3 Analysis of green spaces within the compact urban tissue

3.3 RESULTS OF THE REGRESSION MODEL

The outcomes of the regression model are consistent with expectations on signs and significant in terms of p-values (always lower than 2%) as regards the estimates of the explanatory variables' coefficients (Tab. 4).

3 Compact urban fabric is identified within a municipal area by the "artificial surfaces" of the CORINE Land cover (European Environment Agency, 2013b).

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Explanatory variable	Coefficient	Standard deviation	t-statistic	p-value
L_TAKE	-0.716	0.300	-2.395	0.0180
ΔL_TAKE	-4.370	1.126	-3.879	0.0002
RESIDS	-0.0003	0.0001	-2.559	0.0110
ML_AREA	0.092	0.019	4.910	0.0001
Dependent variable: C_SEQ - Adjusted R-squared: 0.289				

Tab. 4 Results of the regression model

The estimate of the land-take coefficient entails that, everything else being equal, an increase of 1% in land take implies a decrease of about 700 kg/ha in carbon capture and storage. This also implies that the total land-taking process related to Cagliari4 in 2018 reveals that about 40% of the municipal land is artificialized, which determines a loss of about three million Mg in carbon capture and storage.

Furthermore, the estimates of the regression model reveals that between 1990 and 2018 the change in land take (variable ΔL_TAKE) causes a negative impact on carbon capture and storage, in addition to variable L_TAKE, which represents the level of land take. As a consequence, the results show that carbon capacity decreases not only in correlation with an increase in the land take level, but also in connection with an increase in the change rate of land take. Taking into consideration Cagliari, an increase of 6.5% in the level of land take5 is correlated to an additional decline of around 235,000 Mg in carbon capture and storage.

The estimated coefficients of the control variables RESIDS and ML_AREA are significant and present negative and positive signs respectively, as was expected.

The concentration effect of RESIDS is a decrease of 5.6 kg/ha in carbon capture and storage related to an increase of 20 residents. This entails that, ceteris paribus, Sassari (127,533 residents) reveals an additional capacity of 399,000 Mg compared to Cagliari (154,083), as a consequence of less residents.

Lastly, carbon capacity is positively correlated to the size of the municipality (ML_AREA), because the estimate of the correspondent coefficient is positive, and, as a consequence,

[4] Cagliari is the capital city of Sardinia and the most populous municipal area. Data drawn from Copernicus, see Tab. 1.

[5] Data drawn from Copernicus, see Tab. 1.

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the impact on carbon capture and storage of an additional 1-km2 of municipal area is connected to an increase of around 90 kg/ha in carbon sequestration.

4 CONCLUDING REMARKS[6]

The outcomes of the regression model show an important and significant correlation, at the municipal level, between carbon sequestration and land take, and indicate that NDVI is a very effective proxy for carbon sequestration capacity, since it identifies the size of carbon captured and stored, and provides a way of measuring this capacity as a phenomenon independent from land take, and, in so doing, it makes it possible to estimate the regression model in stochastic terms. Moreover, since the coefficients of the variables representing the factors that were tentatively assumed as determinants of carbon sequestration are significant and the goodness of fit of the model is relatively high (adjusted R-squared is about 30%, see Tab. 4), it can be concluded that our research perspective is effective in explaining, in quantitative terms, the relationship between carbon sequestration and land take.

Our study puts in evidence a number of important implications concerning the relationship between carbon sequestration capacity and land-taking processes. First, our estimates highlight a robust negative influence of land take (level) and land-taking dynamics, that is, increase in land take through time, on carbon sequestration capacity, which is a finding consistent with Stakura et al.'s (2015) outcomes related to expansion of urban areas (sprawl). This implies that, everything else being equal, the presence, size and dynamics of land take are correlated to a decrease in carbon sequestration capacity.

Second, the reduction in capacity as a consequence of land-taking process is significant in quantitative terms. From this standpoint, our results imply that the presence and size of protected areas, which limit urban expansion and, in so doing, land-taking processes (Hazeu et al., 2009; Martínez-Fernández et al., 2015), are important factors to conserve and possibly enhance carbon sequestration capacity.

This entails that land saving and, as a consequence, conservation of carbon sequestration capacity spreads over the whole municipal land area in correlation with the presence and size of protected areas. An important type of protected areas are the Sites of the Natura 2000 Network (SN2Ns), established under the provisions of the Habitats (no. 92/43/EEC) and Birds (no. 2009/147/EC) Directives. According to the Habitats Directive, an Appropriate

[6] This Section partially reproduces a discussion proposed in a previous study (Lai, Zoppi, 2017, Section "5. Discussion and Conclusions").

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assessment procedure7 must be applied not only in case of plans and projects concerning land parcels located within SN2Ns, but also in case of plans and projects related to areas outside the SN2Ns' boundaries, if such plans and projects may possibly damage habitats and species within the SN2Ns.
A third important policy implication, related to the positive impact of Natura 2000-related policies on the conservation of the non-artificial status of land, is that, because the impact of Natura 2000-based environmental protection on land take is not related to other conservative planning rules, there is no need for severely restrictive planning codes, if SN2Ns are properly established. Indeed, the establishment of SN2Ns does not imply that there are land uses or developments which are forbidden in general terms. However, the mere presence of a SN2N entails that developers, public administrations, planners, and practitioners, have to show that their projects or planning proposals will not damage or generate loss of habitats and/or species, which, according to the outcomes of our analysis, significantly reduces land-taking processes.
Finally, an important implication of this study is the following. Municipal masterplans should state, as regards new development proposals, that such proposals should describe their impacts on existing land uses and demonstrate that artificialization processes are minimal, if any, as for the Appropriate assessment procedure, in case of plans and projects that may possibly generate negative impacts on habitats and species of the SN2Ns. The four points highlighted above entail important implications for planning policies, both at the local (municipal) and regional levels. A first consequence is that policies aiming at reducing land take and at preserving carbon sequestration capacity, should imply the establishment of new protected areas, or the enlargement of existing ones. Both policies need effective and continuous cooperation involving the local and regional administrations, since the complex and long-lasting time period concerning the establishment of new or enlarged protected areas needs a substantial integration of planning visions on behalf of the local and regional authorities. Cooperation is necessary since the identification of conservation objectives and the subsequent establishment of conservation measures entail that the local authorities propose these measures, possibly in the context of a management plan, and the regional administration approves them and, in some cases, brings them to the attention of national

[7] Paragraph 3, art. 6, of the Habitats Directive establishes that "Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives," and that "the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."

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administrations. Cooperation and integration of the local and regional planning processes would imply an important enhancement in the quality of Sardinian public planning, which has been characterized by a lack of coordination in recent years (Zoppi & Lai, 2010). A second significant implication is that in public planning processes, especially at the municipal level, experts in nature conservation should systematically participate and cooperate with spatial planners and developers in the process of definition and approval of local plans, in order to support the identification of sites to be proposed for the establishment of protected areas and, in so doing, to define policies aimed at limiting land take and at preserving carbon sequestration capacity. At present, this expertise is not considered as a necessary component of local planning teams (Leone & Zoppi, 2016). Thirdly, attention should be paid to the possibility of proposing new protected areas in the strategic environmental assessment processes of local plans. These processes entail the inclusion of objectives related to the protection of environmental resources and to the sustainability paradigm into the definition of spatial plans, which implies the possibility of the integration of such goals into the plans, even though they were not considered in the first place (Zoppi & Lai, 2014). Moreover, since the presence and size of protected areas are effective against land take and in support of preservation of carbon sequestration capacity, conservation measures consistent with those adopted for the protected areas could be extended over areas located outside the boundaries of protected areas. From this perspective, complete and detailed maps concerning the spatial distribution of natural resources are needed. A fifth point is related to the necessity of a comprehensive coordination of conservation measures between plans of cities and towns whose municipal areas are adjacent to each other. From this point of view, a fundamental role should be played by the planning office of the regional administration, which coordinates local plans under the provisions of the Sardinian rules concerning the approval of regional and local plans. Finally, as widely recognized in the literature, conservation measures may prevent the implementation of traditional land uses related to urbanization, agriculture and pastures, and, by doing so, they may possibly generate conflicts between local communities and municipal authorities (Kovács et al., 2015; Leone & Zoppi, 2016). The issues of information, participation and consensus-building should not be undervalued in the definition and implementation of local plans that entail conservation measures and policies against land take and in support of carbon sequestration capacity, and inclusive participatory processes should be carefully designed in detail long before plans are discussed and approved. Our methodology and results are based on a regression model that assesses the relation between carbon capture and storage capacity, defined on the basis of the NDVI spatial taxonomy, and land-taking processes. The model considers the municipalities of Sardinia as spatial units. From this perspective, it has to be

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put in evidence that it would be interesting to detect what would happen if spatial units, different from the Sardinian municipalities and related to more detailed spatial taxonomies, were considered, especially with reference to the most relevant conurbations, such as Cagliari and Sassari. The comparative assessment of the relationship between carbon sequestration and land take related to different areas identified within the fabric of the main Sardinian conurbations would help to improve the goodness of fit of the estimated model, its explanatory power, and the quality of its implications in terms of the definition and implementation of policies to preserve and enhance carbon sequestration capacity and to limit or prevent land-taking processes.

NOTES

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AUTHOR'S PROFILE

Maddalena Floris graduated in Architecture at the University of Cagliari, Italy (2013). She is presently a graduate student in the doctoral program in Civil Engineering and Architecture at the University of Cagliari. Her research areas are sustainable urban and regional planning, and environmental policy-making. Her research studies focus on the relationships between ecosystem services and spatial planning, and, in particular, on the issue of carbon sequestration enhancement.

Corrado Zoppi, Civil engineer, is Doctor of Philosophy in Economics (USA, 1997), Doctor of Research in Territorial Planning (Italy, 1992), and MSc in Economic Policy and Planning (USA, 1990). He is a Professor at the University of Cagliari (Sector ICAR/20 – Spatial planning). He is presently teaching at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari in the Undergraduate and Graduate Programs in Environmental and Territorial Engineering and in Sustainable Tourism Management and Monitoring (Regional and Urban Planning, Strategic Planning and Environmental planning).

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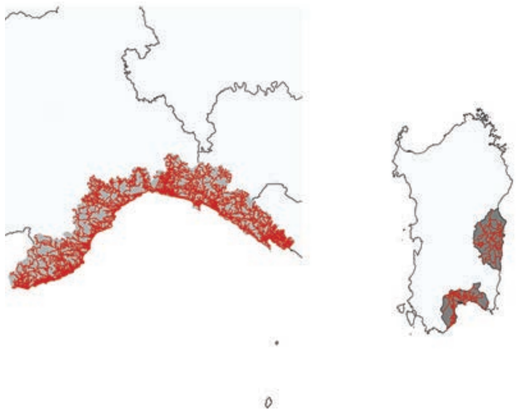

THE IMPACT OF URBANIZATION PROCESSES IN LANDSCAPE FRAGMENTATION

A COMPARISON BETWEEN COASTAL ZONES OF SARDINIA AND LIGURIA

GIAMPIERO LOMBARDINI[a]
ANDREA DE MONTIS[b], VITTORIO SERRA[c]

[a] Department of Architecture and Design
University of Genova, Italy
e-mail: atp.lombardini@gmail.com

[b] Department of Agricultural Sciences
University of Sassari, Italy

[c] Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy

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ABSTRACT

Landscape fragmentation (LF) is the process, according to which landscape parts (patches) become smaller and more isolated. LF is partly due to human activity and has always accompanied man since prehistoric times. In recent decades, the increase of human population, the exponential growth of human needs and the construction of settlements and transport and mobility infrastructures have accentuated the effects of LF. These situations result in a reduction of connectivity of habitats, due mainly to a barrier effect that hinders the movement of animal species. In literature, numerous indices have been proposed for the quantification of LF. In this paper, we apply the Urban Fragmentation Index (UFI), that evaluates the fragmentation caused by urbanized areas, and the Infrastructural Fragmentation Index (IFI), that evaluates the LF caused by road infrastructure. In addition, we aim at comparing LF in the Italian regions of Liguria and Sardinia, with a typical focus on coastal and inner areas. We demonstrate how LF is always higher in coastal landscape units, where there is a higher impact of human development.

KEYWORDS
Landscape Fragmentation; Fragmentation Index; Coastal Zones; Urbanization

1 INTRODUCTION

Landscape fragmentation (LF) can be defined as a dynamic process, where larger landscape fragments, or patches, tend to become smaller and more insulated than in their original condition (EEA, 2011). This process can be caused by linear and mobility infrastructures, such as railways and roads and urbanised surfaces, which reduce the range of movement of animal species and the connectivity of the landscape (Bissonette & Adair, 2008). An important consequence of an increase in LF is a decrease in landscape connectivity (LC), i.e. a higher impedance to movement for mainly animal species, depending on land cover pattern (Scolozzi & Geneletti, 2012).

LF is measurable through indices, such as the Infrastructural Fragmentation Index (IFI), that measures LF caused by roads, motorways and railways, and the UFI, that quantifies LF caused by urbanized areas. In this paper, we aim at measuring LF through the IFI and UFI in two Italian regions: Liguria and Sardinia. We direct our application to the assessment of LF in the four provinces of the Liguria and of the metropolitan area of Cagliari and the historic region of Ogliastra in Sardinia. This essay unfolds as follows. In the next section, we describe the selected methods. In section 3, LF indexes are applied and results presented and discussed with some short concluding remarks.

2 METHODOLOGY

IFI and UFI are LF measures that allow the assessment of the overall level of disturbance caused by transport and mobility infrastructures, such as roads and railway traits, and human settlements (Biondi et al., 2003; Bruschi et al., 2015; Romano, 2002; Romano & Tamburini, 2001). IFI can be expressed with the following equation

$$IFI = \frac{\left(\sum_{i=1}^{i=n} L_i \cdot O_i\right) \cdot N \cdot P}{A} \tag{1}$$

where Li stands for the length in meters of the road or railway trait with the exclusion of discontinuities (viaducts, bridges, tunnels), Oi for a (dimension less) occlusion coefficient, A for the extension in squared meters of the landscape unit (LU) area; P for the perimeter in meters of the LU, and N for the number of patches. We consider patches larger than 0.20 ha to eliminate the distortion due to fictitious parts (Bruschi et al., 2015; De Montis et al 2017; Lega, 2004;). Oi varies, according to the difficulty that the fauna has in crossing the transportation infrastructure (Bruschi et al., 2015): it is equal to: 0.30, for municipal and

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local roads, 0.50, for national and provincial roads, and 1.00, for national four (or more) lane roads and railways. UFI obeys to the following equation

$$UFI = \frac{\sum_{i=1}^{i=n} S_i}{A} \cdot \frac{\sum_{i=1}^{i=n} p_i}{2\sqrt{\pi \sum_{i=1}^{i=n} S_i}} \qquad (2)$$

where S_i stands for the extension in squared meters of the urban area, p_i for the perimeter in meters of the urban area, and A for the extension in squared meters of the LU area. The first term of equation 2 quantifies the incidence of urbanized areas on the *LU* surface; the second term is the ratio between the perimeter of the urban area and the circumference of the equivalent circle (Battisti & Romano, 2007; De Montis et al., 2017; Romano & Zullo, 2013). These indicators have been used in various contexts, quantifying fragmentation in natural parks (Bruschi et al., 2015) and in rural Spain and Italy (De Montis et al., 2017).

3 APPLICATION TO A CASE STUDY AND RESULTS

We use the GIS to perform our study, because it has been proved useful in spatial analysis and in measuring landscape (habitat) fragmentation (De Montis et al., 2017; De Montis et al., 2018). We use data freely available online (RAS, 2003, 2008; Geoportale Regione Liguria, 2003, 2009, 2010, 2015). In order to apply the IFI, we implement a GIS and use data in shapefile format.

Roads and railways layers have been imported in GIS environment as shapefile in polyline format and measured excluding discontinuity traits, namely tunnels and bridges. Reference years depend on the availability of data set for calculations.

IFI variation has been assessed in the time period 2003-2008, for Sardinia, and 2003-2010, for Liguria. As for the UFI, the time periods selected are 2003-2008, for Sardinia, and 2009-2015 for Liguria. We obtained the absolute values and average yearly variations reported in Tab. 1.

Tab. 1 shows the results. As time periods vary for different regional spatial data sets, with reference to IFI T0 refers to the year 2003 for both the regions and T1 to 2008 for Sardinia and 2010 for Liguria; with respect to UFI, t0 means 2003 for Sardinia and 2009 for Liguria, while t1 stands for 2008 for Sardinia and 2015 for Liguria.

As for the absolute values, the area with highest IFI is recorded for Coastal Liguria municipalities (113331.5 in 2010), while the lowest one is obtained for Sardinian Coastal Ogliastra municipalities (1018.23 in 2008). The lowest UFI value was recorded in Ogliastra (0.30 in 2003), while the highest value was obtained in Coastal Liguria municipalities (12.80 in 2015).

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NAME OF THE LU	IFI_{T0}	IFI_{T1}	UFI_{t0}	UFI_{t1}	Δ IFI	Δ UFI
Imperia	938.84	7237.30	2.50	2.50	95.84%	0.00%
Savona	1862.46	13698.56	3.77	3.80	90.79%	0.13%
Genova	5483.06	17325.79	5.32	5.42	30.86%	0.31%
La Spezia	1723.29	9371.98	4.14	4.16	63.41%	0.08%
Coastal Liguria municipalities	32843.81	113331.5	12.62	12.80	35.01%	0.24%
Cagliari metro area	3005.56	3300.96	2.41	3.03	1.97%	5.15%
Coastal Cagliari metro area municipalities	2416.35	2439.87	2.12	2.64	0.19%	4.91%
Ogliastra	1201.95	1135.36	0.30	0.34	-1.11%	2.67%
Coastal Ogliastra municipalities	1104.23	1018.65	0.42	0.49	-1.55%	3.33%

Tab.1 LF in Liguria and Sardinia. IFI and UFI absolute values and average yearly change

In Fig. 1, we report a representation of the geographical data used in the analysis.

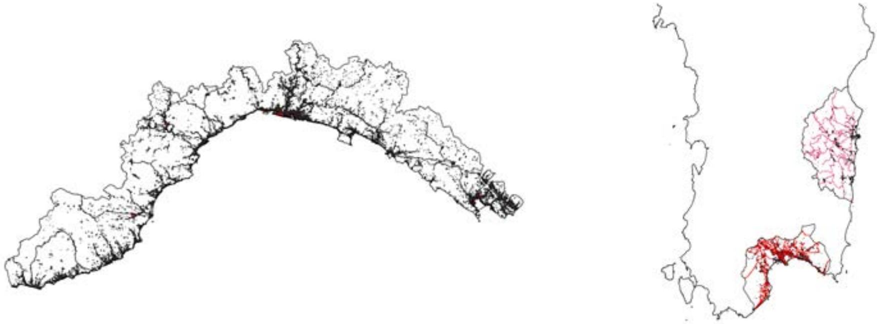

Fig. 1 On the left, urbanized areas and linear infrastructures of Liguria; on the right, fragmenting elements in two case studies of Sardinia

As for the average annual growth rates, the highest average annual increases for IFI is recorded in Imperia (95.84%), the lowest in Coastal Ogliastra municipalities (-1.55%). This decrease is in counter trend, with respect to the general inclination of Italian coastal areas, including Coastal Liguria municipalities (35.01%). As for the UFI, the highest annual increase is recorded in Coastal Cagliari metro area municipalities (5.15%), Liguria's areas display negligible values.

4 CONCLUSIONS

In this work, we have studied LF due to settlements and transport infrastructure expansion, by assessing its values and dynamics in space and time. In particular, we have applied a set

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of metrics to describe the dynamics of two LUs of Italy, in Liguria and Sardinia. We have developed a comparative approach, applying two indicators, IFI and UFI, able to give us information on the degree of fragmentation. We have found that the highest values are found in the coastal and most populated areas. The work can offer indications to planners, so that they can plan works that can limit the effects of fragmentation, the so-called defragmentation works.

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WEB SITES

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AUTHOR'S PROFILE

Giampiero Lombardini. Architect and urban planner, PhD in urban planning Sapienza (University ofRome), assistant professor Department of Architecture and Design of the Polytechnic School of the University of Genoa. He gained research experience in the field of urban planning both locally and in large areas. He has also carried out research in the field of environmental and landscape issues. His writings concern planning tools, computerized processing of spatial data (GIS), strategic environmental assessment and decision support systems.

Andrea De Montis. Civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural development at the Department of Agriculture, University of Sassari. He is principle investigator of a research project on Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Vittorio Serra. Master's degree in forestry and environmental system, University of Sassari, Phd student in Civil Engineering and Architecture, University of Cagliari. His research interests focus on historic rural buildings, rural areas and landscapes, and landscape planning, landscape fragmentation and defragmentation measures.

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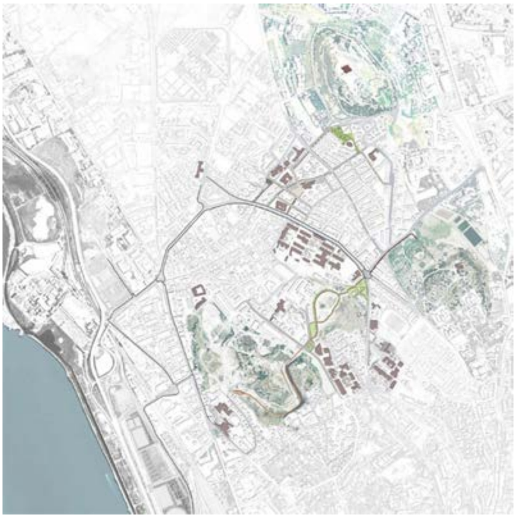

AREAS OF CONSIDERABLE PUBLIC INTEREST, TERRITORIAL COMMON GOODS AND ECOSYSTEM SERVICES

AN APPLICATION CASE FOR THE CITY OF CAGLIARI

MARZIA MORITTU, ALESSANDRO PLAISANT

Department of Architecture, Design and Urban planning, University of Sassari, Italy
Department of Alghero
e-mail: marzia1993@hotmail.com
plaisant@uniss.it

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ABSTRACT

The areas of considerable public interest (Decreto legislativo 42/2004, Article 136), as a spatial representation of landscape protection, are not circumscribable to a category of immediate identification in an applicative manner. They are affected not only by acknowledged, interpretative and representative inhomogeneities, but also management and operational ones. Against this background, territorial common goods are a topic of debate and the object of numerous interpretations that make it a whole from indefinite boundaries. This research is aimed to summarize all the different definitions and applications on the areas of considerable public interest and on the territorial common goods which are devoid of consolidated and recognized identification and execution practices and, therefore, need some forms of governance and management. An operational framework allows the definition of public policies in the field of urban common goods, starting from the identification of operational requirements and relatives criteria and indicators. On the one hand, this is a cause for reflection on the concept of "considerable public interest", on the other hand, it highlights a useful path for governance or management through the identification, representation and evaluation of potential public spaces to be involved and connect, intended as territorial common goods. In this sense, they play an essential role as a connective space for ecosystem services supply and driver for converting the character of marginal areas and improve their living condition. To illustrate this, a recent experience is presented here, concerning the potential of the connective spaces in the urban renewal in a peripheral neighborhood of Cagliari, Italy.

KEYWORDS
Areas of Considerable Public Interest; Territorial Common Goods; Ecosystem Services; Urban Regeneration

1 INTERPRETATIVE-REPRESENTATIVE AND PARTICIPATORY-NON-HOMOGENEITY ON THE TERRITORIAL COMMON GOODS

The areas of *considerable public interest*[1], as environmental resources and territorial goods, are affected by some problems in the national and regional legal frameworks, due to the different criteria of interpretation, which deviate from a homogeneous reading of the territory based on specific categories. In fact, several Italian regions have defined different approaches in terms of methods of interpretation, representation and prescriptions for use. Some of them, e.g. Emilia Romagna, Friuli Venezia Giulia, Lazio and Sardinia identify specific areas, landscape systems, sub-areas or sub-zones *etc*. by the presence of identity elements and features. Veneto is the only region that does not refer to specific places, while others, such as Piedmont, Puglia and Basilicata refer to places only in terms of prescriptions for types of interventions. As far as the representation is concerned, the identification of areas or categories of interventions, with the exception of the Puglia, Basilicata, Sardinia and Emilia Romagna regions, can’t be supported by cartography. Although present, the latter has a technical nature, scarcely representative of the characteristic elements of the territory and limited to the identification of the perimeter of the constraints, with the exception of Emilia Romagna.

The Decreto Legislativo 42/2004 (hereinafter “Code”) brings out some elements of reflection about the territorial goods and services that could not be verified in reality (e. g. to be characterized by different degrees of interest, to be able to public belonging, to be destined for the use of the community, *etc*.[2]). According to the Code, the process of recognition of territorial goods and services is deficient in terms of an active participation of citizens. In contrast, the Emilia Romagna Region (2015) foresees several participatory moments throughout the whole process aimed at the definition of environmental quality objectives. In the European context, Catalonia stands out for the central role of citizens in recognizing the environmental values by the so called “Landscape catalogues”.

[1] Article 136 of Decreto Legislativo 42/2004 “Codice dei beni culturali e del paesaggio” identifies these four categories: a) "The immovable things that have conspicuous characters of natural beauty, geological singularity or historical memory, including monumental trees"; b) "Villas, gardens and parks, (...) that stand out for their uncommon beauty"; c) "The complexes of immovable things that make up a characteristic aspect having aesthetic and traditional value, including the centers and historical nucleuses"; d) "The panoramic beauties and also those points of view or belvedere, accessible to the public, from which one can enjoy the spectacle of those beauties".

[2] Reference: art. 2, c. 4.

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2 OPERATIONAL DEVICE FOR MANAGEMENT: THE IDENTIFICATION, REPRESENTATION AND EVALUATION OF TERRITORIAL COMMON GOODS AND SERVICES

Starting from the critical issues emerged from this survey, the authors introduce an operative device to explore and manage the potential of the territorial common goods and services for provision of benefits. This device is aimed at highlighting the connections between public spaces, practices and way of living, laying down some actions for urban regeneration and recognizing their role as ecosystem services supply. It draws from the literature, practices and tools and it is structured as follows: requirements-spatial dimensions-quality criteria of the public space-criteria and indicators.

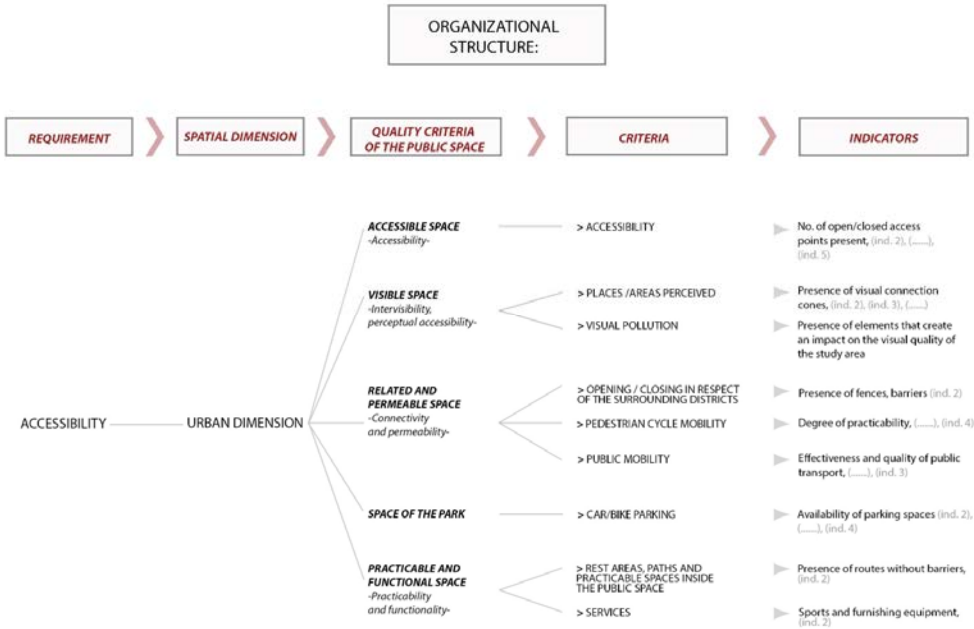

Fig. 1 The organizational structure on territorial common goods for the requirement of *accessibility* as an example. Source: personal elaboration.

The requirements for identifying the territorial common goods are outlined in: *identity*, *accessibility*, *management* and *sharing*, *membership* and *contribution to supply ecosystem services* (see Fig. 2). Further sub-requirements help clarify and emphasize details.

The *identity* sub-requirements are structured as follows:

- "Recognizability**"** represents the *degree of affection* and the *sense of belonging*. The territorial common goods are related to identity, culture, traditions of a territory and are functional to the social life of a given community (Iaione, 2012). This implies that

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the recognition by citizens of a given urban-architectural context as a common good is essential to evaluate the degree of affection and the level of appreciation;

- "Unity of the context" refers to the identity of a place and it implies a *sense of belonging* as soon as *"The community embodies the 'conscience of the place' therefore 'the awareness of the heritage value of the territorial common goods' (...)"* (Bonesio, 2012). The common goods are therefore *"'foundation and result' of a process of enhancing the territory (...) intended as (...) not merely a space but a 'place' ('space with distinctive characteristics') and 'place of places', based on differences, on different 'territorial values'"*. (Ferraresi, 2012).

Accessibility sub-requirements are:

- "Accessibility" implies *equal access* and *direct use* to places for everybody, by laying down the potential usability of the good (Garau et al., 2014). It also fosters the definition of community usability-oriented policies. Both physical and perceptual accessibility can affect different levels. Nevertheless, Iaione (2012) states that urban space as a common good *"(...) is subject to the principle of universal access."* since *"... everyone must have access to them and no one can claim exclusive demands (...)"* (Rodotà, 2012).

The *management* sub-requirements are organized as follows:

- "Direct participation". The awareness of the uniqueness of a common good and its sense of belonging and recognition can determine participatory moments triggered by *general willingness*, *management commitment* and *cooperation*. This requirement is the basis for getting involved in the common good[3] through maintenance, care and regeneration, considering that *"(…) a 'common good' felt by the people is the result of direct involvement, a convincing acceptance of responsibility for its conservation and management"* (Garau et al., 2014).
- "Sharing of strategies". Ferraresi (2012) interprets a common good as a "(...) shared good in which people lives by building it (...)". Basically, a common good acquires this feature because of the fact that citizens recognize its functionality to individual and collective well-being and, consequently, they decide to agree on its use and management improvement or re-acquisition.

The *membership* sub-requirements are organized as follows:

- "Widespread ownership" (Rodotà, 2012). In this case we refer to the legal system of belonging that characterizes the common goods and guarantees that they can be used

[3] "One does not possess a common good, one participates in the common good" (Iaione, 2012).

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as spaces and services for all, especially for local communities that share rights and obligations (Carestiato, 2010).

- "Non-exclusive rights". This requirement claims the collective use and denies the intention to require exclusive rights of use4 since " common goods should focus primarily on the idea that they are goods which everyone has the right to use (...)" (Seppilli, 2012).

The *contribution to supply ecosystem services* sub-requirements are organized as follows:

- "Ecological-environmental functionality". This sub-requirement refers to the opportunities of a good to supply environmental services. At the design stage it implies the *maintenance or restoration of constitutive ecological functions*, for example through actions aimed at restoring ecological-environmental processes *etc*.
- "Socio-cultural functionality" is linked to the opportunity to offer socio-cultural services and, therefore, new land uses and activities for enhance the effective capability of people to use and benefit from places.

All these requirements pertain to different "spatial dimensions": affective, urban, managerial/participatory and shared, perceived and concerning the construction of ecosystem services.

According to the *Place diagram*[5] (Project for Public Spaces, 2018), they are strictly related to the criteria that a public space should have to be endowed with (see Fig. 2-diagram below). For this purpose, they are divided in different typologies, contains several qualitative and quantitative criteria and indicators able to operate following a multi-dimensional, multi-scalar and multi-level approach.

For this purpose, *recognizability*, *visibility*, *practicability*, *functionality*, *salubrity*, *safety etc.* along with *support to ecosystems and environment* become some of the essential qualities and characteristics for public goods to attain and support decisionmakers by addressing the interventions and their evaluation.

[4] "(...) Their use belong (in full freedom and without demanding exclusive rights) to all citizens (...)" (Garau et al., 2014).

[5] https://www.pps.org/

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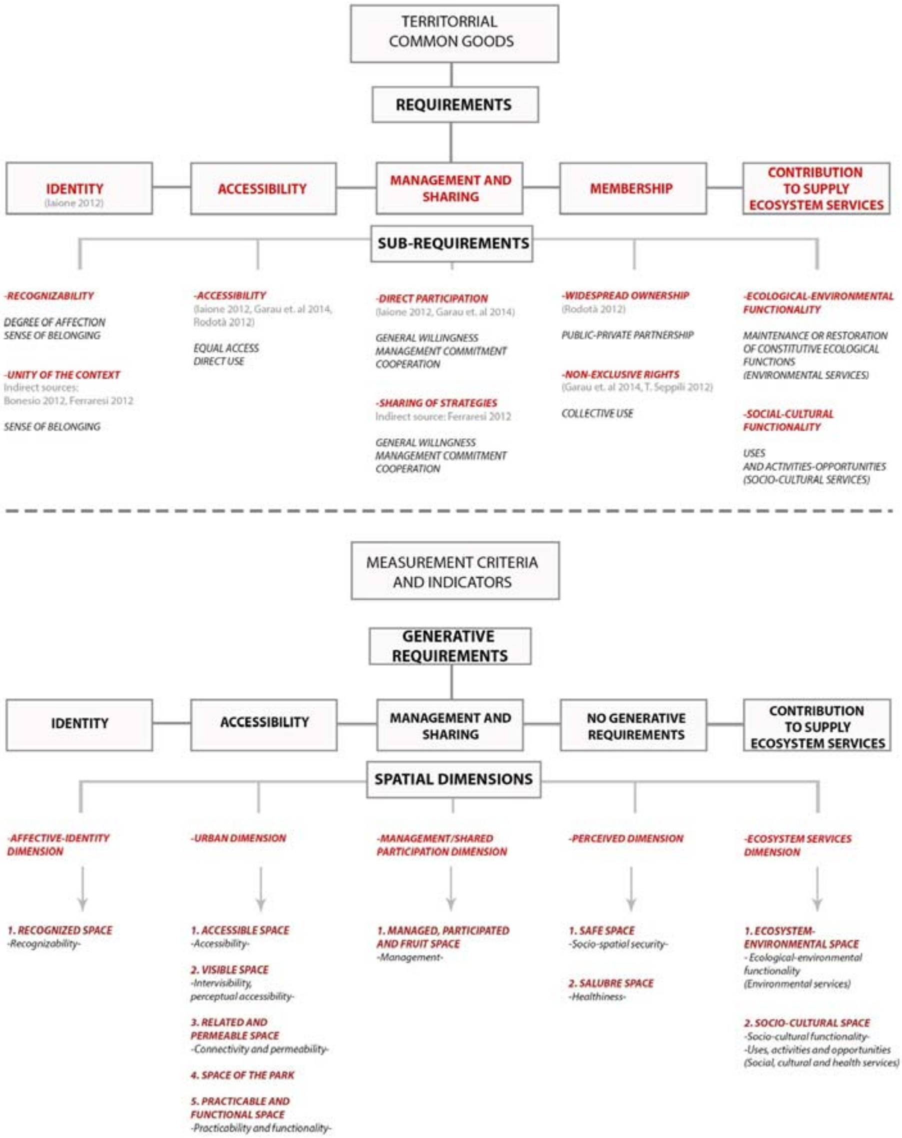

Fig. 2 Top diagram: requirements and sub-requirements for the identification of territorial common goods. Bottom diagram: transition from generative requirements to spatial dimensions and quality criteria of public space. Source: personal elaboration

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3 OPERATIONAL DEVELOPMENTS: THE INTEGRATION OF THE TERRITORIAL COMMON GOODS REQUIREMENTS AND INDICATORS WITH THE ECOSYSTEM SERVICES PURPOSES

The ecosystem services approach allows us to reconsider the role of the areas of public interest in relation to the mitigation of certain risk factors/problems in a peripheral neighborhood of the city of Cagliari.

We have, therefore, looked at the interactions between different disciplinary fields, concepts, projects and scales.

Note that the interaction between the concepts "considerable public interest", "common goods" and "ecosystem services" gains a further justification in the fact that they presents common features and elements[6] starting from the goals of the Millennium Ecosystem Assessment (2005) and the requirements for identification of public goods. For example, the *sense of place* (link 1.2), finds direct correspondence with the *recognisability* and both converge in the requirement of *identity* (see ig. 3).

From this background, we describe the operating device to explore and manage the potential of the system of connections at the different level of scale in the neighbouring districts of S. Avendrace, Is Mirrionis and S. Michele in Cagliari, Sardinia, by highlighting the operative contribution of actions, single and combined, to the fixed spatial dimension goals according to the abovementioned requirements and criteria.

These districts are characterized by a mixed medium density fabric with low quality buildings, lack of public spaces and several abandoned sites waiting for restoration. This paper focuses the attention on the physical and functional accessibility and integration of spaces, land uses and practices of use introduced in the study area of "considerable public interest" of Tuvixeddu-Tuvumannu-Is Mirrionis located in the city of Cagliari, Sardinia.

Note that this area is endowed with important historical-environmental features of the landscape system (the Santa Gilla Lagoon, the Hills of San Michele, Monte Claro and Tuvixeddu-Tuvumannu, which houses one of the largest Punic necropolis, in the Mediterranean basin. In this sense, the potential of urban regeneration coming from the system of connecting the territorial common goods and services is strictly inherent to their opportunity to supply ecosystem services (ES). However, this does not imply that all these areas necessarily have a reference to ecosystem services but, in case of applications, they present themselves as areas incorporated in the urban environment able to provide specific categories of services at the different (metropolitan, urban and neighbourhood) scales.

[6] Common requirements: *construction of ecosystem services* (socio-cultural and ecological environmental functions), *identity*, *accessibility* and *management* and *sharing*.

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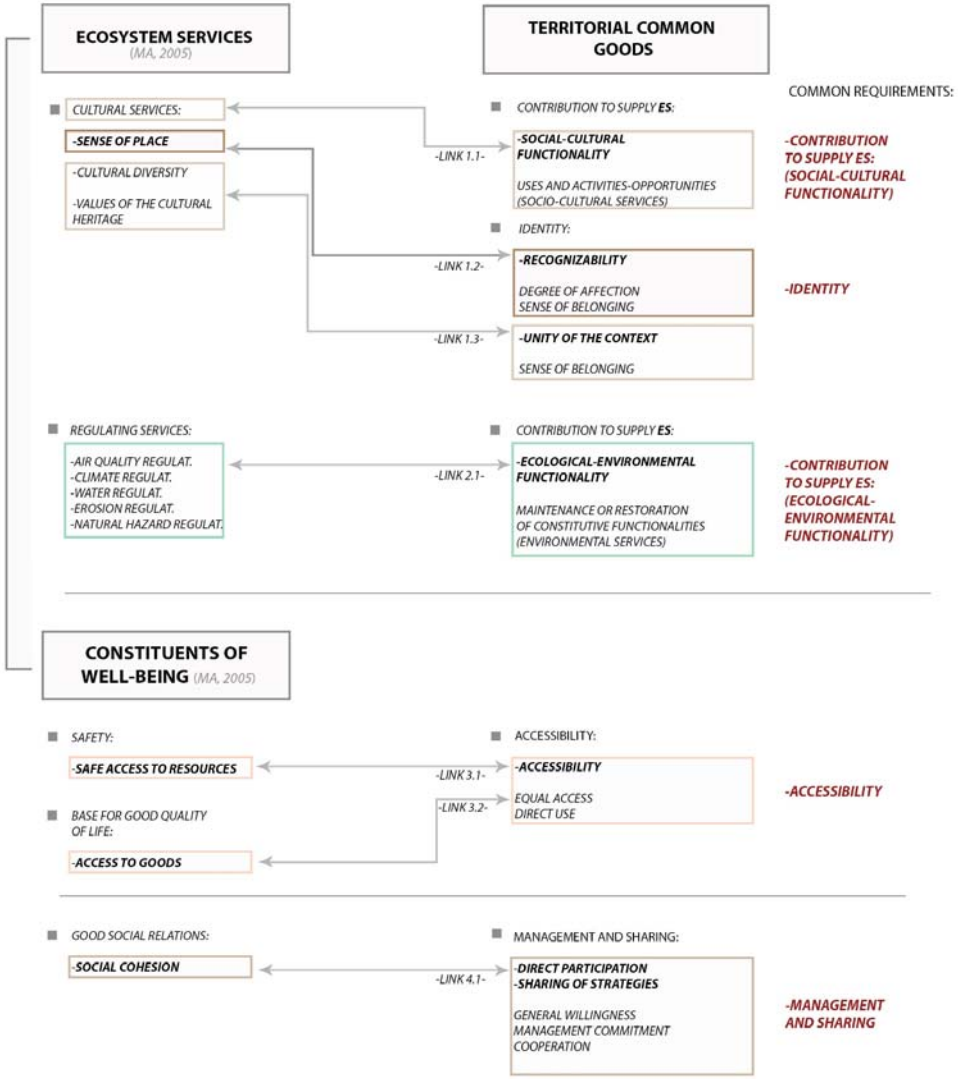

Fig. 3 Common requirements between territorial common goods, ecosystem services and components of well-being. Source: personal elaboration.

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4 CONSTITUENTS OF WELLBEING AND ECOSYSTEM SERVICES, PUBLIC GOODS AND AREAS OF CONSIDERABLE PUBLIC INTEREST: RETHINKING CROSS-CONNECTIONS FOR URBAN

The operating device to explore and manage the potential of the system of connections at the different level of scale fosters the framework of scheduled interventions for the Sant'Avendrace and Is Mirrionis districts in Cagliari, as a means of implementation of the Extraordinary Program of intervention for urban redevelopment and security of the suburbs, c.d. *Bando Periferie*[7] and the *ITI Is Mirrionis*[8].

The connections of the areas of considerable public interest define two project axes (*transversal connection paths*) intercepting other public goods and determinants of well-being. Among these:

- The first axis connect the Lagoon of Santa Gilla, a new large urban park located next to the lagoon, equipped with sport, educational and leisure planned in the area of San Paolo (*Allotment B-Bando periferie*), the social housing complex of Via Po (*Allotment* C), the Hills of Tuvixeddu-Tuvumannu and the Park of Monte Claro;
- The second axis systematizes the different services planned by the ITI Is Mirrionis (the civic market of Via Quirra, the Ciusa school of Via Meilogu, the Hangar as a community center) between the Via Is Mirrionis and the Hill of San Michele.

The first axis is mainly part of the green corridor connecting the Santa Gilla Lagoon to the Pond of Molentargius and restores the relations between the Hills of Tuvixeddu and Tuvumannu through network of connective walkable spaces and then with the Park of Monte Claro, thus contributing to revitalise those parts today ignored and fragmented.

Further measures concern a new system of public spaces which has the purpose of organizing meeting points and rest areas between the new functions, services and territorial common goods, continuous and pleasant to walk and bike.

The second axis designes as a system of connective public spaces, including the new services and functions on which *ITI Is Mirrionis* actions are foreseen, to prevent the episodic, punctual and fragmentary nature of extraordinary interventions. In this case, the main intervention is designed with the aim of improving physical connections with the introduction of new land uses, services and the reconfiguration of public spaces. In

[7] "Programma straordinario di intervento per la riqualificazione urbana e la sicurezza delle periferie delle città metropolitane e dei comuni capoluoghi di provincial" (Legge 208/2015). The project for S.Avendrace neighbourhood ranked 23rd/120 with a proposal focused on new urban functions and uses and their accessibility and connections.

[8] Integrated territorial investments (delibera 26/6 - 2016), outlined for the neighbor districts of Is Mirrionis and S. Michele.

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particular, the interventions concerning the Vie Quirra-Serbariu-Ciociaria and the Vie Meilogu-Bugerru relate important services such as the local market and the square, the Ciusa primary school and some interstitial area classified as S3 by the Town Plan. Thus the market square and the school become two fundamental operational focuses to address the design requirements. As well as the redesign of the system of connections with a main corridor of Via Is Mirrionis with different functions and services, reconverted into safe and inviting places to live in, walk and rest give new supply nourishment at the local and urban scale, as the under-requirements of fairness of access and direct fruition point at.

5 CONCLUSIONS

The proposed device guides the definition of public policies in the field of territorial common goods.

In an urban context where the "considerable public interest" areas are present, the approach of the ES allows to go beyond the logic of demarcation of the goods (the Hill of Tuvixeddu-Tuvumannu), to extend it to other environmental centres (the Hills of M. Claro and St. Michele) by revealing their physical, perceptual and functional connections.

In order to avoid fragmentation, an integrated program of interventions carefully combined to each other, operate at the local, urban and metropolitan scale. The actions proposed (for illustrative purposes) show important connections at different scales and also involve interstitial areas relevant to the functions of ecosystem services and to the components of wellbeing. The project deals with physical connections also through slow mobility systems which redirect the accessibility and the function of the common goods in a logic of integration (Tuvixeddu-Tuvumannu Hill, public spaces, the marketplace, etc.). and ensure fairness of access and direct fruition from different neighborhoods. Finally, the research addresses some of the five questions raised by Haase (2017) about the difficulty of understanding and applying the ES concept in an urban environment, the potential to facilitate the diffusion of common goods linked to nature in the cities, the complementarity to the infrastructure and the multiscalarity.

Multiscalarity is crucial for ES to be functional: it allows to reconnect territorial elements fragmented by urban transformations, it guides the interventions within the city and facilitate the integration between functions, environmental and perceptual elements. The complementarity to the infrastructure is also necessary as it ensures the restoration of environmental functions and pays attention to the components of well-being considered in terms of access to resources, health and quality of life. In short, ecosystem services enter fully into the discourse on territorial common goods and operate in a logic of integration, complementarity and orientation to the city's project.

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AUTHOR'S PROFILE

Marzia Morittu. Newly graduated student (December 2018) in "Planning and policies for the city, the environment and the landscape" (LM-48) at the Department of Architecture, Design and Urban Planning, Alghero, Italy (University of Sassari) with a thesis entitled *"Areas of considerable public interest and common assets such as the identification and planning of ecosystem services. An application case for the city of Cagliari"*. In 2016 she graduated in "Urban Planning. Planning of the city,

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territory, environment and landscape" (L-21) at the same university, discussing a thesis with the following title: *"Open landscapes in the Marghine. Territories to low density: the resources of the territory as input for a local development process "*. In 2018 she worked as a curricular trainee at the office of the Sardinia Region "Service of landscape protection and surveillance of the provinces of Sassari-Olbia Tempio" for the development of a useful methodology for the "vestizione" process (elaboration of requirements and criteria for management) on areas declared to be of "Notable Public Interest" by Article 136 of Decreto Legislativo 42/2004. Between 2017-18 she studied with the Erasmus Plus program at the University of Girona, Spain where he acquired specific competences on the use of the Arcmap program and knowledge on the themes of climate change (causes and effects on the territory). In 2015 he collaborated as curricular internships (Erasmus traineeship program) at the studio of Arriola & Fiol arquitectes, Barcelona, Spain.

Alessandro Plaisant. I am an associate professor of the Department of Architecture, Design and Urban Planning, the University of Sassari, where I teach Urban Planning and Analysis of urban systems. I held a Ph.D. at the University of Cagliari, after spending eight month as a fellow at the School of Anthropology, Geography and Environmental Studies, the University of Melbourne, focusing my research on decision-making processes in public policymaking, strategic planning, policies and pluralism-oriented tools. I combine my research activities with higher education, international and institutional cooperation activities, as director of the II level International Master's Program "Advanced Methods and Tools for Sustainable Planning", developed in academic cooperation with Harbin Institute of Technology and as scientific coordinator of the activities planned for the funded national call "extraordinary Program of intervention for urban redevelopment and security of the metropolitan suburbs", specifically in Sant'Avendrace district, the Municipality of Cagliari (Sardinia, Italy). Among my recent publications: Urban regeneration of peripheral areas: the critical role of the connective space in an italian city. (Aa.Vv) Urban Design Journal, 2018; Risk Prevention and Management. A Multi-actor and Knowledge-Based Approach in Low Density Territories (Aa.Vv.), Computational Science and its Applications (ICCSA 2017), in Gervasi, O., Murgante, B. et. al. (Eds.), Springer (ISBN 978-3-319-62397-9), Switzerland

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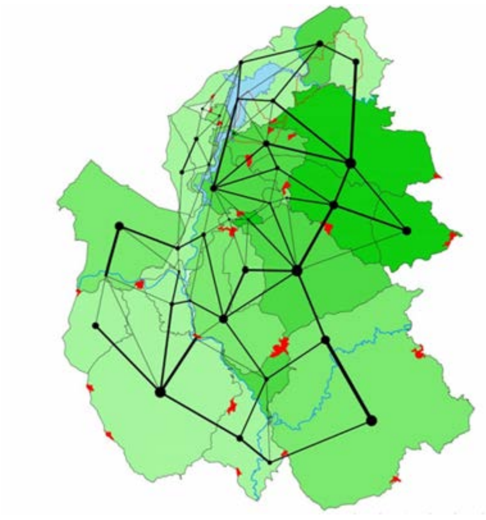

A BOTTOM UP INITIATIVES FOR BIODIVERSITY

ECOLOGIC REPRESENTATION FOR THE INNER AREAS OF SARDINIA

GIUSEPPE ROCCASALVA

Department of Architecture and Design
Polytechnic of Turin, Italy
e-mail: giuseppe.roccasalva@polito.it
URL: www.polito.it

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ABSTRACT

Since 1992 with the Rio Conference and more after 2010 with the start of Italian National Strategy for Biodiversity (NSB), planning research and practices are trying to likewise analyze and integrate biological diversity. Even though biodiversity plays an important role for all living species and the loss of biological variety has also made ecosystems weaker in front of natural disasters, it is still an hidden topic in public opinion and debates. This article discuss the limits of the main normative framework about biodiversity with a focus about NSB central objectives. Even though local administrations are involved by the consequences of biodiversity loss, they are not aware about their responsibilities and NSB do not directly engaged them to propose plans and policies. In this regards, a pilot study is outlined, describing a bottom up participative initiative which has involved 6 inner areas of Sardinia on the themes of NSB. Several geographical analyses were produced and a tentative analytic representation of biodiversity was set and used in the inclusive participatory planning process. The article describe in methodological term a ecologic representation (ecologic mosaic and graph analysis) and how it enabled 6 local authorities to start the discussion on local planning perspectives with concern about biodiversity. Finally, a serious of critical issues pertaining the case study are discussed to open the debate for further development.

KEYWORDS
Biodiversity in Planning; National Strategy for Biodiversity; Ecologic Graph Analyses; Ecologic Mosaic; Inner Area of Sardinia

1 INTRODUCTION

Since 1992 at Rio de Janeiro Conference, the Convention on Biological Diversity (CBD) has drafted the road map and the responsible coordinating bodies for defining in each countries strategy for protecting biodiversity[1].

So far, 193 countries signed CBD, promising to reduce the loss of biological diversity[2] and preserve the habitats both at local/regional and national level. However, despite decades of efforts the global loss of biodiversity is increasing[3], and very few and un-coherent initiatives are dealing with this topic at a very local level.

There are comparative studies[4] which have analyzed worldwide Local Biodiversity Strategies and Action Plans (LBSAPs) as tools for integrating biodiversity issues locally, finding there is not a consistent definition and use of biodiversity in planning practices. Typical planning tools are limited in ability to address biodiversity.

There is a need to build analytic cross-disciplinary tools that facilitate cities and sub-national governments in the integration and implementation of these decisions. With this background, this article focuses on the main Italian normative framework in biodiversity (section 2) with a critical description of the National Biodiversity Strategy (NSB) with respect to local planning practices.

It is then outlined a pilot study interpreting the themes of NSB at local level (section 3), describing a bottom up participative approach which has involved 6 inner areas of Sardinia. A focus on the indicators and tools for analyzing biodiversity at local level is described (section 4). Several geographical analyses were produced and a tentative method for the management of local natural assets was set. Finally, a serious of critical issues pertaining the case study are discussed (section 5) to open the debate for further development.

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[1] Biodiversity or biological diversity is defined as the life richness on the earth planet. The number of world living species is estimated between 4 to 100 million, only a part of them (from 1.5 to 1.8 million) were scientifically observed while many plant, animals, invertebrates, fungi are unknown and less than 1% of bacteria has been cataloged (source ISPRA:topics)

[2] It is estimated that 50 species disappear every day, which means that biodiversity decreases between 100 and 1000 times faster than the natural extinction time of the last 65 million years (source ISPRA:topics)

[3] The third Global Biodiversity Outlook (GBO-3) indicates an overall failure to achieve biodiversity targets and an increasing rate of decline in biodiversity (SCBD 2010)

[4] A comparative study of 48 LBSAP in 17 Countries. Pierce J.R, *Planning for biodiversity in a divided world*, Master thesis, Cornell University, 2015

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2 DISCONNECTION BETWEEN RESEARCH AND PLANNING PRACTICES: LIMITS OF THE NORMATIVE FRAMEWORK ABOUT BIODIVERSITY

Against a very vast amount of scientific studies, guidelines and books discussing biodiversity, there are several normative steps which shows limits and opportunities for applied research experiences. The transition between researches and planning practices for biodiversity needs a reciprocal integration[5]; research experiments must make experience of the limits of legal processes of local practices; cities practices must try to scale down research findings, indicators and analytic methods for building a new institutional knowledge and capacity. [6]

Several signals of disconnection between research and practices can be seen in the results of the development of normative tools both at global, national and regional level.

In 2010, the Global Strategic Plan have set the world strategy for biodiversity, with 20 objectives to be reached within 2020 and 56 indicators to be monitored (known as Aichi Biodiversity Targets). Unfortunately, the last Global Biodiversity Outlook made by UN reported that most of Aichi Biodiversity goals will not be achieved for 2020 (only 5 indicators are on track, while 33 indicators report low rated progress, 10 indicators show no progress, 5 indicators are getting worse than last outlook and 3 indicators have not been evaluated). It has been estimated that only 17% of surface protection will be achieved compared to the total world need[7].

In 2015, in the context of the 2030 Agenda, UN General Assembly integrate biodiversity into the Sustainable Development Goals (SDGs), bringing biodiversity into a more direct contact with planning proposal and the expectation of European funded projects (Life, Horizon2020...).

In this regards, Italian local Administrations have the chances to propose bottom up initiatives which are also concern about biodiversity by working, for example, on renewable sources, low carbon initiatives, nature based solutions for polluted soil and so on. However, this is only a chance for local planning practices within a wide European objective, whose coordinating plan is not defined and not visible at local level. At the national level, since 1994, Italy has taken several steps towards a coherent approach to the theme of biodiversity[8].

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[8] Law n. 124, February 14, 1994, which ratifies the CDB signed in Rio de Janeiro on 5 June 1992.
DLGS (legislative decree) n. 267, December 30, 2010, which implements the EC-Directive 2009/145 on conservation vegetable varieties.

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In 2010 Italian Ministry of Environment defined a coordinating policy with the adopting the National Strategy for Biodiversity (NSB). From a the point of view of local practices and researches several critical points rise up in the definition of the 3 objectives and the working areas of NSB.

By 2020 NSB ask to protect diversity of species which implies to maintain and possibly restore eco-services because they are supporting directly or indirectly all the living being. According to the Millennium Ecosystem Assessment (MEA), ecosystems services are divided in *supporting, provisioning, regulating* and *cultural services*. If the definition of eco-services is broadly accepted, it is rather difficult to make common and diffuse computation of them and consequently to define a protection policy, especially at local level. For example, biodiversity as cultural services, plays a "psychological role" which is difficult to be computed or inserted in a local planning processes. How is it possible to make "visible" the quality of life which is directly affected by ecosystem services . Is it possible to compute the "environmental reputation" of a local territory in order to attract new tourism? [9]

By 2020 NSB ask to reduce the impact of climate change on biodiversity, defining appropriate adaptation measurements, mitigate their effects and increase the resilience of natural and semi-natural ecosystems. This objective focus on the reduction of vulnerability of nature in order to guarantee that ecosystems can better withstand - be resilient - to unforeseen disturbances of climate change. The higher is the diversity of species the better is the resilience of ecosystems towards climate changes. In this regards, the main focus is to understand how to impact climate changes with mitigation policies and adaptation plans. However, Local municipalities aren't often able to coop/counteract land vulnerability and hazards nor to face the consequences of a natural disaster. Is it possible that sub-national public institutions provide an integrated framework of information and funding for natural risks which let local municipalities warned and responsible on how to start local adaptation policies?

By 2020 NSB ask to integrate biodiversity protection plans into economic policies as an opportunity for new employment and social development, by strengthening the benefits of ecosystem services and by assessing the costs of their loss. This objective try to bridge the

DPCM (Ministry of the Environment) March 5, 2010, which establishes the National Committee for Biodiversity. 6 June 2011, which establishes the Joint Committee for Biodiversity, the National Observatory for Biodiversity and the Consultation Table.
DPCM (Ministry of agriculture, food, forest, tourism policies) 6 July 2012, concerning the adoption of national guidelines for in situ, on farm and ex situ conservation of plant, animal and microbial biodiversity of agricultural interest.

[9] Roccasalva G., "PRA Piani di Reputazione Ambientale: i dossier paesaggio per i territori interni della Sardegna" In URBANISTICA DOSSIER Territori competitivi e progetti di reti / Competitive territories and design of networks 013(2017), pp. 321-324.

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gap between the economic values and biologic values, making biodiversity's values "visible" to all stakeholders, decision makers and investors. Here, the quantitative/qualitative approaches of researches are the weak points and leave lots of spaces to discussions and experiments. In general, biodiversity is difficult to be systematically quantified in economic terms both globally and locally, even though there are generic reasoning, for example, that the more a soil is able to purify water the less it will cost to provide clean water, or that the presence of trees will increase the capacity to purify the air and reduce the welfare cost of air-pollution dependent diseases, or that the more fertile a soil is the less fertilizers cost will be spent. However, it is possible to give values to local planning practices that work on this topic indirectly, for example, with the management of waste and recycling, with traffic congestion policies, with management of urban and peri-urban public green spaces whose costs are well known to public administrations.

Moreover, due to the cross-cutting themes which can regards biodiversity, the NSB was divided in 15 working areas[10], which were assigned a set of 10 indicators for assessing the present state and a set of 30 indicators for monitoring the future impact. From a methodological point of view, planning practices and researches have a distinct working area which is loosely integrated. Periodic reports give the status of biodiversity but focusing mainly on qualitative aspects: how many Plans and policies have integrated biodiversity, or how much public investments have boosted protected areas, or how many research initiatives have increased the knowledge of biodiversity in each working areas. In this regards, NSB does not suggest a common evaluations methods, does not promote the integration with new assessments methods among the disciplines and does not specifically encourage the Regions to improve initiatives also at local level. Literature offers a variety of indicators[11] and analytic methods which are usually hardly comparable to one another, and have been developed and used relatively independently of one another (müller and wiggering, 2004, 122).[12]

At the regional level, even before 2010, Italian Regions have adopted laws that define or encourage coherent but different local strategies on biodiversity[13]. Regional laws were mainly

[10] 1. Species, habitats, landscape; 2. Protected areas; 3. Genetic resources; 4. Agriculture; 5. Forestry; 6. Inland water; 7. Marine environment; 8. Infrastructure and transport; 9. Urban areas; 10. Health; 11. Energy; 12. Tourism; 13. Research and innovation; 14. Education, information, communication and participation; 15 Italy and biodiversity in the world

[11] Müller F., Burkhard B., *The indicator side of ecosystem services,* in Ecosystem Services*,* Volume 1, Issue 1, July 2012, Pages 26-30

[12] Ulrich Walz, Landscape Structure, Landscape Metrics and Biodiversity, Living Rev. Landscape Res., 5 (2011)

[13] In chronologic order: Lazio (2000), Umbria (2001), Friuli Venezia Giulia (2002), Basilicata (2008) "Protection of autochthonous genetic resources of agricultural interest; Marche (2003) "Protection of animal and plant genetic resources of the Marche region"; Tuscany (2004), Emilia Romagna (2008)

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dealing with specific work areas (agriculture, forestry, local breeds), trying to protect autochthonous species but without an overall strategy for biodiversity and without any specific commitment of local municipalities in dealing with these themes.

In synthesis, the development of normative tools for biodiversity have not succeeded in leading the complex cros-disciplinary efforts in research and practices, have not demand specific and integrated analytic methods and targets for the sub-national levels. Local administrations are involved by the consequences of biodiversity loss but they are oftne not aware about their responsibilities and NSB do not directly engaged them to propose plans and policies.

3 A BOTTOM UP INITIATIVE FOR THE INNER AREAS OF SARDINIA

At the end of 2015, the Association BAI[14] engaged 6 small and medium size municipalities of the inner areas of Sardinia (Laconi, Masulla, Neoneli, Olzai, Orotelli e Sorradile) in order to co-design a long-term strategic Plan. Initially, the work aimed at the submission to the Major adapt then it became an applied research experience that tried to deal with complex topics at a local level and with a participatory approach which included seminars with local practitioners, workshop and conferences for discussing and disseminating the initial results.

All the work refers to boundaries broader than the local administrative limits, specifically 3 boarder homogeneous area (ATO of Barbagia, Barigadu, Alta Marmilla)[15] encompassing the areas with coherent or similar/connecting natural identities (see Fig. 1).

This pilot research experience focused on three main objectives:

- the development of guidelines for the management of public green spaces and proximity farming. The pilot study provided a protocol (*Green Guide*) to lead the design and maintenance of local urban and suburban green public spaces based on pre-established sustainability criteria derived from the Millenium Ecosystem Assesment (MEA). This

"Protection and enhancement of the heritage of local breeds and varieties of agricultural, zootechnical and forestry interest"; Piedmont (2009) "Consolidated text on the protection of natural areas and biodiversity"; Liguria (2009) "Provisions on the protection and enhancement of biodiversity". And after NSB: Puglia (2013), Sardinia (2014) "Rules on agriculture and rural development: agrobiodiversity, collective mark, districts".

[14] The author of this essay (Giuseppe Roccasalva) was the scientific coordinator for BAI of the pilot study. BAI (Borghi Autentici d'Italia) is an association bringing together hundreds of small and medium-sized municipalities all over Italy, working for building sustainable, fair local development models in order to enhance local identities and preserve people and places.

[15] ATO stands for "optimal territorial areas" which were identified by a regional law in 2005. These type of boundaries were used in regional planning during the period between 2007-2013. The Regional Landscape Plan (2006) define 27 zones which were not used cause these are referring mainly to the coastal areas which are not covering the municipalities of the pilot study.

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protocol was also designed in accordance to national Law 10/2013 ("Rules for the development of urban green spaces") and it aimed to considering each green urban space as a part of a larger system where local actions can have a quantifiable impact on the whole ecosystem and vice versa.

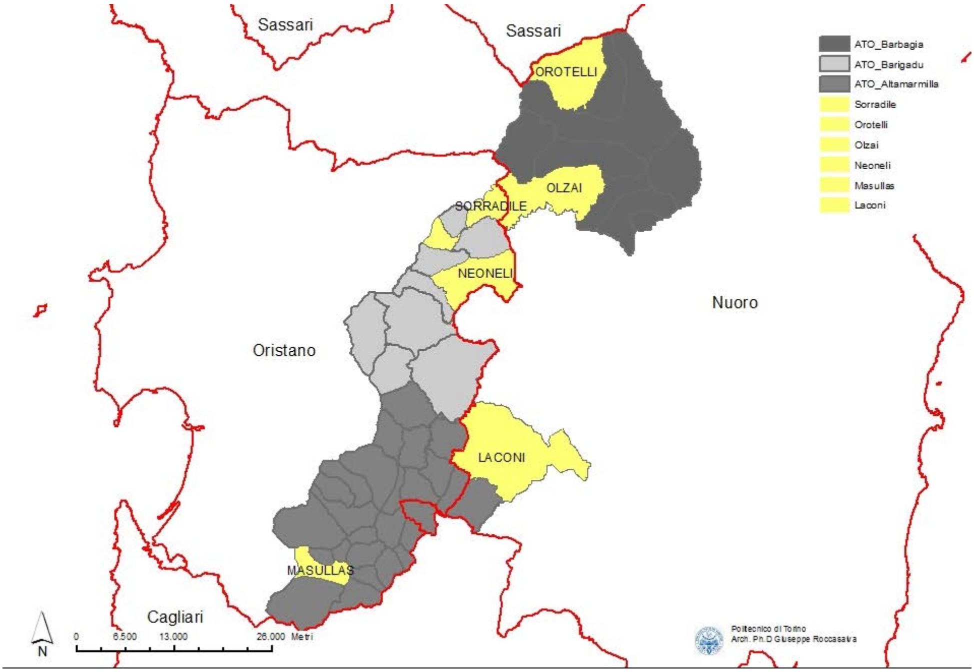

Fig. 1 The inner areas of sardinia (optimal areas) involved in the pilot study with highlighted the 6 leading municipalities (source own)

- the protection and enhancement of local landscape in order to foresee possible ideas to exploit in the touristic sector. It was carried out an interpretation of main elements of the local landscape which were also depicted - both in a map and charts - with respect to their spatial and quantitative distribution in order to highlight present strength/weakness and future opportunities/threats of each element (see Fig. 2a). Four types of landscape's elements were depicted: elements that have a significant role in the processes of transformation (*the structure of landscape*); elements that represent factors which distinguish a field from others (*the character of landscape*); specific qualities and values which are *typical* elements of a landscape; *critical* elements of a landscape which is corrupting the structure of the landscape. In general, the output of these analyses had the role to easily show to local authorities the quantitative and qualitative distribution of natural asset and the interaction with rural activities and the

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urban settlements. It was possible to understand the neighboring status and presence of specific elements (eg. garigue, forests, pastures, building fabric), comparing their ecologic capacity and fragmentation in an extended area which connect local territories. Without entering in the details of the results, it is important to say that this map tried to draw attention to specific qualities (positive and negative) in order to enable an initial discussion with local administrations.

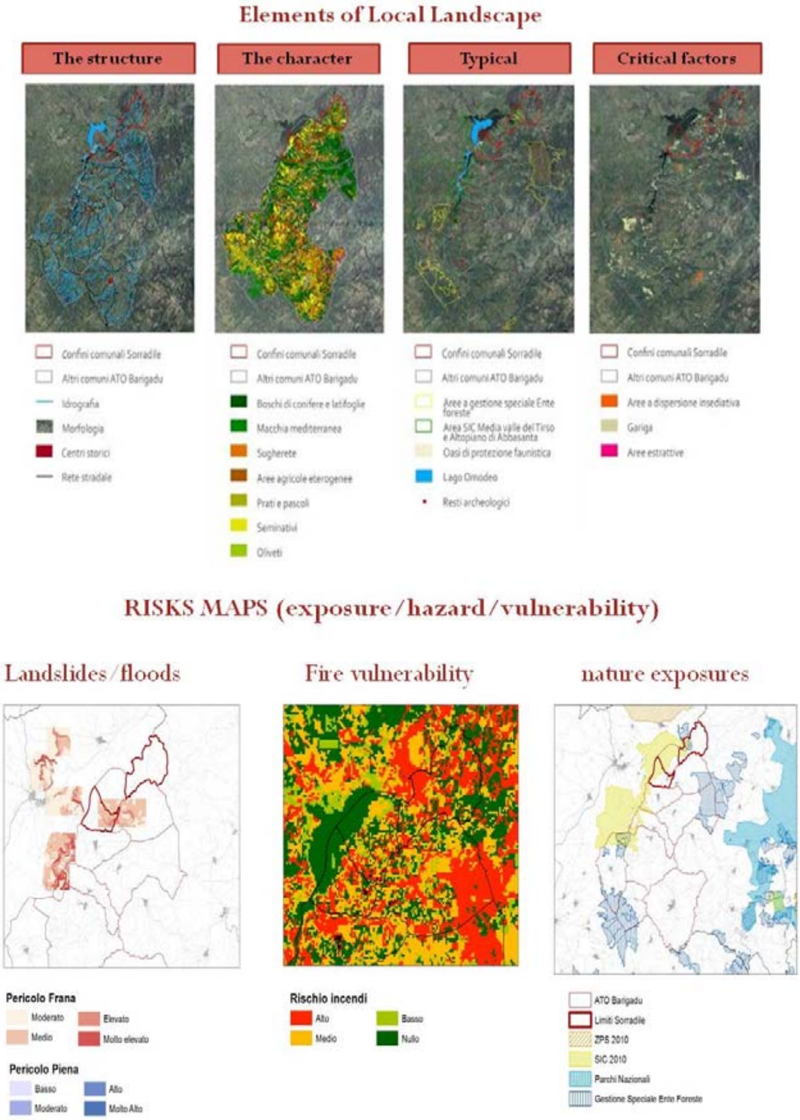

Fig. 2 - One example of geographical survey of elements of local landscape (2a- left). One example of geographical survey of territorial risks conditions, with focus on exposure, hazard and vulnerability (2b - right)

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- the development of geographical analyses as tools for setting policies for climate change mitigation and adaptation. A set of geographical analyses tried to build an integrated framework of "visible information" (static and interactive maps). In particular, main aspects of *natural risks* were analyzed according to the definition of MEA. Thus, all the municipalities were provided with an *exposure/hazard/vulnerability* map (see Fig. 2b). These maps reported the current territorial and management conditions of natural risks with a non-technical language. In alignment with international protocols on climate change (IPCC), these geographical analyses will have the role to assist local municipalities to *coexist* or *cooperate* with the potential issues or to *counteract* the uncertainty of the problems encountered. In this regards, decision-makers can define policies that goes from passive to proactive in relation to the capacity to contrast risks in a short-long time perspective.

Together with the previous geographical surveys, the pilot study provided an integrated "biodiversity analysis" which encompassed all neighboring municipalities and will be the focus of the next paragraphs. This section has only outlined the main objectives and results of the pilot study in order to give a fair picture of the extensive work and the role it had toward local administrations. At the end of the study, the Green Guide, the maps and reports discussing landscape and ecologic qualities were officially adopted by all the city councils involve in the pilot study.

4 THE ECOLOGIC REPRESENTATION: HOW TO "SEE" BIODIVERSITY

Together with the previously described work, in accordance with the objectives of NSB, the pilot study provided the 6 inner areas of Sardinia with a geographical representation of ecologic features (ecologic mosaic of habitat's tiles) and their resilient/resistant capacity and fragmentation conditions (ecologic graph). The graph representation is made of nodes and arcs which allow local stakeholders to clearly see on a map:

- (nodes) the total amount of *metastability* of each habitat's tile, which is the capacity to react to possible disturbances by keeping uniformity (resistant ecosystem) or recovering uniformity (resilient ecosystem)
- (arc) the quantification of connections or internal fragmentation among different soils, which are the flows of biologic energy between the tiles of an habitat

The graph can be represented in static and dynamic maps in accordance to the inclusive design process of local stakeholder and to the planning needs. The use of the ecologic representation in the pilot research experience was twofold:

- showing natural habitat's in order to monitor the resiliency of ecosystems

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— understanding how internal fragmentation work against the conservation of biodiversity
More than the detailed results of the ecologic mosaic and graphs, it is important to focus on the way this analytic approach was used in the co-design practices.
The decision makers, the experts of different disciplines had work together toward the increase of ecosystem's resiliency and the management of fragmentation. Regarding resiliency, it must be said that the computing of biodiversity was mainly defined as a ecologic "quantity". Increasing local quantity of biodiversity could decrease the variety of qualities of the whole analyzed area and consequently decrease the resiliency of an ecosystem. If, for example, we do exchange tiles with small amount of species having rare qualities with bigger tiles with larger but more common qualities, we lose the global ecologic variety.

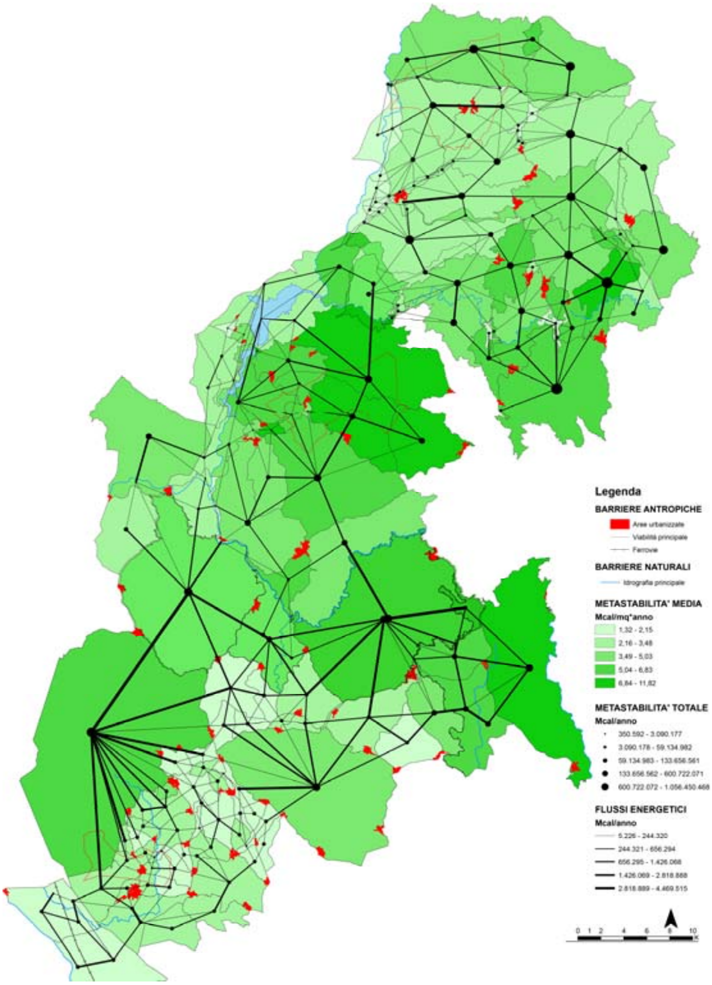

Fig. 3 Ecologic graph analyses of optimal bourdary areas of 6 inner local municipalities of Sardinia.

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The representation adopted in the pilot study was often followed by a qualitative assessment in order to make the biodiversity of all the inner areas the main target also while we were discussing of local and specific planning interests. The ecologic representation had the role to clearly shows quantities, qualities and spatial distribution/connections of each mosaic's tile. In the general planning perspective of local stakeholders, the fragmentation phenomena was often analyzed as the "geometrical subdivision" of previously continuous tiles into other patches due to different design proposal (new urban sprawl/infrastructure, harvesting natural resources, introducing new species, human activities).

This generic geometric definition of habitat fragmentation was the only one adopted during the engagement process of the pilot study; however, it can be refined with other type of expert analyses: the decrease of the total area of tiles, the reduction of the "edge effect" between two tiles[16], the segregation of one tile from others, the reduction of average dimension of tiles of the whole habitat. Much of these analyses of fragmentation require a diachronic survey of the land cover or a monitoring system that allow the analyses to detect them.

The ecologic representations assist local stakeholder in providing suggestions and ideas that were concern about the homogeneity/variety of ecologic assets (eg. reducing the boundaries of new developments), the aesthetic value of areas dense with same ecologic element (eg. olive or pomegranate groves), and also the economic potential of abandoned areas (eg. touristic exploitation of areas with high biodiversity). The belief is that the sum of all suggestions collected around the ecologic representation will boost new proposal or strategy for sub-regional territorial development with a specific and new concern to the overall landscape conditions, risk constrains and ecologic qualities.

5 CONSIDERATIONS: BIODIVERSITY IN LOCAL PLANNING PERSPECTIVES

This article outlines a non-conventional applied research which has had a focus on biodiversity, however, some critical considerations must be pointed out.

- Legally binding processes for biodiversity: there must be a legally binding national regulation which empower local experiments as the one described in the article to work over the local administrative boundaries of responsibility. In fact, even though all the analyses were shared and legally adopted by local city Councils, these were loosely implemented into local planning initiatives of the coming years. In this regards, a new

[16] The variety of species declines at the border between two habitat and biodiversity is reduced

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kind of Plan for detached but ecologically connected local administrations must be legally demanded at local level.

- Integration of biodiversity in planning practices: even if the Directive of European Union encourage planning sectors to integrate biodiversity in practices[17] there are several bias on this purpose. Local planning practices have time span which are different from the ecologic changes (years vs decades/century). This means that Planning with respect to biodiversity must consequently work with uncertainty. Planning mitigation or adaptation initiatives can only contribute to improve the capacity of natural systems to be resilient to climate changes but the consequences are unpredictable. In this regards, the pilot study of the 6 inner area of Sardinia can enable decision makers to anticipate future responsibilities beyond the political time limits and practices.

Ecologic methods integrated to planning are still under development. Most of the estimations of biodiversity do not suite directly with planning purposes. The ecologic representation described in the article is a trial which had the ability to communicate to a wide range of experts and to give back to the municipalities a monitoring tool to be easily improved in the future.

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[17] *Member States shall endeavor...in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence ... to encourage the features of the landscape which...are essential for the migration, dispersal and genetic exchange of wild species* (Art. 10 Habitat Directive 92/43/EEC)

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AUTHOR'S PROFILE

Giuseppe Roccasalva. Since 2003, is research fellow and lecturer at Polytechnic of Turin where he was engaged for multi-criteria analyses and development of urban and territorial projects, commissioned by private/public stakeholders. He was invited speaker to scientific conferences and had disseminated publication on assessment tools, multidimensional Gis analyses and processes of participatory planning. He was editor and author of a book titled "Future Cities and Regions: Simulation, Scenario and Visioning, Governance and Scale" which was published by Springer. In addition, he is consultant for different public Authorities and municipalities working on strategic projects, environmental and landscape assessment-design and European fund procurement. He is the president of a joint landscape commission of four municipality in the area of Turin. He holds a Bachelor in architecture and urban design, a Master in Spatial Planning with focus on built environment and a PhD in Building Design. He had working and formative experience with Swedish Universities (CTH and KTH) and has collaborated with Goteborg's Town Planning Office (SBK), where he have worked in order to develop a strategic plan for the Southern River Shore development. He was involved in international cooperation on the basis of European projects (Horizon2020, Life+, Interreg, COST, Creative Europe) and other national and bilateral projects.

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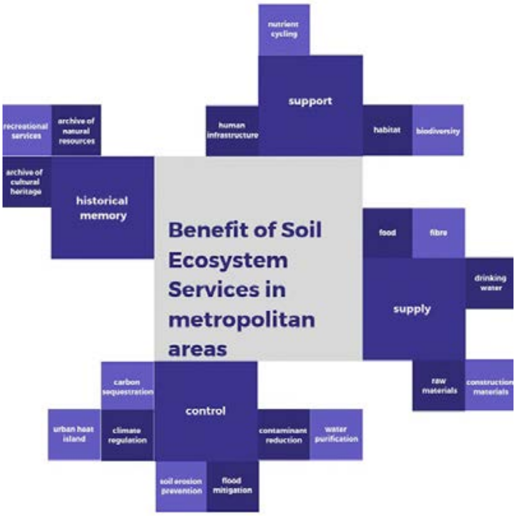

THE SOIL MATTER BETWEEN ECO-SYSTEMIC PERFORMANCE AND SPATIAL PLANNING IN METROPOLITAN AREAS

***SAVERIO SANTANGELO**
PAOLO DE PASCALI
ANNAMARIA BAGAINI

Department of Planning, Design and
Technology of Architecture
University of Sapienza, Italy
e-mail: saverio.santangelo@uniroma1.it
paolo.depascali@uniroma1.it
annamaria.bagaini@uniroma1.it
URL: https://web.uniroma1.it/pdta/

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ABSTRACT
Although soil represents an essential resource for the sustainability of anthropic life, through the provision of different and relevant "ecosystem services", it does not emerge as an object of effective protection and safeguard actions. It results considerably underestimated in space policies while, when it is being considered, it appears as a generating factor of conflicts between instances of exploitation and safeguard requirements. The present paper focuses on the phenomenal and regulatory aspects concerning the soil resource in metropolitan areas, where the rate of "soil demand" is particularly relevant. Moreover, the recent establishment of the "metropolitan cities" in the Italian institutional framework, in accordance with the law 07 April 2014 n. 56 "Provisions on metropolitan cities, provinces, union and merging municipalities", provides a new field of action and new – regulatory and strategic - planning tools for the governance and safeguard of the soil resource, on which it seems appropriate to suggest a path of investigation.

KEYWORDS
Soil Ecosystem Services; Land take / Soil Consumption; Metropolitan Areas; Spatial Planning

* The other authors are: Clara Musacchio, Francesca Perrone.

1 SOIL, AN UNDERESTIMATED RESOURCE IN THE SPATIAL PLANNING

The following article seeks to systematize the researches carried out during the Phd program,[1] regarding the issues of sustainability and its peculiarities in metropolitan areas.

Soil is one of the key elements from which most of the natural resources of our planet originate and, on whose quality, and consistency depends the survival of living beings (Klaus, 2015). It has been recognized as "primary good" since 1972[2] and, later, as a "resource to be safeguarded" according to the European Commission drafts for sustainability and environmental actions (CE, 2011, 2013). However, at European level, an unitarian strategy for soil protection has not been achieved yet.

The soil value cannot be exclusively measured through a quantitative evaluation of the land area amount but it results from the combination of structural, physical, chemical and biological characteristics: as a basic factor of a complex "ecological-environmental infrastructure" (Dominati, 2013), it is able to alter the functioning of the "biosphere system" (Zamprogno & Cattaneo, 2012) and, in these terms, its subsistence becomes crucial for the environmental, economic and socio-cultural life.

Along with the consequences of physical, chemical and biological degradation processes, the main risks that derives from the loss of natural soil mainly concerns:

- the fragmentation of habitats and the reduction of the continuity of ecological corridors, with the consequent decrease in biodiversity;
- the loss of sustainable agricultural production, due to a reduced and qualitatively poor humus (on which the natural fertility of the soil depends) as well as its natural nutritional elements;
- the loss of carbon storage capacity, considering that soil represents an important carbon sink, second only to the oceans (EEA, 2015);
- the reduction of water retention, incurring in situations of hydrogeological risk (Pileri, 2015);
- the alteration of balances of some landscape conformations.

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[1] Doctoral degree in "Urban planning, design and architecture technology", Curriculum "Territorial, urban and landscape planning", XXXI cycle, a.a. 2015-2018. Sapienza University of Rome - PDTA.

[2] "Le sol est un des biens les plus précieux de l'humanité. […] Il est essentiel à la vie de l'homme en tant que source de nourriture et de matières premières. Il est un élément fondamental de la biosphere et contribue, avec la végétation et le climat, à régler le cycle hydrologique et à influencer la qualité des eaux. […] il contient les traces de l'évolution de la terre et de ses êtres vivants et constitue par ailleurs le support des paysages" (Conseil de l'Europe, 1972: art.1).

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In this regard, recent studies (Dominati, 2013) have recognized and emphasized the specific value of the soil in the production of eco-systemic support, supply and regulation services.
Nevertheless, the extent and importance of the benefits related to the soil protection are still of little consideration in the disciplinary areas of spatial planning: a condition that is attributable to the difficult of recognizing, on a scientific level, the distinctive qualities and features of the soil, referred to specific geographical areas or periods of time (Calzolari et al., 2015), as well as to the lack of organicity of the ongoing researches.
Furthermore, even where soil is the subject of targeted policies, technical and political conflicts, between instances of exploitation and protection petitions, between the pursuit of rapid consumption profits and long-term lasting benefits, compromise the achievement of effective results (Glaesner, Helming & De Vries, 2014).

2 THE SOIL RESOURCE IN THE METROPOLITAN AREA

The "soil issue" is particularly relevant in metropolitan contexts, both because of the "soil demand" produced in these high density/high diversity areas and for the emerging policies of protection adopted in the renewed institutional framework realized by the Italian law 07 April 2014, n. 56, "Provisions on metropolitan cities, provinces, union and merging municipalities".
The available researches for diagnostic and statistical purposes on metropolitan phenomenon can be referred mainly to three approaches: the physical-morphological, the administrative and the functional one (EC, 2012).
As regards the demographic and physical-morphological components, which are the most relevant for the purposes of this study, the 14 Italian metropolitan cities cover the 17% of the national territory (corresponding to around 50,000 km^2) and involve 1,300 municipalities, 16% of the total. In them 21 million inhabitants live, more than 30% of the Italian population and over 50% of which resides in "belt" municipalities (ISTAT, 2017).
Moreover, in the 14 metropolitan cities, the percentage of urbanized areas from the 50s to nowadays has more than tripled, with the conversion to urban uses of approximately 3,500 km^2 of soil, while, as regards the population, it is recorded that between 1950 and 2001 in the territory of the actual metropolitan cities there was an increase of 12 million people, while in the decade 2001-2011 the population growth decreased, registering only 600,000 new inhabitants (Fregolent et al., 2017).
The administrative aspect of the metropolitan areas constitutes the territorial expression of the political structure and represents a framework for the implementation of policies concerning the quality of life, socio-economic development and environmental protection. The law of 7 April 2014, n. 56 defines the general institutional goals of metropolitan cities: "a strategic development of the metropolitan territory; integrated promotion and management

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of services, infrastructures and communication networks; management of institutional relations associated to their level, including those with European cities and metropolitan areas" (art. 1, co. 2).

Land use policies concern the new metropolitan institutions because, first of all, they require a supra-municipal level of governance. Secondly, they involve the "new planning", affecting, on the one hand, strategic goals of sustainability as well as the aspects of mobility, "the communication structures, the service and infrastructure networks", namely themes of territorial planning according to the provisions of law 56/2014 (art.1, co. 44, lett. b).

3 EFFECTS OF LAND TAKE ON SOIL QUALITY IN METROPOLITAN AREAS

As far as has been mentioned, even in the presence of a less population growth than in the past, critical conditions in the consideration and use of the soil resource remain conspicuously consistent in metropolitan areas. The demand for land induced by anthropic pressure (especially in terms of quality) and unsustainable development conditions are the two main causes of soil consumption.

The processes of degradation of anthropogenic soil - due to building and infrastructural uses (residence, services, activities, networks) and activities associated with them (excavation, compacting, soil sealing, etc.) and the increasing amount of abandoned and disused areas - has led to the loss of soil, the habitat fragmentation into a smaller patches of isolated and heterogeneous areas that are increasingly less functional to ecological continuity (strong environmental stress).

In Italy, between 2013 and 2015, the "functional ability" of about 35 hectares of land per day was definitively lost, because of soil sealing. Recent studies (ISPRA, 2018) show how these conditions occur especially in large cities and in neighboring municipalities. In fact, "more than a fifth (21.4%, almost 5,000 km2) of artificial soil in Italy (2017), correspond to the area of 14 metropolitan cities" (Congedo et al., 2018a: 19) [3].

Under certain circumstances, artificial soil takes up more than 60% of the entire municipal area, reaching peaks of 70% in smaller municipalities and 50% in outlying municipalities.

[3] Metropolitan cities with the highest percentage of soil consumed are: Milan and Naples (> 30%); Rome and Venice (10-15%); Bari, Bologna, Cagliari, Catania, Florence, Genoa, Messina, Palermo and Turin (5-10%) (Congedo et al., 2018a: 22-23).

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METROPOLITAN CITY	POPULATION (inhab.)	LAND AREA (ha)	SOIL CONSUMPTION (ha 20[1]7)
Venice	853.552	247.300	36.487
Turin	2.269.120	682.700	59.595
Rome	4.355.725	536.300	72.481
Reggio Calabria	551.212	321.000	19.213
Palermo	1.260.193	500.900	29.277
Naples	3.101.002	117.900	39.896
Milan	3.234.658	157.600	50.384
Messina	631.297	326.600	21.237
Genoa	844.957	183.400	15.600
Florence	1.013.260	351.400	29.386
Catania	1.109.888	357.400	29.652
Cagliari	431.955	124.900	10.351
Bologna	1.011.291	370.200	34.645
Bari	1.257.520	386.300	38.104

Tab. 1 Population (inhab.), land area and consumed soil (ha) of 14 metropolitan cities (Congedo et al., 2018a: 22)

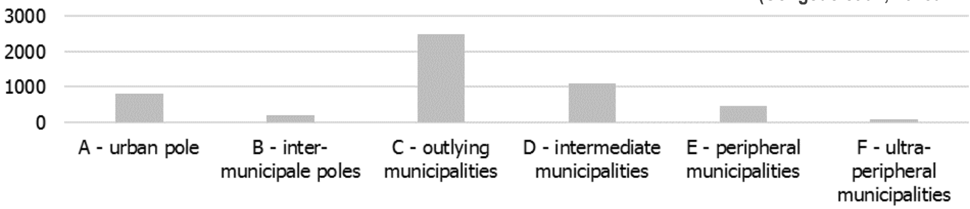

Fig. 1 Soil consumption in Italy (ha) between 2016 and 2017, by type of municipality (Congedo et al., 2018a: 26)

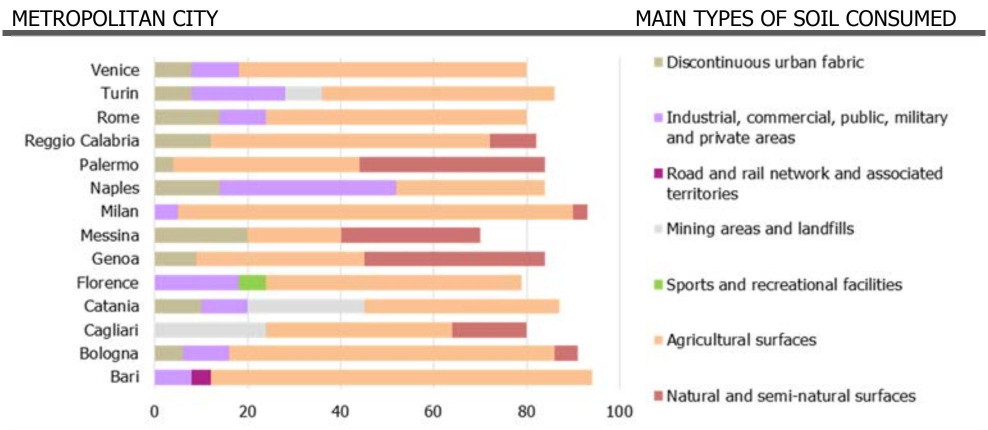

Fig. 2 Main types of soil consumed (no. 3/4 for metropolitan areas) in metropolitan cities of Italy (%) between 2012 and 2017 (Congedo et al., 2018b: 47)

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4 STRATEGIC PLAN AND TERRITORIAL GENERAL PLAN SHARING LAND TAKE MANAGEMENT

The final withdrawal, in 2014, of the European structural directive on soil protection[4] and the arrest at the Italian Senate of the D.d.L. 283/2016 for the "Containment of land consumption and re-use of built land", have generated, at different administrative levels, acclimate of uncertainty in the management of land consumption and in the promotion of collaborative and integrated actions.

Regional initiatives are quite heterogeneous and norms on land use management and soil protection can essentially be found in:

- territorial policy and governance laws (Piedmont; Valle d'Aosta; Lombardy; Tuscany; Umbria; Campania; Sardinia; Sicily; Liguria);
- urban regeneration and requalification laws (Lazio; Apulia; Calabria);
- targeted laws on land consumption soil control (Abruzzo; Emilia-Romagna; Friuli-Venezia Giulia; Marche; Veneto) (ISPRA, 2018).

With respect to the regional normative framework, metropolitan bodies have undertaken autonomous initiatives on reduction of soil consumption which are reflected, in the various metropolitan statutes,[5] as general sustainability objectives or, more incisively, as explicit content of spatial planning (Giglioni, 2016).

With reference to the planning tools granted to *metropolitan cities* by law 56, it can be said that the strategic plan undoubtedly plays a significant role in the promotion of essential principles of sustainable development and in the institutional – administrative coordination for the adoption of widespread artificialization control tools.

However, it is in the general territorial plan, through regulatory and operative actions, that a semantic switch/enlargement from "territory" to "soil" can actually be realized. It is in the ambit of this planning tool (more than in the strategic one), in fact, that strong regulatory measures can be taken such as a radical distinction between urbanized, non-urbanized and *urbanizable* spaces as well as the recognition of the value of natural soils in provision of ecosystem services.

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[4] The decision was taken following the imposition of a "blocking minority", composed by five of the main Member States: Austria, France, Germany, Netherlands and the United Kingdom.

[5] In the Italian institutional framework, the statutes have a decisive role with the respect to the allocation of powers among institutional bodies, in the selection of the fundamental values as well as the general principles and objectives that inspire and guide the governance of different institutional bodies (Vandelli, 2014).

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While awaiting the drafting of the future general territorial plans,[6] two approaches can be essentially recognized: one “structurally oriented”, able to specify regional directives, through the production of constraints for local plans, in line with the sustainability objectives specified in the strategic plans; the other, in line with the old, traditional provincial coordination plan, weakly proactive and mostly analytical of land resources and properties.
The first ones are, evidently, appointed to perform a “strong” guarantee of land consumption control and in this direction seem to be oriented the plans of Turin, Milan, Genoa, Bologna and Naples: in their statutes the reduction of land consumption, variously declined, is indicated as explicit content of the territorial planning act.

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[6] All metropolitan cities have assumed their own provincial territorial coordination plans as general territorial plans *ex lege* 56, while only the metropolitan city of Milan and the Metropolitan City of Genoa have approved the Metropolitan Territorial Plan guidelines.

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AUTHOR'S PROFILE

Saverio Santangelo. Associate professor in Urban Planning, PDTA Department, Sapienza University of Rome. He carries out research on public action issues in urban planning, and on topics of strategic planning, social housing, local sustainable development. Member of PhD Department board in Planning, Design, Technology of Architecture. Scientific coordinator on behalf Sapienza, PDTA Department, in the European funded project Interreg MED Coasting.

Paolo De Pascali. Full Professor in Urban Planning (ICAR 21), PDTA Department, Sapienza University of Rome. Chair of Urban Regeneration and Urban Planning Fundamentals. Director of the II level University Master Course URBAM (Urban planning in public administration). Since 1983 he is the Director of research institutes, responsible for research & innovation projects in national and European programs in the fields of energy and settlements. Currently, his studies mainly focus on the relevance of energy-environmental factors in Urban plans to foster urban regeneration and local development.

Annamaria Bagaini. Urban and Environmental Planner, PhD in Planning, Design and Technology of Architecture. She works on increasing awareness related to the relationship between Urban Planning and energy turn, by a better integration between them, also provided by using new technologies and smart tools, able to inform the decision-making process and enhance social inclusion in the energy chain.

Clara Musacchio. Architect, PhD in urban and landscape planning. She usually works as development planning and policy consultant for public administration and private players. She participated in national and international research groups on planning itineraries for weak social categories. She currently deals with large area planning, metropolitan cities and instruments for controlling and rebalancing settlement expansion.

Francesca Perrone. Landscape planner. She received her Ph.D. in Planning, Design and Technology of Architecture, Sapienza University of Rome. She got her post graduate degree in GEOinformation and Geographic Information Systems, for systemic analysis of territory and geographic data. She obtains the international certificate of Esri ArcGIS User. She has engaged in issues ranging from land take control to soil ecosystem services. Her research interests focus on sustainable landscape planning, territory management and soil ecosystem services.

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KNOWLEDGE-BUILDING MODELS FOR ENVIRONMENTAL PLANNING: THE CASE STUDY OF BARI

STEFANIA SANTORO, DOMENICO CAMARDA
PASQUALE BALENA

Department of Civil, Environmental, Land,
Construction and Chemistry (DICATECh)
Polytechnic University of Bari, Italy
e-mail: stefania.santoro@poliba.it
domenico.camarda@poliba.it
pasquale.balena@poliba.it
URL: ww.poliba.it

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ABSTRACT
The concept of ecosystem services arises as a formal outcome of historical processes of understanding and interpreting settlements as complex ecological systems. Because of a straightforward, bottom-up demand for environment enhancement, that concept increasingly occurs in discourses, in narratives, in the demands of common people, triggering a new urban environmental awareness. This is now often arising spontaneously in the protocols of participatory construction of plans, especially when planning for the future of complex environments such as city areas. The present study tries to elicit reflections around the weight of ecosystem issues in the case study of Bari (Italy), which is experiencing an inclusive process of construction of shared knowledge for the new master plan. Starting from an initial campaign of civic walks along urban neighborhoods and a subsequent questionnaire-based survey on the community, the paper carries out comparative analyses using problem-structuring methods, in order to evaluate and reflect on community behaviors and expectations about ecosystem services.

KEYWORDS
Knowledge Modelling; Spatial Planning; Problem Structuring Methods

1 INTRODUCTION

In the so-called Italian season of *third-generation plans* following earlier post-war planning experiences, issues of qualitative (as well as interstitially speculative) transformation of cities appear, apparently in terms of urban facilities and services.

This type of approach is generally considered as extended until the 1980s, with some medium-sized cities often cited as examples, such as Pavia, Pistoia, Arezzo.

This is also the period, however, of an irruption of the environmental question in scientific debates. New reflections focus on the limits of dissipative growth especially within residential settlements. What emerges is the need for progressively increased attention to natural resources and their regeneration cycles, especially in urban areas. Some observers even deduce from this circumstance an emerging *fourth generation* of spatial plans, contaminated by new increasing socio-environmental operational programs, such as Agenda 21.

Certainly, a new awareness is growing around the need for closing natural cycles must close, to avoid problems of liveability, health, consumption of ecological resources. Settlement areas are increasingly considered, planned and managed as complex ecological systems and not as simple territories to be transformed.

The hand of public administration and policymaking can do much in this framework, in its role as a service provider to support the life and welfare of communities. By the new millennium, the new and simple reading of this commitment is thus immediately turned into operationally considering the role played by service places as also resource regenerators.

Also thanks to this simple, natural evolution, the new concept of ecosystem services arises, a lexical outcome of a historical process of understanding and interpreting settlements as complex ecological systems. It is therefore a formal name which corresponds to a straightforward, bottom-up demand for environment enhancement. It increasingly occurs in discourses, in narratives, in the demands of common people, triggering a new urban environmental awareness. This is now arising spontaneously in the protocols of participatory construction of plans, especially when planning the future of areas at environmental risk.

The present study starts from these considerations, trying to elicit reflections around the weight of ecosystem instances along inclusive processes of cognitive planning, with the aim of verifying their final policy enhancement. The work refers to the case study of Bari (Italy), in which a multi-faceted process of construction of shared knowledge is in progress for the preparation of the new urban plan of the city. After the present introduction, section 2 shows a literature review about ES while section 3 presents the case study. Section 4 describes the methodology applied and section 5 outlines and discusses the case study. Final remarks and future developments close the paper (section 6).

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2 ECOSYSTEM SERVICES RELEVANT BACKGROUND

Literature offers a large variety of Ecosystem Service (ES) definitions and classification approaches (Binning et al., 2001; Boyd & Banzhaf, 2007; Landers & Nahlik, 2013; Millennium Ecosystem Assessment - MEA, 2005; Wallace, 2007, 2008). However, there is general agreement that human well-being is supported by the existence, processes, and outputs of ES. According to MEA (2005), ES are "the benefits of nature to households, communities, and economies". Studies show that ES can develop neutral, synergic, and trade-off relationships between households, communities, and economies at different scales (e.g. Howe et al., 2014; Lee & Lautenbach, 2016). The comprehension of these relationships is crucial for making more informed and sustainable decisions on economic, environmental and land use policies and practices (Dennis & James, 2017; Holt et al., 2015; Vogdrup-Schmidt et al., 2017).

In order to establish a common system necessary for ES incorporation into decision-making and economic accounting systems, the Common International Classification of Ecosystem Services (CICES) was issued. The CICES framework uses and classifies ES into *provisioning* (e.g., food and fresh water), *regulating and maintenance* (e.g., water purification) and *cultural* (e.g., recreation and aesthetics). In the present study, started from a thesis work at Polytechnic University of Bari, the CICES framework has been synthetized, according to Environmental Protection Agency (EPA) into (i) Natural Resources: water, land, soil and air: (ii) Drivers of change: policy, land use, climate, pollution; (iii) Benefits: economy, well-being, food-water and materials and integrated into the methodology.More in detail, the methodology is based on the combination of a Participatory Modeling Techniques (PMT) analysis and Problem Structuring Methods (PSMs) in order to overcome some critical issues of PMT and to understand the level of knowledge of citizens regarding ES, thanks to the integration of a synthetic framework drafted by EPA.

3 THE CASE STUDY OF BARI

The capital of Apulia in Southern Italy, Bari city is extended over 117,38 km^2 with 324,198 citizens. It is subdivided into five districts (Fig.1). In 2015 its Department of urban planning opened a public channel to citizens at several levels, asking everyone to participate in the drafting of the Master Plan of the city (PUG). The path was designed in different time steps, performed between May and November 2016, through (i) nr.30 *Urban front offices* activated in the Municipal Area, (ii) nr.9 *Civic Walks* (CWs) to single out peculiar aspects and features of relevant areas and (iii) nr.5 *Public Workshops* to include citizens in the decision-making process of PUG drafting.

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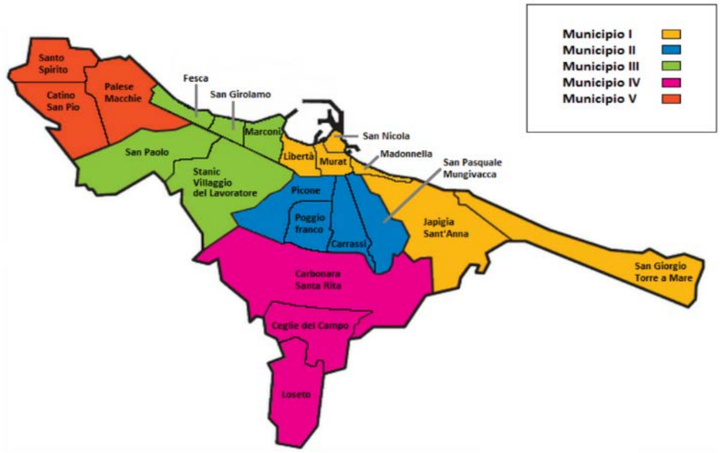

Fig. 1 Municipalities of Bari (Wikipedia 2014)

Starting from some considerations emerged during the CWs, in order to share new visions of the places (Jones, 1990) between *expert* knowledge (scientists, institutional officers, technicians) and *non-expert* knowledge (citizens), the aim of this study is to investigate about the limits of the approach adopted by the Public Administration and to understand the level of knowledge of citizens involved about ES. Section 4 describes the adopted methodology.

4 METHODOLOGY

The present study proposes an approach based on knowledge structuring to (i) overcome the limits emerging during the involvement of citizens, and (ii) to investigate the level of citizens' knowledge about ES.

Specifically, the reflection on CWs raised three critical issues: (i) numerical predominance of considerations by expert knowledge on non-expert knowledge, (ii) the lack of information structuring, broadly following narrative patterns, (iii) a small number of participants, never exceeding 30 units.

In the present study, in order to overcome these limits, information emerged in narrative patterns deriving from CWs has been recorded and formalized using ad-hoc structuring platforms, particularly relevant to PSMs modelling area.

Specifically, a qualitative analysis of the information deriving from CWs was needed to build Causal Loop Diagrams (CLDs) and semi-structured interviews (SSIs). CLDs was oriented to build a problem framework (Homer & Oliva, 2001), whereas SSIs held a dual function of validating CLDs and involving a more significant sample of citizens.

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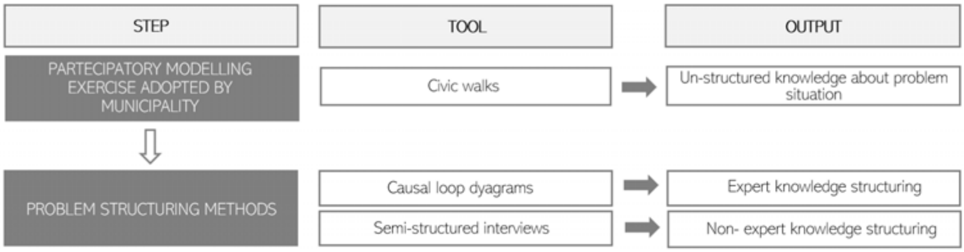

Fig. 2 The developed methodology

The analysis led on one of the nine CWs will be described below, as an explicatory example.

4.1 PARTICIPATORY MODELLING EXERCISE: CIVIC WALK

CWs are an early and widespread instrument of citizens' participation in the field of urban policies in order to activate new forms of knowledge about the city (Jones, 1990). According to literature analysis, CWs seem to ensure some important features: (i) the implementation of *de-professionalization* visions, i.e., not only professionals shape the future of the districts; (ii) a *demystification* of problems, turning territorial planning into real and concrete perspectives, away from a virtual or mediatized knowledge; (iii) the *democratization* of knowledge and decisions, as many citizens are directly involved in the process of reflection and decision, especially those that represent an interest in the future of the districts (Jones, 1990).

Several examples are applied in different parts of the world (Fregolent et al., 2014).

The CW analyzed here has crossed areas coming from two planning seasons of the city of Bari. The first one is the urban plan drafted by Calza-Bini and Piacentini characterized by a traditional urban design (concentric and equidistant road links connected by radial roads with tridents, the medians) that does not relate to the expanding Bari of the post-war years.

The second one is Quaroni's urban plan, characterized by the gigantism of roads and buildings in view of demographic growth and city flows (report PUG, 2016).

During the CW analyzed, 22 citizens and 3 technicians were involved. The CW was focused on three places: Alcide De Gasperi street (Place 1); Gandhi Mohandas street (Place 2); Mother Teresa of Calcutta street (Place 3).

4.2 PROBLEM STRUCTURING METHOD: CAUSAL LOOP DIAGRAM

CLDs are a formal modelling tool of Group Model Building Technique. It aims at setting up a process of mutual understanding of a problem situation between knowledge agents and analysts, typically starting from storytelling, interviews, facts and narratives (Voinov et al.,

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2010). CLDs are used to identify key factors and the causal relationships between variables (Binder et al., 2004). CLDs is symbolized by variables and links with polarity representing the effect of one variable on another (Richardson, 1995).
In this work, CLDs were used to build a structured approach of problem situations deriving from CWs. According to Basco-Carrera et al. (2017), an un-structured approach is characterized by low degree of consensus and scientific certainty. The recording of conversation emerging during CW were analyzed, dividing the key concepts to be transformed into variables and then creating CLDs (Tab. 1).

QUOTES FROM CONVERSATION	VARIABLES
The road suffers from an urban load unproportionate to what was designed	Road size efficiency
It isn't possible to enlarge the section road now, perhaps it would be possible to think of alternative routes to decrease the traffic	Traffic plan re- building
The traffic has changed especially with the grafts of the ring road	Connection with ring road
The road section is originally from the 1930s. The traffic has changed	City development

Tab. 1 Quotes from expert knowledge translated into variables and relationships (CLD along Place 1)

From the CLD referring to Place 1, two main themes emerged: (i) excessive vehicular traffic and (ii) the lack of public green spaces (Fig. 3a).
Specifically, on one hand, the road section is claimed to be unable to meet contemporary mobility demands. On the other hand, the problem of lacking green public spaces is due to intensive buildings and possibly worsened by the misappropriation of the few remaining areas by some private owners. A re-building of the traffic plan for the management of vehicular flows on the one hand, and the supervision by the Public Administration on the other, are the solutions proposed by the *expert* knowledge in response to the issues raised.
The CLDs show the causes and the effects that these variables entail. Following the same procedure, the other map has been built, in which the CLDs of Place 2 and 3 have been aggregated referring to the same issues (Fig. 3b).The use of land, deriving from the reduction of some road sections firstly conceived as urban highway and never completed, was a central theme referring to the Place 2 and 3. Specifically, two suggestions have been proposed: (i) urban gardens for community along the roads and (ii) the reorganization with partial pedestrianization and bicycle path of the street to reduce the speed of traffic. The need to expand public spaces, by redeveloping the underutilized areas, was claimed in a different part of the district.

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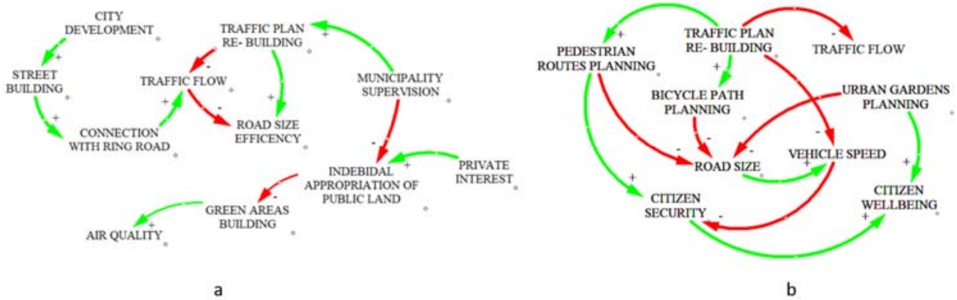

Fig. 3 CLD referring to Place 1 (a), 2 and 3 (b)

4.3 PROBLEM STRUCTURING METHOD: SEMI-STRUCTURED INTERVIEWS

SSIs are commonly used in policy research and are applicable to many research questions (Barriball et al. 2004). They combine some structured, formalized questions with some unstructured exploration. They are useful when dealing with complex systems, thanks to the use of spontaneous approaches able to better explore, understand, clarify answers to questions (Wilson, 2014).

In this context, SSIs have been carried out and submitted to citizens, retracing the same places of the CWs, also aiming at checking the relevance and consistency of issue previously raised by *expert* knowledge. SSIs have been structured in three sections: (i) citizen profiles; (ii) mobility issues and (iii) public space issues.

Citizens could express own preferences on a Likert (1932) 1-5 scale of agreement and to insert a free contribution on the actions to be addressed on the issues raised. A sample of 88 citizens, divided into 53 women and 35 men, aged between 35 and 50 years, were interviewed.

5 RESULTS AND DISCUSSION

CLDs building tried to overcome the limit relating the unstructured approach emerged during CW. The information thus emerging was subsequently connected to ES (EPA) classes, so making it possible to draw out considerations regarding the issues related to ES, by observing Tab. 2.

It can be noted that the most common drivers of change are the Land Use and Policy. The benefits related to Well-Being and Public Health are connected through cause-effect relationships.

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NATURAL RESOURCES	PLACE	DRIVERS OF CHANGE		BENEFITS	
		Policy	Land Use	Well-being	Pubblic Health
LAND	1	Municipality supervision	traffic plan re- building	decrease traffic flow	increase air quality
			use of public green area	areas for children	
	2/3		traffic plan re- building	increase bicycle path planning	decrease veichle speed
				increase pedestrian route planning	
				decrease traffic flow	
			urban gardens planning	increase citizen well-being	

Tab. 2 ES emerged from CW expert knowledge

The ‘traffic plan re-building’ variable emerged in all three Place. Referring to Place 1, it was suggested to act on the traffic flow, through a study of vehicular flows, not being able to physically modify the undersized road section. Referring to Place 2 and 3, the construction of cycle paths, pedestrian route and urban gardens was suggested.

The latter seems to meet a dual function of reducing the road section and (consequently) vehicle speed, while promoting sustainable mobility and equipping the district with urban gardens. In terms of benefits, these actions induce an improvement in the well-being of citizenship thanks to the presence of areas for leisure, a decrease in vehicular traffic with more safety for pedestrians, an increase in health and clean air-related benefits.

The above statements have been submitted to citizens' opinion and degree of validation through SSIs. On the one hand, this allowed a general validation by the citizens on the issues emerged from expert knowledge, thus somehow balancing the preponderance of interventions by expert knowledge.

On the other hand, it helped to bring out new issues such as waste management, the inclusion of public lighting and the planting of new plant species. Variables have been relocated to relevant ES categories (Tab. 3).

The issues emerged, which are added to those already known deriving from expert knowledge are: the planting of new tree species in order to reduce the problems linked to allergies that characterize children residing in Alcide De Gasperi street (Place 1); the strengthening of public lighting at Place 2 in order to increase pedestrian safety and finally, at Place 3, the need of improving the waste management system to guarantee adequate hygienic conditions of spaces and healthiness of air.

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The validation of CLDs took place through the analysis of semi-structured interviews. The preference of citizens in relation to questions have been analysed. For a sake of simplicity one example is show "Corso Alcide De Gasperi is undersized" (Fig. 3a).

NATURAL RESOURCES	PLACE	DRIVERS OF CHANGE		BENEFITS	
		Policy	Land Use	Well-being	Pubblic Health
Land	1		planting of different tree species		decrease of allergies
	2/3		public lighting	pedestrian security	
			waste management	neighborhood cleaning	increase air quality

Tab. 3 ES emerged from semi- structured interviews by non-expert knowledge

48% of citizens involved expressed an agreement at Likert scale 4, whereas 34% of citizens agreed at grade 5 (Fig. 4a). The majority of citizens involved acknowledges that Alcide De Gasperi street is undersized. It is possible to summarize the results obtained from the questionnaire through a histogram in which the abscissas represent the questions, and the ordinates represent the average of citizens' preference for each question (Fig. 4b).

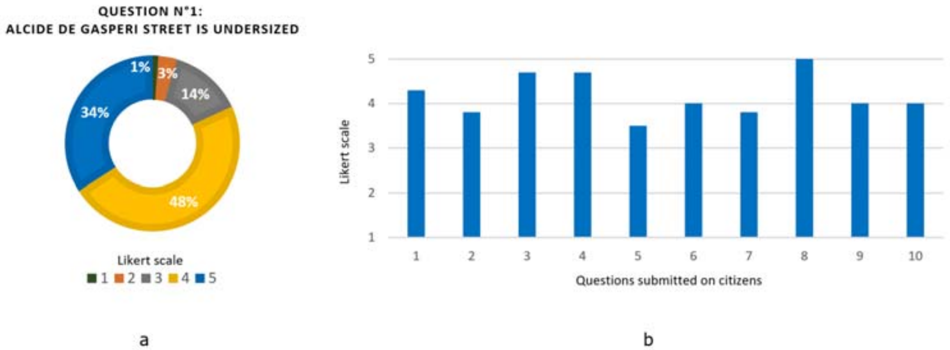

Fig.4 Percentage of citizens' agreement with the question n°1 (a); average of 88 citizens' preferences on each question of the semi- structured interviews (b)

5 CONCLUSION

The application of knowledge structuring models trough PSMs aims to challenge some limits of participatory modelling technique and to investigate the level of citizens' knowledge about ES.

The study has brought about some general considerations, that can be synthesized as follows. Firstly, CWs seem to be not completely able to lay out, analyse and understand issues and

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problem situations emerging along walking discourses. An integration offered by other methods, such as extended SSIs, seems to be effectively integrative of the knowledge building process, being also possible to involve a greater number of people.
Secondly, the concept of ES seems to be now somehow inherent in the culture of citizens. In fact, virtually every action that emerged from CWs and SSIs can be assigned to a category of ES. However, some limitations still appear, such as: (i) emerging ESs take into account only the natural resource *Land*; (ii) the drivers used are only *Policy* and *Land* use and the benefits arising are only related to *Well-being* and *Public Health*.
Interestingly, CLD seem to usefully integrate future-modelling activities -such as scenario-building models. For example, they seem to be useful to investigate on the implications of citizen potential decisions on areas, as well as to facilitate citizens' knowledge about ES and, more broadly, to support the construction of collective futures. In this perspective, more work will be devoted to check such issues on different case studies.

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FROM ECOSYSTEMS TO ECOSYSTEM SERVICES

A SPATIAL METHODOLOGY APPLIED TO A CASE STUDY IN SARDINIA

***MATILDE SCHIRRU[a], SIMONA CANU[a]**
LAURA SANTONA[b]

[a] Agenzia Regionale per la Protezione dell'Ambiente della Sardegna (ARPAS), Italy
e-mail: matildesschirru@gmail.com
scanu@arpa.sardegna.it

[b] Regione Autonoma della Sardegna
Direzione Generale della Difesa dell'Ambiente, Italy
e-mail: lsantona@regione.sardegna.it

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ABSTRACT

Ecosystem services (ES) evaluation is the most recommended approach to assess and monitor environmental health and quality of human life. A key role to ensure provision of ecosystem benefits is played by protected areas and nature conservation projects worldwide. Natural capital accounting includes ES evaluation in sustainable land management and planning, setting the challenge to monitor ES over time and to update governance tools considering ES flows. The MAES initiative by the European Environmental Agency suggests ecosystems as the proper land units to evaluate, map and monitor related ES. Ecological Land Classification methodology was applied to obtain Asinara island (Sardinia, Italy) Ecosystem Map within the activities of GIREPAM project (INTERREG Program 2014-2020), aimed at integrating management policies in marine protected areas and parks governance. An ES inventory was also implemented, among others, through expert opinion survey, and carbon sequestration potential was estimated and mapped. Preliminary results of potential ES all over Asinara island territory and carbon sequestration mapping are presented, representing important tools for Asinara National Park future management planning and governance.

KEYWORDS
Ecosystem Services; Ecological Land Unit; Carbon Sequestration; Asinara National Park

* The other authors are: Sabrina Lai, Andrea Motroni.

1 INTRODUCTION

The GIREPAM project, funded by the 2014-2020 INTERREG V-A Italy-France Maritime Programme (http://interreg-maritime.eu/web/girepam), aims at sharing a Mediterranean cross-border strategy for the integrated management of marine-coastal areas, focusing on biodiversity protection and ecosystem services maintenance in protected areas and Natura 2000 sites. Among others, methodological tools have been proposed in order to assess, map and evaluate ecosystem services (ES) according to Systems of Environmental and Economic Accounting (SEEA).

In order to support Systems of National Accounting, the European Environmental Agency (EEA) developed CICES – the Common International Classification of ES (Haynes-Yang & Potschin, 2017).

ES are clustered in four categories according to the Millennium Ecosystem Assessment (MEA, 2003): provisioning ("all nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs - including water-"), regulating ("all the ways in which living organisms can mediate or moderate the environment that affects human health, safety or comfort, together with abiotic equivalents"), cultural ("all the non-material, and normally non-rival and non-consumptive, outputs of ecosystems - biotic and abiotic - that affect physical and mental states of people"), supporting ("those that are necessary for the production of all other ecosystem services, such as primary production, production of oxygen, and soil formation). The latter, however, is not regarded as a group in the CICES taxonomy, which regards as ES only those that are demanded and used by humans.

Natural capital can also be defined in spatially-explicit ways, through geographic instruments which may help to analyze, assess, monitor and map homogeneous ecological patterns together with related services (MAES, 2013; MAES, 2014).

The European initiative for Mapping and Assessment of Ecosystems and their Services (MAES) by EEA, aims at (i) mapping ecosystem, (ii) evaluating their conservation status; (iii) assessing ES. In order to implement the 2020 EU Biodiversity Strategy, member states and European Institutions implemented an Ecosystem map (MAES, 2016; Erhard et al., 2017) at the continental level, based on Corine land cover (CLC), which clusters main terrestrial ecosystem types, transitional waters and coastal areas in seven CLC classes.

European Nature Information System (EUNIS) was integrated with the CLC one, which led to better defining and characterizing current ecosystem conditions, merging "ecosystem" and "habitat" concepts, thus finding key indicators for mapping and assessing ecosystem conditions (MAES, 2018). Several case studies have been recorded and published in the EEA portal (https://biodiversity.europa.eu/maes/maes-digital-atlas) in order to implement National

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Ecosystem Maps. In Italy, recent case studies in ecosystem mapping are based on the integration of Ecological Land units (MAES sensu) with the Potential Vegetation series (Blasi et al., 2014) as ecosystem quality facies; for local assessment (at regional, sub-regional, little island scales), a first critical issue is represented by properly scaled data in order to implement local land and nature conservation management policies (Blasi et al., 2017).

The objective of this work is to define an Ecosystem map for Asinara island, applying the Ecological Land Unit (ELU) approach (Smiraglia et al., 2013) through spatial and reasoned overlay of abiotic Land Facets and land cover maps.

Related potential ES, with particular reference to carbon stock map, are here presented as preliminary results of the GIREPAM project for Asinara National Park.

2 CASE STUDY

Asinara island is 50 km2 in size and it extends from South-West to North-East to the North of Sardinia, Italy (Fig. 1). The geology of the island is characterized by metamorphic rocks in the north and granitic ones in the south. Asinara presents high cliffs on the western side, and smoother sandy profiles in the eastern side facing Italy's main land. Mean annual rainfall amounts to 480 mm, average of annual temperature approximately being of 18°C (Carboni et al., 2015). Following Rivas-Martinez et al.'s (2011) approach, Canu et al. (2014) described six isobioclimates for the island. More than 50% of the island is characterized by Upper thermomediterranean, upper dry, euoceanic strong, while 31% by Lower mesomediterranean, lower subhumid, euoceanic strong. 8% of total territory presents an Upper thermomediterranean, upper dry, semihyperoceanic weak bioclimate. Only 6,5% of total land is characterized by Lower mesomediterranean, lower subhumid, euoceanic strong. The island vegetation is characterized by typical Mediterranean maquis with some more degraded areas. Endemic flora has been described by Bocchieri and Filigheddu (2008) and explored exhaustively by Pisanu et al. (2014) and Drissen et al. (2019). Populated by a rural community until expulsion in 1885, the environment of the island was next largely affected by the presence of an agricultural penal colony (Forteleoni & Gazale, 2008; Gutierrez et al., 1998). The subsequent abandonment of farming activities previously carried out by prisoners in the early '70s led to land degradation due to overgrazing by cattle and other rewilded animals and frequent forest fires across the island, as summarized also by Mantilla-Contreras et al. (2018). In 1997 Asinara National Park was established turning the island into a great important biodiversity hotspot, due to the presence of several rare, threatened, endemic marine and terrestrial habitat and species.

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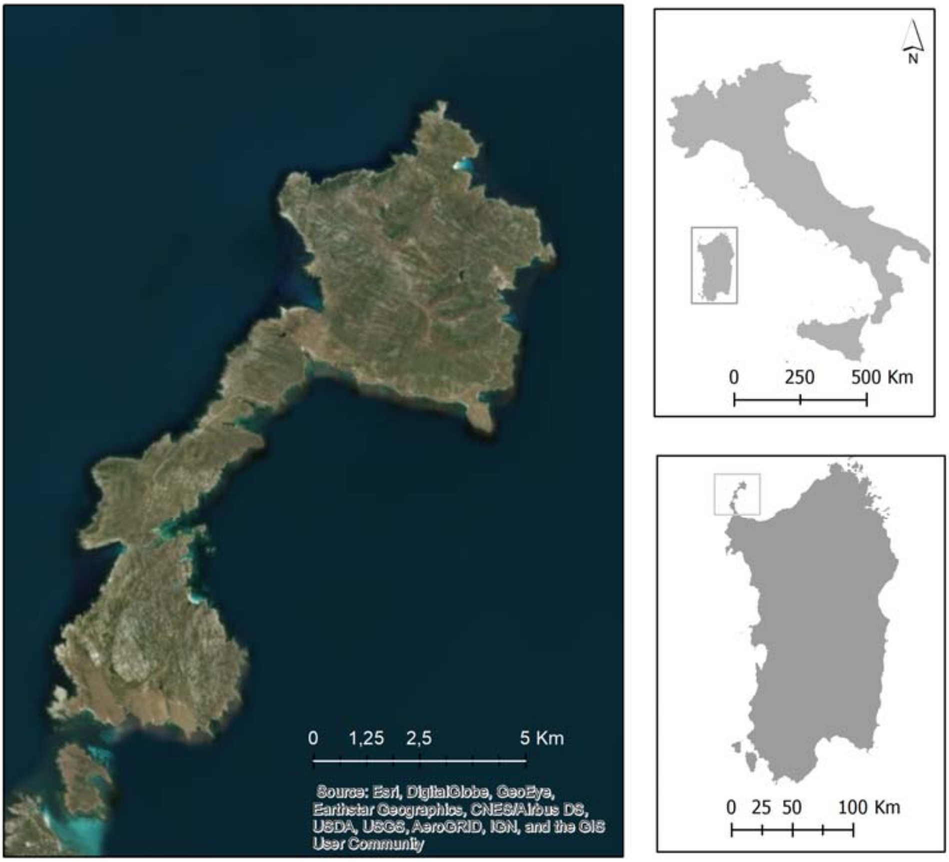

Fig. 1 Asinara island

3 ECOSYSTEM MAP: MATERIALS AND METHODS

Asinara's ecosystem map was obtained following the "Ecological Land Classification" (ELC) framework by Smiraglia et al. (2013), who identify ecological homogeneous areas of abiotic drivers, based on land facets which greatly influence biotic distribution such as vegetation series potential and ecological processes (Blasi et al., 2014; Blasi et al., 2017). Bioclimatic, lithology and landform geographic information layers were overlaid in order to obtain a Land Facet Map (LFM). Asinara climate has been classified using Sardinia Bioclimatic Map (Canu et al., 2014), while lithological map has been produced at a 1:10,000 scale. Phytoclimatic heterogeneity depends not only on bioclimate and lithology but strongly on the wide altitudinal gradient of the island, which can reach quite high altitudes (Punta Scomunica, 408 m a.s.l, in the northern part, and Punta Maestra Fornelli, 265 m a.s.l.) within a short distance from the

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coast. Landform map has been implemented using a Digital Elevation Model for Sardinia island (resolution 10m x 10m), based on Topographic Position Index based on a 10-class landform classification. A Land Facet Map of 44 hierarchical classes was obtained (Fig. 2) and combined with an updated land use map of Asinara (Fig. 3) in order to produce an Ecosystem Map with 188 Ecological Land Units.

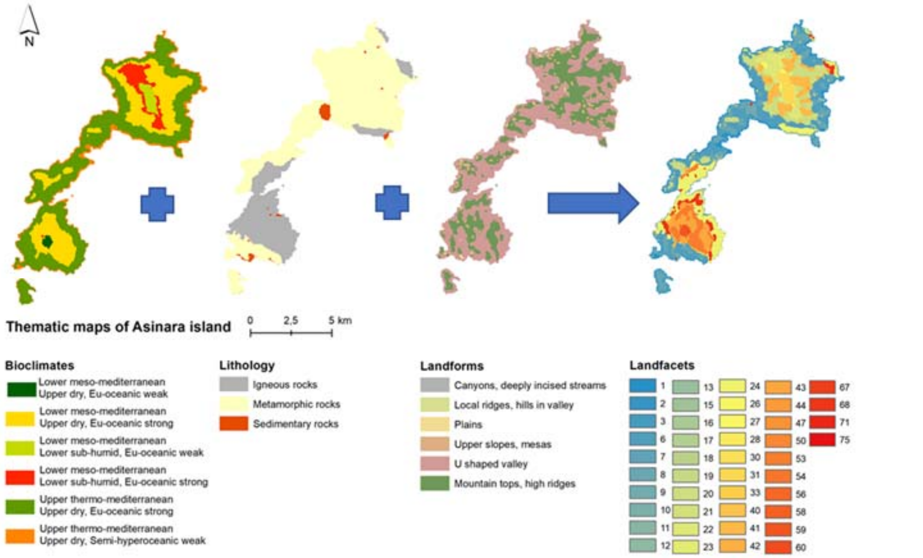

Fig. 2 Bioclimates, lithology, landform and land facet map of Asinara

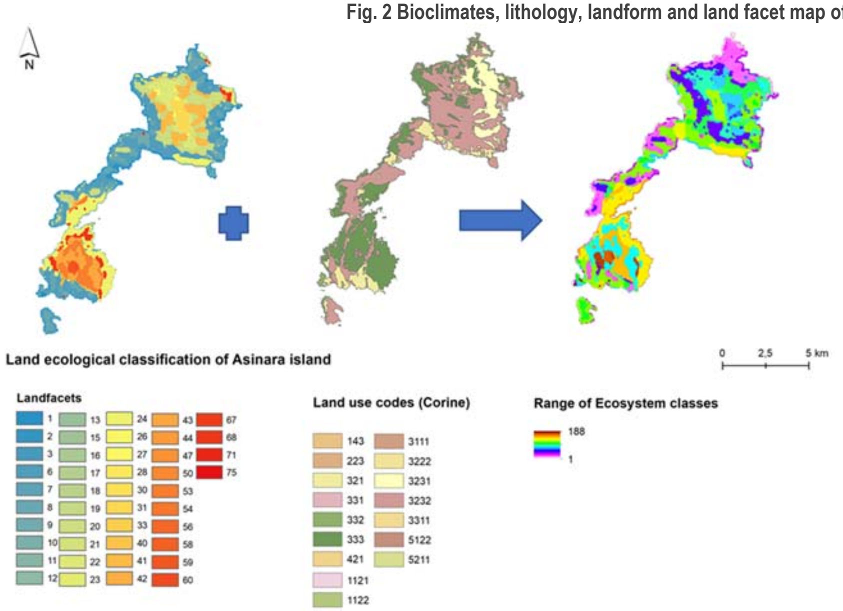

Fig. 3 From land facet and land use combination to the Ecosystem Map of Asinara

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4 PRELIMINARY RESULTS

4.1 POTENTIAL ECOSYSTEM SERVICES

Qualitative evaluation of Potential ES for Asinara island was carried out through an expert opinion questionnaire submitted to a group of Asinara National Park members, nature conservation academics and socioecological experts.

	SECTION	CLASS
Biotic	Cultural	Characteristics of living systems that enable education and training
		Characteristics of living systems that enable aesthetic experiences
		Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge
		Characteristics of living systems that are resonant in terms of culture or heritage
	Regulation & Maintenance	Elements of living systems that have symbolic meaning
		Elements of living systems used for entertainment or representation
		Characteristics or features of living systems that have an existence value
		Decomposition and fixing processes and their effect on soil quality
		Seed dispersal
		Bio-remediation by micro-organisms, algae, plants, and animals
		Disease control
		Visual screening
		Control of erosion rates
		Fire protection
		Hydrological cycle and water flow regulation (Including flood control, and coastal protection)
		Regulation of temperature and humidity, including ventilation and transpiration
		Regulation of the chemical condition of freshwaters by living processes
		Maintaining nursery populations and habitats (including gene pool protection)
		Pollination (or 'gamete' dispersal in a marine context)
	Provisioning	Seeds, spores and other plant materials collected for maintaining or establishing a population
		Animal material collected for the purposes of maintaining or establishing a population

Tab. 1 Biotic classes of CICES (ver.5.1) as perceived by expert opinion as Asinara potential ecosystem services

Firstly, experts were asked to identify CICES ES classes for Asinara ecosystems, following the same approach used in other studies of ES assessment of Protected Areas (Gaglioppa &

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Marino, 2016; Manolaki & Vogiatzakis, 2017). Moreover, a value ranging 0 to 5 for each ES class was assigned. A participatory approach and discussion with National Park entrepreneurs was carried out in order to assess their perception of real and potential ES, and results were mapped in order to make them available to further support future Asinara Park management policies. In the following table a list of ES evaluated by experts is shown. 33 CICES Classes for Asinara, out of the 65 listed by Haynes-Yang and Potschin (2017), were identified and valued (Tab. 1; Tab. 2). Biotic ES are those perceived as most important for the island, provisioning and maintenance classes are the most redundant ones but both cultural biotic and abiotic ES represent an interesting field of natural protected values to be explored, analyzed, conserved.

4.2 CARBON STOCK POTENTIAL

Carbon (C) monitoring is important to quantify carbon dioxide and C compounds amount produced by human activities. In C balance accountability, incrementing carbon sink capacity of terrestrial pools is crucial at the local, regional and global scale, to accomplish obligations stemming from the Kyoto protocol.

Among ES, C sequestration recorded in a given time period and referred to a specific land use/land cover change, has become not only a key indicator (MAES, 2018) to track conservation status of ecosystems but also a climate change policy tool for adaptation and mitigation strategies.

A map of Asinara carbon stock as derived from ELU ecosystem classification is presented, using C data available in scientific literature for comparable land uses. Forest carbon estimation follows the approach of the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006), which identifies “gain-loss” and “stock-difference” methods, designed respectively to estimate changes in carbon content and in biomass growth in a fixed time interval (e.g. two forest inventories). In this study, 2018 C stock is estimated to be the yearly mean value of C stock in Asinara island.

C stock was evaluated in 4 different pools of living vegetation: *above ground biomass* (ABGB), *below ground biomass* (BGB), *litter* and *Soil Organic Carbon* (SOC), following IPCC (2006). In order to estimate biomass carbon content, IPCC suggests considering 0.5 g of C per 1 g/cm^3 of biomass volume (dry weight), expressed in tons of C/hectare when estimated values are reported in a map. Land uses related to artificial surfaces, wetlands, bare rocks, open spaces with no vegetation, beaches are not considered. Olive groves land use class, due to the small size and restricted number of plants, has been treated as an evolution of Mediterranean maquis.

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SECTION		CLASS
Abiotic	Cultural	Natural, abiotic characteristics of nature that enable intellectual interactions
		Natural, abiotic characteristics of nature that enable spiritual, symbolic and other interactions
		Natural, abiotic characteristics of nature that enable active or passive physical and experiential interactions
		Natural, abiotic characteristics or features of nature that have either an existence, option or bequest value
	Regulation & Maintenance	Dilution by freshwater and marine ecosystems
		Mediation by other chemical or physical means (e.g. via Filtration, sequestration, storage or accumulation)
		Maintenance and regulation by inorganic natural chemical and physical processes
		Mediation of nuisances by abiotic structures or processes
	Provisioning	Wind energy
		Solar energy
		Ground (and subsurface) water for drinking
		Ground water (and subsurface) used as a material (non-drinking purposes)

Tab. 2 Abiotic classes of CICES (ver.5.1) as perceived by expert opinion as Asinara potential ecosystem services

Above ground biomass C potential for forest (*Quercus ilex*) has been evaluated considering tree phytomass allometric equation by Tabacchi et al. (2011), taking as tree variables for biomass: a) mean Diameter Breast Height (DBH) 20 cm; b) mean plant Height 8 m; c) mean density of 150 trees/Ha. Above ground biomasses C for Mediterranean maquis, sparsely vegetation areas, moors and shrublands have been evaluated as vegetation types at different recolonization degree (Sirca et al., 2016). Sclerophyllus vegetation (garrigue, sparsely vegetated areas and 5-40% of bare soil) was here considered as *Cistus monspeliensis* dominant land cover (*sensu* Stadmann, 2016*).* Since *Cistus monspeliensis* represents 33% of total cover of low recolonization degree, only this portion of Mediterranean maquis C stock was considered. In order to determine Natural grasslands C stock, 2017 Agristat data for unproductive grassland in North Sardinia were used (Agri.istat.it).
Below ground biomass (BGB) has been estimated using the Root/Shoot coefficient ratio applied to Above ground biomass C (ABGB) amount, referring to *Quercus ilex* (Hildell, Candell, 1985), to Mediterranean Maquis and *Cistus monspeliensis* (Bianchi et al., 2005) values. For natural grassland another Root/Shoot coefficient for open grasslands in temperate climates was used, as suggested by IPCC (2006).

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In order to estimate Soil Organic Carbon (SOC), the 2005 National Inventory of Forest Carbon data (Gasparini et al., 2013) has been used for *Quercus ilex* forest, while local data for bare soils or areas temporarily uncovered by vegetation have been applied to the other categories. Zero value in SOC has been assigned to natural grasslands. For Litter data, weighted C content data related to areas at different recolonization degree were found in Sirca et al. (2016). Data for each pool are presented in Tab. 3.

LAND USE	ABGB (tons C/ha)	BGB (tons C/ha)	LITTER (tons C/ha)	SOC (tons C/ha)
Forest (*Quercus ilex* woods)	15	7.5	2.8	2.4
Mediterranean maquis	24.02	25.23	1.5	19.88
Garrigue	2.25	1.14	1.5	6.99
Sparsely vegetation areas	7.04	7.39	1.5	21.18
Natural grasslands	1.65	4.62	0	0

Tab. 3 Mean of potential C stock per hectare in main land uses of Asinara island

5 DISCUSSION AND FUTURE RESEARCH DIRECTIONS

The GIS approach here presented, and the resulting high-resolution Ecosystem Map, represents an innovative tool for land management plans and policies, due to spatial resolution and the lack of data at the local scale.

ELC allowed to classify ecosystems at the local scale using the Asinara island as a case study. Potential ES evaluation and mapping was possible using CICES classification potential ES classes. Only C stock was estimated for the territory of Asinara National Park deriving data and information from the literature. Data show that, in our case study, Mediterranean maquis contributes to C storages more than the remaining land covers. Further investigation on other ES will be useful to Asinara National Park administration for land use planning in mid- and long-term scenarios, hence supporting land management policies, such as restoration of natural vegetation series and habitats.

Experts' opinions offered a preliminary assessment of potential ES in the island, and the perceived weakness/strength among different ES classes was recorded. A more advanced and thorough analysis of preliminary results and the implementation of participatory approaches involving a wider target group of Asinara end-users will help build a more complete inventory of ES profile. Cultural features (archaeological, historical, spiritual, etc.) have not been taken into account at this level of investigation but they will be considered particularly if different ES scenarios might lead to conflicting goals and policies.

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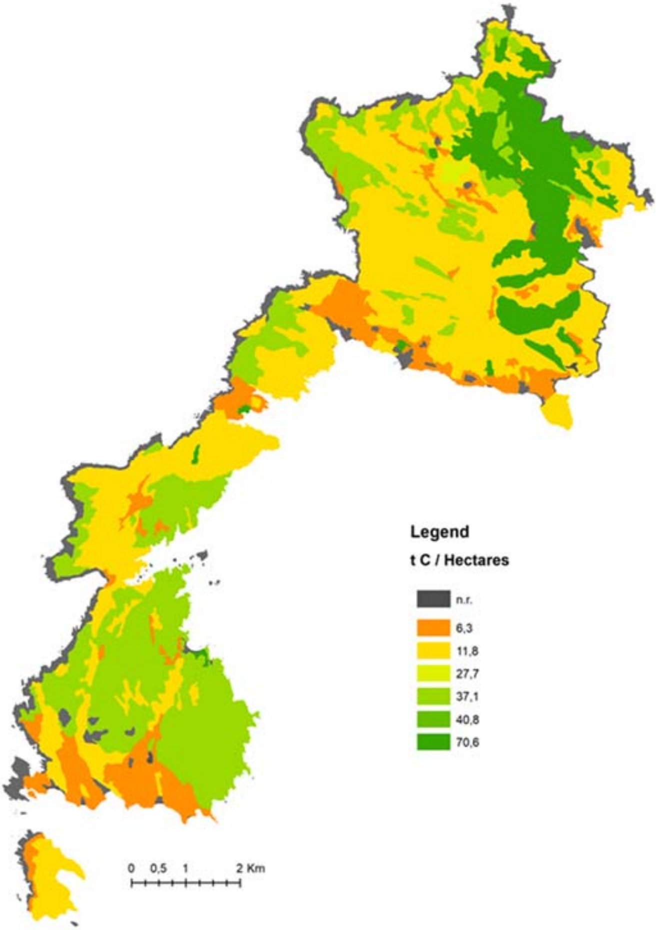

Fig. 4 Carbon stock potential in the Asinara island

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AUTHORS' PROFILES

Matilde Schirru. PhD, rural geographer and environmental consultant for Private and Public institutions, e.g. ARPAS for Autonomous Region of Sardinia in GIREPAM project.

Simona Canu. An environmental scientist, Simona Canu is expert in advanced GIS analysis. She is currently an officer at Environmental Protection Agency of Sardinia (ARPAS), Department for Sassari and Gallura. Her main fields of interest are Environmental Impact Assessments and Strategic Environmental Assessment.

Laura Santona. An Agronomist, Laura Santona is Research Doctor in Agricultural, Forest and Food Sciences (Italy, 2006). She is currently an officer at the Regional Administration of Sardinia, Department for the Environment, Division for Nature Protection and Forestry Policies.

Sabrina Lai. A Civil engineer, Sabrina Lai is Research Doctor in Land Engineering (Italy, 2009), and MSc in International Planning and Development (UK, 2008). She is currently an officer at the Regional Administration of Sardinia, Department for the Environment, Division for Nature Protection and Forestry Policies.

Andrea Motroni. Doctor research in Agrometorology (2001), his main fields of interests are climate change, desertification and environmental education. He is currently an officer at the Environmental Protection Agency of Sardinia, Department for Meteorology and Climatology.

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ORGANIZE THE MANAGEMENT OF PROTECTED AREAS ACCORDING TO AN OPTIMAL FRAMEWORK

AICHA BOUREDJI

Department of Corsica
University of Corsica, France
e-mail: aichabouredji@yahoo.fr

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ABSTRACT

Protected areas are more than ever asked to intervene on the current climate situation. Faced with global changes, these protection tools are questioned by public policies about their contact with the field. Thus, the return to their evolution over time and the analysis of their way of managing space are the concerns that are constantly growing. Given current realities, it is wise for decision-makers to adapt by reviewing their management tools. This approach is realized from the moment when the constraints that come up frequently are clearly spread out. The operating mode must be refreshing and must be reinvented. This article provides an experience to recycle one of the best-known management tools and optimize it to help management. Through a field study, a semantic analysis and a thorough research, a proposal to help the management of protected areas is generated. The goal is to demonstrate an idea of adaptation and optimization of existing tools. At the end of this analysis, a ready-to-use tool is made available to natural environment managers to help them be more efficient.

KEYWORDS
Management Tools; Efficiency; Protected Areas; Objectives

1 INTRODUCTION

The geographical image of protected spaces in the world is growing and literature evokes its brilliance as described by Dudley (2008). These protection areas have lasted so long because they have a positive impact on the environment. Peach et al (2019) when analyzing the utility of these spaces in the face of climate change have joined the opinion of Hannah et al (2007) and Virkkala et al (2014) on the benefits that these areas provide. Today, their effectiveness needs to be questioned: the report by Worboys and Trzyna (2019) discusses management systems and emphasizes the need for a focus on tools. The authors note a collective awareness.

To achieve their development strategies, protected areas are highly regulated. They are framed by specific objectives that allow them to operate in harmony with environmental requirements. For example, Ervin (2003) analyzed the case of four protected areas in different countries; its conclusions announce negative consequences on the quality of management. To know the causes, we must look at the elements that hinder the achievement of strategies. Thus, the idea is to look at the pressures on the management structure. This can be defined in two types of constraints: time and variation of legal status.

First, the time constraint is the biggest challenge facing managers. It has a non-derisory weight in protection strategies. The temporal system is the parameter that connects the environment to the movements of society and the economy that remain; it is also one of the witnesses of quality management. Homogenization of interventions is an ongoing challenge. In his analysis of integrated management, Gourlay (2010) questioned temporal adaptation. The time of realization required by the actions wavers between short and long-term combinations; in addition to the volatility of policies and regulations. The work of Gullison and Hardner (2018) has resulted in similar reflections. During their investigation to evaluate the variables that have the greatest impact on the quality of management, and they demonstrated the role of the time effect. To achieve a certain level of conservation, the natural space must evolve to deliver results.

Secondly, the influence of the legal status which states the type of protected area and its objectives of creation. Protected areas can take different statutory forms. If we take the French example, twelve areas share the territory. Some have a greater responsibility than others and a different mode of operation. For example, according to the French Agency for Biodiversity, there are ten national parks in 2017 and nine marine natural parks in 2018. Also, 51 regional parks (Baron and Lajarge, 2016, p.163) and more than 343 reserves according to the line of 2017 of the Reserves Naturelles de France network. In addition to 7580 sites classified and registered according to the declarations of 2018 of the Regional

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Direction of the Environment. The intervention areas reach 3108, natural areas have 18583 sites and biological reserves 251 sites. With 672 biotope protection areas, 1758 Natura 2000 sites, 700 sites of the Conservatoire du Littoral. In addition to the recent creation of fisheries conservation areas. These figures show the dimensions that the same territory can muster. Thus, in addition to variation at various scales, protected areas may have different objectives and different operating environments. This impacts the management and it distances the possibilities of connection between the sites.

Finally, being aware of such constraints, it is possible to remedy the lack of time by using good tools. Faced with the diversity of the statutes, a harmonization of the objectives is a way of connecting the protected areas in a territory. Thus, managers will work simultaneously and can exchange experiences. The work proposed in this document is an experience of optimizing a management tool with an experience-based approach. In an adaptation perspective, this approach leads to a homogenization tool for better efficiency.

The goal is to connect protected areas and facilitate management and environmental assessment. Therefore, a common list of long-term objectives is proposed at the end of this work, reusable according to the needs.

2 METHOD

In order to produce a working tool to optimize management practices, a study was conducted. It was done according to the following method: the choice of a type of protected area; the selection of a management tool for analysis and cross-breeding and the production of a model tool. The analysis was carried out on the French case as a result of the availability of documentation and data. France is particularly concerned about the ecological transition and is suitable for the experiment. Therefore, by identifying the types of protected areas, their objectives and their management process that the framework of application has been continued. This initiative required the analysis of the legal texts of ranking of sites.

For this, parameters have been set following a bibliographic search and the following information has been extracted: year of creation, size, legislator instructions, type of management tools, duration of intervention, quality assessment. These variables were transcribed to select the type of protected area for this study.

The five selection parameters are:

- priority by seniority: the type of protected area must be old enough to trace the evolution over time. The study is established at the level of the most experienced areas in terms of management;

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- good spatial distribution: we aim for sites that are geographically well distributed throughout the study area. The goal is to focus on types of protected areas with high coverage; it is the way to reach diversified ecosystems;
- under regulatory standards: the study must be done on areas with a creation decree clarifying all the necessary modalities for their management. This serves to set the choice of the tool to analyze;
- use of common management tools: the analytical work requires the presence of precise tools common between all the selected sites,
- sites under quality control: subject to assessments of the quality of their management, the selected areas have the obligation to improve the quality of their intervention. Hence the interest of offering them a way to readjust their work.

Thus, these criteria have led us to areas of type "nature reserves" which have a triumphal seniority. They also have a fairly developed geographical coverage throughout the country. In terms of management, they have strong creation decrees with clearly identified management instructions. They rely on a solid management tool "management plan" to plan their actions in the short, medium and long term. Nature reserves have extensive environmental management experience and bilateral impact at the regional and national levels. The treatment of protected areas gives us access to a wide range of data since most management documents are open to consultation. At the same time, it was a question of taking the example of a management tool necessary for the running of operations on the site. We are interested in the management plans that represent the basic management tool. Where setting the long-term goals is the first step. As Yaffee (1999) and Bioret (2003) point out: "The definition of the management objectives is an opportunity for the manager to lead a global reflection allowing in particular to specify the role that can play the reserve." (P.73). It was therefore interesting to analyze this management tool and to cross-check the long-term objectives of a sample of official documents.

The choice of objectives remains an ongoing challenge in conservation areas as revealed by Jantke's (2019) work. It highlights the fact that assessments of protected area networks reflect a negative relationship between the achievement of set objectives and expansion in space. This finding is also shared by other authors such as Venter et al (2014); Klein et al (2015); McGowan and Possingham (2015); Kuempel, Chauvenet and Possingham (2016). This article proposes a list of objectives to help managers initiate planning. Since this step is very important for effective management as stated by Gullison (2018).

This study materialized through the analysis of more than seventy-seven management plans and the treatment of a batch of several long-term objectives validated in nature reserves. The method of analysis is based on the classification of the titles of the objectives under

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different categories. At the end of the ranking, the list is stopped gradually and the components of each of them are represented in order of priority in the form of a Pareto diagram. Indeed, in order to collect priority crossing points in the database, the Pareto chart provides the expected order of priority of the objectives.

3 RESULTS

Since not all protected areas manage to produce management plans (despite their obligation), the selection of a random sample was made on the sites that own them. A batch of 77 documents was considered sufficient enough for our experience. As a result, more than 658 long-term goals were analyzed.

Where 511 of them were selected, for the remaining 22% were discarded being very specific objectives to status quo sites.

3.1 CATEGORIZATION OF LONG-TERM GOALS

Following the cross-fertilization of the information drawn from the management plans, eight categories of objectives were identified:

- conservation and maintenance objectives. At 29% of the total population, the nature reserves take ownership of two conservation targets. The initial results of the analysis show ten targets for conservation objectives. These are: 1)Habitats; 2)The species; 3)The patrimony; 4)Biological Diversity; 5)Landscape aspect; 6)Conservation state; 7)Offsite backgrounds; 8)Water quality; 9)Wealth reserve; 10)Partnerships; 11)Bird populations; 12)Biological connection. In equal parts, habitats and species are the main targets of the long-term objectives. They are primarily the focus of conservation strategies. Heritage and biodiversity are targets that then occupy an important position and return frequently in most lists. These four targets accumulate a percentage of 97% of the workforce in this category. In total, over 150 objectives have been identified where landscape conservation and state of conservation are non-priority targets. In addition to other targets that are also more marginal ;
- organizational and development objectives. The issue of nature reserves is also to establish a continuous monitoring exercise on knowledge. This is done through the realization of scientific studies of discoveries and diagnoses. These are the following: 1)Knowledge; 2)Communication; 3)Biodiversity; 4)Operation; 5)Information; 6)Extension of the site; 7)Practice. The dominant objectives in this category are twofold and are those that target the development of scientific knowledge and those that aim to communicate the results to more than 85% of the workforce. Then, at

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smaller slices, the non-priority objectives concerning: the valorization of biodiversity, the development of the functionality of the reserve, the collection of information in all its forms (use, frequentation). Also, those who emphasize the motivation of an adaptability of the size of the site (positive dimensional change) and the improvement of synergistic practices. A total of 108 objectives were classified under this category;

- insurance and guarantee objectives. Managers have obligations related to the conservation policy. Steps are necessary for proper functioning to form objectives. Crossing the various lists allowed to cumulate 81 objectives dedicated to this kind of missions. As shown the results, several targets appeared about these concerns: 1)Optimal management; 2)Administration; 3)Regulation; 4)Reception; 5)Integrity; 6) Pedagogy. The projection of insurance objectives is fairly homogeneous and management optimization objectives take precedence in this category. Managers organize themselves by setting efficiency limits and assign great importance to administrative tasks. At the same time, the respect of the regulations is very present in this category. The potentiality of reception of certain species imposes the presence of specific objectives (objectives favoring wintering). Also, the non-modification of places is taken into account through integrity and pedagogical transmission;
- control and awareness objectives. 37 objectives of management of the tourist frequentation and the control of the flows were identified. This is a non-negligible proportion where nature reserves attempt to regulate these practices. Also, 38 awareness objectives are identified to encourage respect for the environment. They aim at public awareness, users and professionals: 1)Awareness and 2)attendance. The results show the distribution of targets for long-term goals of this type with 75 goals cumulated here. The two types of objectives do not have the same scope, but together they target the establishment of a nature-friendly environment. The flow of visitors flows through the awareness phase that allows users to better respect the site;
- objectives of dissemination and popularization. Communication is a convenient way to highlight the actions that staff are performing. The sites share results with the general public and disseminate various information to enhance the effects of site management. Targets in this category point to the six : 1)Integrity; 2)Naturel reserve effect; 3)Observatory; 4)Sociocultural; 5)Scientific; 6)Protection. The main target of these 34 goals set to promote communication and make the reserve a place of local socio-economic exchange. In addition, other objectives are present about the reserve effect and the positioning of the site as a heritage observatory and overall interpretation scheme;

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- objectives of participation in the event. Here, 27 objectives share targets in this category: 1)Development; 2)Exchange; 3)Feature; 4)Policy. The analysis of this type of objectives has demonstrated a broad fixation on local and national development missions, even international. This type of target is the means for reserves to contribute to the growth of the territory in which it is planted. Also, knowledge exchange objectives are also chosen for the same purpose of development. The first two targets are the ones that are prioritized under this category;
- measurement and evaluation objectives. Nature reserve managers are also entering an audit phase. This evaluation step allows them to arbitrate their actions by consulting the results of the analyzes. The two targets of measurement and evaluation objectives: 1)State of conservation and 2)management and evolution of management issues. Largely in this category, objectives that focus on the supervision of biological sites and structures take precedence. The state of conservation of habitats is the biggest concern in this category at 75%. Planned goals to control agent actions by verifying compatibilities between program and achievements are non-proprietary;
- incentive and support objectives. In one goal of sustainability, the managers aim to promote the extension of the sites and the optimal exploitation of the places. Thus, they choose objectives to encourage local ownership. They support the transformation of places into a research laboratory and venture into ambitions for sustainable development. The targets of incentive and support objectives of French nature reserves are: 1)Local ownership ; 2)Research laboratory ; 3)Sustainable development. Under this latter category, only local ownership is retained as a significant objective with a workforce of 72%. The other two are non-priority.

In addition to these eight categories, a few other varied objectives have been identified at 9% of the total proportion. These titles concern landscape quality, diversification of activities and some specific orientations of biodiversity. It is useless to spread this minority since it is very marginalized. At the end of this analysis, all the long-term priority objectives are cataloged to constitute the planned management assistance tool.

In the Fig. 1, which summarizes the analysis, they are mentioned in red the priority targets that the long-term objectives must aim in the management documents. The rest of the targets are certainly interesting and deserve a lot of interest, but only after determining the priority objectives. Generally, nine targets are on the horizon and more than thirteen are secondary. It is now clear that management documents of French nature reserves target, in priority, concern: awareness, Attendance, knowledge, habitats, species, patrimony, optimal management, administration and integrity.

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It is therefore appropriate to talk about the impacts of these protected areas on environmental education, the direction of human flows and the contribution to the development of scientific knowledge. They positively impact the territory and contribute, with excellence, to their development.

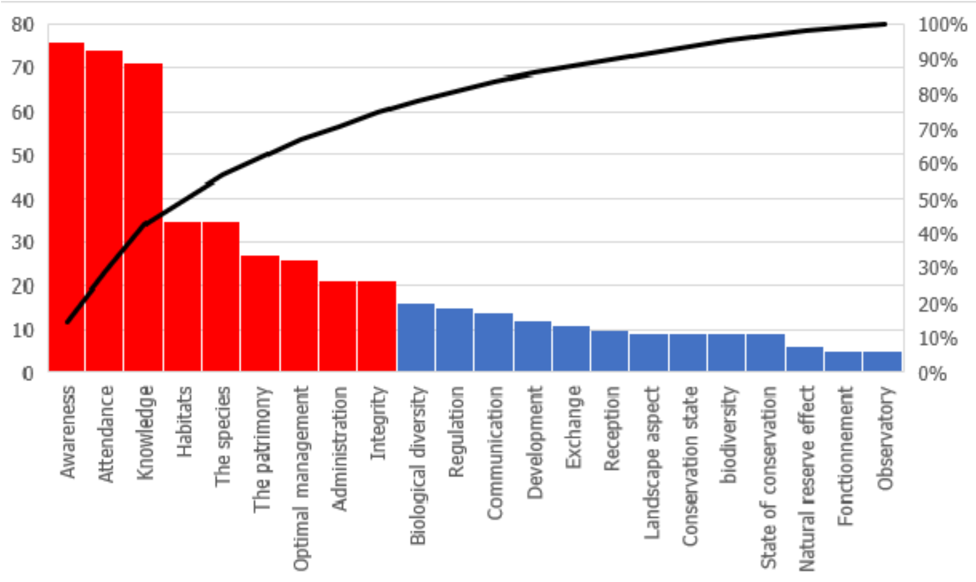

Fig. 1 Long-term priority targets of objectives determined by nature reserves

3.2 TOWARDS A LIST OF HOMOGENIZED LONG-TERM OBJECTIVES

Through this analysis, interesting results made it possible to see the organization of objectives. Crossing the 511 objectives anchored the eight categories to structure a list of management assistance. Using a tool such as the predefined list of long-term objectives, policy makers can facilitate the preparation of management documents.

The goal here is to propose a standard and common enumeration that can help in any writing of a list of long-term goals. This classification demonstrates that there may be several themes that determine the targets. Under these themes several headings are recommended to guide managers. To better manage time and organize work, a common list of long-term objectives is proposed in Tab. 1 below.

Finally, the previously identified categories intersect in a single list to form this tool to help manage protected areas. It is clear that the list proposed here is not exhaustive and can be widened according to the needs of the site. The idea is to make the writing exercise fluid

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and homogeneous. Given the great similarities observed in the trees of the management plans, the future use of this tool promises the connectivity of practices and the coherence of actions.

HOMOGENIZED LONG-TERM OBJECTIVE LIST

Type of objective	The targets	Recommended titles
CONSERVATION AND MAINTENANCE	Habitats	Conserve habitats
	Species	Keep the species
	Patrimony	Preserve the patrimony.
	Biological diversity	To perpetuate biological diversity
ORGANIZATION AND DEVELOPMENT	Scientific knowledge	Deepen scientific knowledge and develop research
	Communication	Organize the communication
INSURANCE AND GUARANTEE	Optimal management	Optimize management and operation.
	Administration	Guarantee the administrative functioning
	Regulation	Enforce regulations
	Reception	Manage the attendance of the protected site
	Integrity	Guarantee the integrity of the reserve
	Pedagogy	Ensure the educational vocation
CONTROL AND AWARENESS	Attendance	Manage attendance
	Sensitization	Sensitize the general public
DIFFUSION AND EXTENSION	The integration	Transform the site into a local socio-economic tool that supports integration
	The effect reserves	Highlight the interest of the protected site
	Observatory	Promote the site as a patrimony observatory
PARTICIPATION IN THE EVENT	Development	Consolidate local and national (even international) development
	To exchanges	Contribute to the exchange of knowledge and experiences
MEASUREMENT AND EVALUATION	State of conservation	Evaluate the state of conservation
INCENTIVE AND SUPPORT	Local approval	Encourage local ownership and appropriation of the protected site

Tab. 1 The homogenized long-term objective list to help management

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AUTHOR'S PROFILE

Aicha Bouredji, Ph.D. student and Temporary Attached of teaching and Research at the University of Corsica. In the research laboratory UMR CNRS 6240 LISA her research interests include: ecological economics, assessment of management of protected areas and treatment of ecosystem services.

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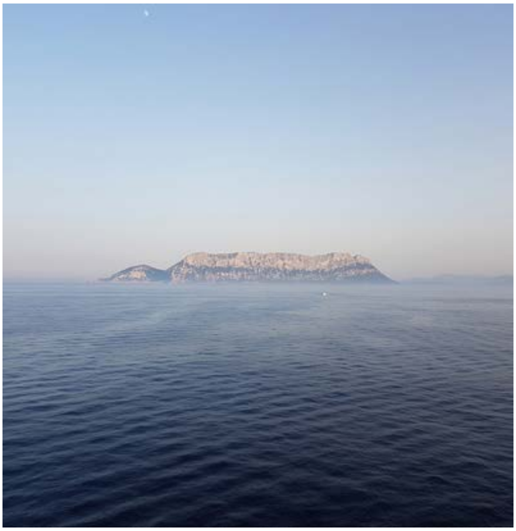

A METHODOLOGICAL APPROACH TO BUILD A PLANNING ENVIRONMENTAL ASSESSMENT FRAMEWORK IN THE CONTEXT OF MARINE PROTECTED AREAS

IGNAZIO CANNAS, DANIELA RUGGERI

Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: i.cannas@outlook.it
daniela-ruggeri@hotmail.it

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ABSTRACT

In the last years, issues concerning the environmental protection of marine-coastal protected areas have become a crucial part in policies related to coasts and sea. In Italy, marine protected areas are established by the laws n. 979 of 1982 and n. 394 of 1991, through a ministerial decree where the areas to be protected are named and defined, and objectives and protection disciplines for marine ecosystems are declared. Marine protected areas need to be managed through regulations based on institutional goals aiming at preserving the biodiversity of the marine ecosystem, and promoting the use of natural resources, also through experiences based on sustainable development. The regulation of marine protected areas often overlaps with additional levels of protection coming from planning and management tools referring to different regulatory tools (e.g. the overlap of marine protected areas with the sites of the Natura 2000 network) and, sometimes, to different territorial contexts. This overlap requires a holistic system to integrate all planning issues of the environment and the territory. This condition entails the creation of a cognitive level taking into account relations of the marine-coastal context with the surrounding territorial systems, with particular regard to transition boundaries. Approaches should be able to support territorial policies concerning interactions between human and nature dimensions. This paper proposes a study concerning the definition of a methodology structure to build an analytical-cognitive environmental framework to be integrated into planning processes related to marine protected areas.

KEYWORDS
Environmental Assessment; Protected Areas; Spatial Planning

1 INTRODUCTION

In coastal landscape, high-value areas are often affected by high anthropic pressure (Benoit & Comeau, 2005). The implementation of systemic approaches to improve the development and practice of territorial policies, aimed at the peaceful coexistence of human and nature dimensions, is crucial in planning. In marine-coastal contexts, the need for socio-economic development and environmental protection requires to balance conservation and development practices, taking into account natural and cultural factors.

Since the year 1960, critical processes causing the degradation of natural capital in marine-coastal contexts were already known: the persistent extension of coastal urbanization, the pollution of coastal marine waters, the artificialization of beach areas and wetlands, and the consumption of land agriculture, the abandonment of rural areas and settled inland areas (Salizzoni, 2012).

The marine environment constitutes a precious heritage that can support marine ecosystem services demand (Rosales, 2018). The preservation of marine ecosystems should be supported by the implementation of thematic strategies.

The Marine Strategy Framework Directive (Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy) suggests implementing in protected areas ecosystem-based approaches to manage human activities that may induce impact on the marine environment. In order to guarantee the sustainable use of marine goods and services for future generations, pressures caused by human activities should be contained within compatible levels of "good environmental conditions" and the ability of marine ecosystems to cope with human-induced changes.

In this paper, the authors suggest the definition of a methodology aimed at implementing an environmental cognitive framework as a crucial point to integrate planning processes in marine-coastal areas with particular reference to marine protected areas. Currently, this methodology has been implemented in the context of the definition of the regulation of the Marine Protected Area of "Tavolara-Punta Coda Cavallo", in Sardinia (Italy), characterised by the overlapping of some Natura 2000 sites.

This cognitive framework enables to include environmental, cultural and socio-economic aspects, by implementing an environmental assessment aimed at defining environmental sustainability objectives oriented both to the protection and the conservation of natural heritage, and cultural, social and scientific development. This conceptual scheme can effectively and dynamically address a holistic planning process characterized by management paradigms towards responsible uses of resources.

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2 THE METHODOLOGICAL APPROACH TO DEFINE AN ENVIRONMENTAL ASSESSMENT FRAMEWORK

The safeguard of marine protected areas is an important issue in several scientific types of research (Douvere & Ehler, 2009; Garmendia et al., 2017; Hogg et al., 2018; Paltriguera et al., 2018) and policies to protect coasts and sea.

Rules of protected areas often overlap with additional planning and management tools established by different regulations set defined by different protection levels and objectives (e.g. marine protected areas may overlap with sites of the Natura 2000 network and/or regional or national parks). Therefore, this overlapping determines that a holistic system is required to integrate environmental issues into spatial planning, through a knowledge framework taking into account the interaction between the marine context and the coastal context, with particular regards to the transition boundaries, combining, in turn, the local protection with widespread protection. In these contexts, integrated management should be designed to simple logic of protection and conservation, in order to assume a complex structure where the implementation of all phases activates a set of competencies, requiring moments of continuous control and arrangements in the definition of the methods to implement strategies (Addis et al., 2011).

In order to support the governance in this integration of overlapping rules in spatial planning, a framework of the environmental state, aimed at defining environmental sustainability objectives, is strictly required. The methodological proposal concerns the implementation of a framework where the environmental dimension is disaggregated and expressed by the knowledge of a detailed environmental assessment analysis, that consists in examining, qualitatively and/or quantitatively, a set of environmental elements representing a series of information on the state of natural resources and pressures exerted by anthropic and/or productive factors. In this way, environmental criticalities may be detected, and peculiarities of the context can be highlighted.

2.1 THE STRUCTURE OF THE ENVIRONMENTAL ANALYSIS

The environmental analysis proposed in this paper consists of a hierarchical structure (Fig. 1): the environmental elements are identified in the context to be analysed; in turn, the complexity of these elements is divided into specific themes; further, these themes are subdivided into quantifiable or qualifiable specific aspects to be evaluated by proper indicators.

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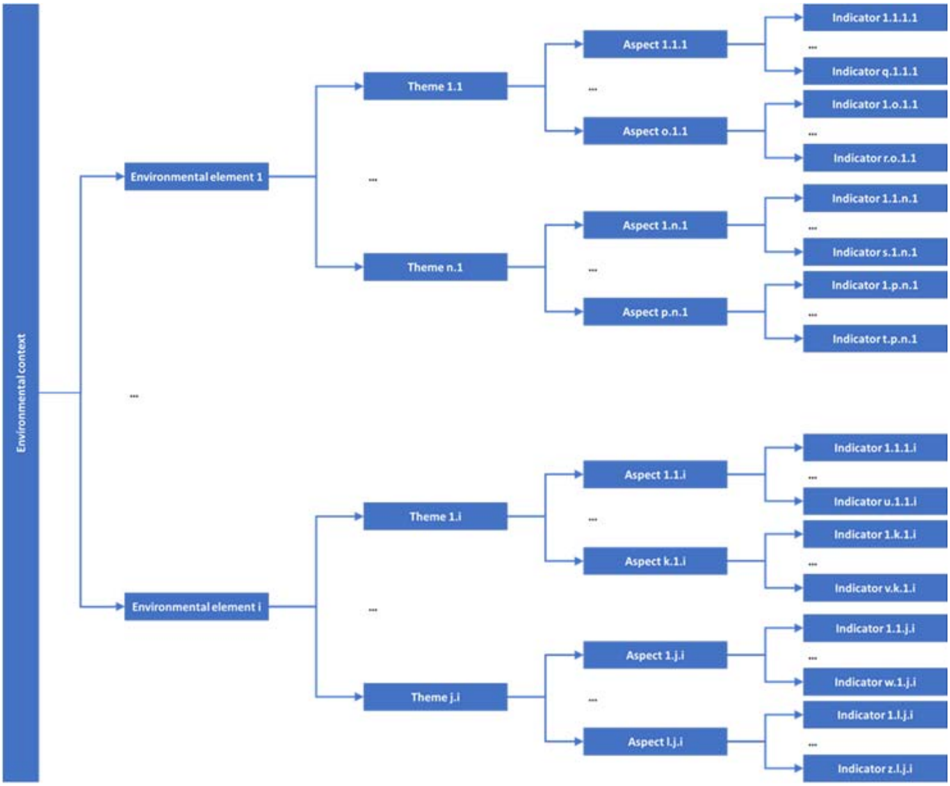

Fig. 1 The hierarchical structure of the environmental analysis. Source: elaboration of the authors

The environmental analysis, therefore, represents a tool able to make understandable complex phenomena not immediately perceptible. It can be structured by specific analysis forms, one for each environmental element of the context.

These analysis forms provide a synoptic framework of the environmental state, by reading the environment through a rational analysis of the context (SWOT[1] analysis), in order to address the definition of objectives concerning the environmental sustainability by including key sustainability criteria[2].

1 Acronym of: Strengths, Weaknesses, Opportunities, Threats.

2 For example, the key sustainability criteria as defined in "A Handbook on Environmental Assessment of Regional Development Plans and EU Structural Funds programmes" of the European Commission, available at: http://ec.europa.eu/environment/archives/eia/sea-guidelines/handbook.htm.

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The declination of the environmental elements

A given environmental dimension may be subdivided into several environmental elements which are specifically chosen by analysing the complex system of the context. ISPRA (2017a, 2017b) suggests useful ways to implement a proper environmental analysis by using specific set of environmental elements and their indicators in spatial planning fields.

Specifically, in a marine protected area, significative environmental elements, that should involve all main terrestrial and marine characteristics of the complex context, can be resumed as following: air; water; flora, fauna and biodiversity; soil and marine geomorphology; landscape; settlement structure; waste; touristic, recreational and educational activities; fishing and other productive activities; marine and terrestrial mobility and accessibility; energy and noise. In turn, the environmental elements can be characterized in a more detailed analytical framework, as shown in Tab.1.

Environmental elements	Themes	Aspects	Indicators
Air	Air quality	Pollution sources	Pollutant value (e.g. NO_x, CO_x, So_x, O_3, ...)
	Weather and climate conditions	Temperature	Average temperature trends
			Air temperature
			Solar radiation
			Isohyets
			Relative humidity
			Atmospheric pressure
		Wind	Main directions
			Intensity
Water	Marine waters	Hygienic and bathing conditions	Bathing quality sampling
			Transparency
			Temperature
			Salinity
			Levels of dissolved contaminants (e.g. P, PO_4^{3-}, N, NO_x, NH_3, SiO_4, ...)
			Main directions of waves
			Average wave height
			Sea conditions
			Colifecal bacteria
	Surface waters and groundwaters	Natural sources	Sources number
		Physical, chemical and	Quality parameters (ph, O_2, turbidity, conductivity, ...)

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Environmental elements	Themes	Aspects	Indicators
		hygienic conditions	Chlorophyll and phytoplankton
			Levels of dissolved contaminants (e.g. P, PO_4^{3-}, N, NO_x, NH_3, SiO_4, …)
			Colifecal bacteria
	Water supply network	Physical and chemical conditions of drinking water	Quality parameters (ph, O_2, turbidity, conductivity, ...)
		Wastewater treatments	Purification plant (number and general characteristics)
Flora, fauna and biodiversity	Habitats of community interest	Marine and transition habitats and submerged caves	Number of marine and transition habitat and submerged caves
			Total surface of marine and transition habitat and submerged caves
			Number of priority marine and transition habitat and submerged caves
			Total surface of priority marine and transition habitat and submerged caves
			Maps of marine habitat
			Maps of marine-benthic biocenosis
		Terrestrial habitats	Number of terrestrial habitats
			Total surface of terrestrial habitats
			Number of priority terrestrial habitats
			Total surface of priority terrestrial habitats
			Maps of terrestrial habitats
	Species of community and conservation interest	Flora of community interest	Number of species
			Number of priority species
		Other floristic species	Number of other floristic species
			Number of other floristic endemic species
		Fauna of community interest	Number of species
			Number of priority species
		Other faunistic species	Number of other fauna species
			Number of other fauna endemic species
Soil and marine geomorphology	Geologic and geomorphologic characterization	Terrestrial geology and geomorphology	Geological and geomorphological maps
		Marine geology and geomorphology	Geological and geomorphological maps
		Active and potential	Coastal erosion
			Hydraulic hazard and risk

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Environmental elements	Themes	Aspects	Indicators
		phenomena of coastal erosion and hydrogeological instability	Landslide hazard and risk
		Bathymetry	Maps
	Land use and cover	Land use and land cover inventory	Maps and surface of land use and land cover
Landscape	Characterization of identity and landscape heritage	Identity heritage	Maps and numbers of elements
		Landscape heritage	Maps and numbers of landscape elements
			Maps and numbers of cultural elements
	Characterization of environmental landscape heritage	Natural areas	Maps and surface
		Seminatural areas	Maps and surface
		Areas for agroforestry use	Maps and surface
		Environmental landscape heritage	Maps, surface and number of punctual elements
	Submarine landscape	Natural elements	Maps and number
		Historic-cultural elements	Maps and number
Settlement structure	Administrative-territorial characterization	Buildings and administrative characterisation	Maps of building distribution
		Zoning of the marine protected area	Zoning maps
		Forecast of the coastal plan	Maps of littoral activities
		Properties and concessions	Maps and surface of permissions
	Socio-economic characterization	Demography	Population density
			Resident population
			Population trend
		Economy	Income
			Employment rate
			Unemployment rate
			Youth unemployment rate
Waste	Production	Produced waste	Total undifferentiated waste produced
			Total urban waste produced
		Abandoned waste	Typology

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Environmental elements	Themes	Aspects	Indicators
	Collection	Management of the marine context	Collection plant and their services
			Number and distribution of eco-centres
			Boating services
		Management of the terrestrial context	Number and distribution of eco-centres
			Services typology
Touristic, recreational and educational activities	Hospitality	Hospitality activities	Number and typology of hospitality activities
		Touristic flow	Touristic flow trend
	Attractiveness	Services	Number and typology of tourist services (e.g. diving, …)
			Number of hygienic services in the beaches
			Areas equipped for dogs
		Organisation of cultural, educational and sport events	Number of InfoPoint
			Number, typology and period
Fishing and other productive activities	Fishing activities	Local fishing	Typology of fish caught
			Number of boats used for fishing activities
			Linked industry (e.g. business volume, number of employees, …)
			Catch distribution in the supply chain
			Distribution and typology of fishing pressure
		Sport and recreational fishing	Number of sport and recreational events
			Typology of sport and recreational events
			Typology and number authorisations
			Distribution and typology of fishing pressure
	Other productive activities	Agriculture and breeding	Characterization of land units by agricultural use
			Characterization of agricultural units by type of farming
		Other sectors	Characterization by sectors and employees in local units
Marine and terrestrial mobility and accessibility	Terrestrial mobility and accessibility	Vehicle presence	Quantity and typology
		Paths	Distribution, type and characteristics of footpaths and driveways
		Accessibility services	Distribution, typology and characteristics
	Marine mobility and accessibility	Vehicle presence	Quantity and typology
		Sailing routes	Distribution, typology and characteristics of allowed routes
		Boating and accessibility services	Distribution, typology and characteristics

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Environmental elements	Themes	Aspects	Indicators
		Passenger transport	Number of access
Energy and noise	Energy	Energy supply and consumption	Production
			Consumption
	Noise	Noise sources	Emissions localisation and intensity

Tab. 1 The environmental elements of the context in marine protected areas declined in themes, aspects and indicators. Source: elaboration of the authors

2.2 THE ANALYSIS FORMS

An analysis form for each environmental element is filled in a proper way (as shown in Tab. 2). The purpose of the analysis form is to recapitulate in a schematic way all information found in the environmental context, in order to refer a SWOT analysis. The integration of key sustainability criteria addresses the definition of environmental sustainability objectives with proper reference to the analysed environmental element. The analysis form is organised into sections as specified as following. The introductory section qualitatively describes the environmental element, declaring all themes to be analysed in the complexity of the context. Afterward, for each theme, specific aspects are identified in reference to the environmental element; they quantify or qualify the analysis through proper indicators. These indicators can be useful tools communicating environmental issues. They have the function to simplify complex environmental issues and to make measurable environmental and policy progress (Stanners et al., 2007). These identified indicators can be used, subsequently, also as an analytical basis for the definition of a further environmental monitoring plan.

2.3 THE DEFINITION OF ENVIRONMENTAL SUSTAINABILITY OBJECTIVES

Effective and positive integration of environmental issues into planning processes, promoting the environment as a vehicle for development, provides a declination of sustainability according to its three "fundamental pillars" (Karrer & Fidanza, 2010). The model of sustainability that predominates thinking is composed of the social, economic, and environmental pillars (Stanners et al., 2007). The objectives of environmental sustainability are the key to the integration of environmental sustainability issues into the planning processes. The definition of the objectives for each environmental element follows the flow chart of Fig. 2. Firstly, once the framework of the environmental analysis is completed, the context is characterised by the SWOT analysis, that means that the context can be read

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through its criticalities, endogenous and exogenous (weaknesses and threats), and its peculiarities, also endogenous and exogenous (strengths and opportunities). In this way, a preliminary strategy which, by mitigating the risks, through strengths and opportunities, can solve any weaknesses.

Environmental element h
[This is a general section where the environmental element is qualitatively described with reference to the planning context; the themes of the environmental element are declared, and, for each theme, specific aspects and their proper indicators are shown]

Theme i
[This is the specific section to describe each theme related to the environmental element]

Aspect j
[This is the section to describe each aspect of the theme of the environmental element]

Indicator k
[This is the section where the indicators describe, in a qualitative and/or quantitative way, each aspect of the theme of the environmental element, specifying source and reference period of data]

SWOT analysis	
Strengths • … • …	Weaknesses • … • …
Opportunities • … • …	Threats • … • …

Environmental sustainability objectives	Key sustainability criteria
ES_Ob_1 - … … ES_Ob_n - …	• … • …

Tab. 2 The structure of the environmental analysis form of the environmental elements. Source: elaboration of the authors

However, this strategy is contextualised by the concepts of sustainability by using the key sustainability criteria; the strategy is stated through one or more sustainability objectives. These defined objectives can address the decision-making process towards sustainable and effective planning.

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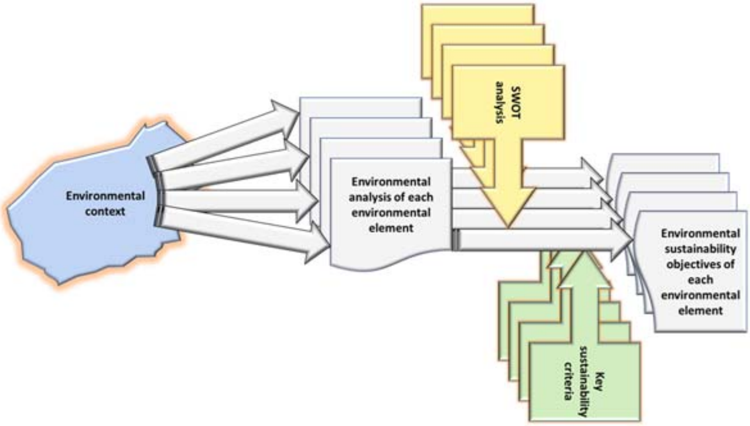

Fig. 2 The flow diagram for the definition of environmental sustainability objectives.
Source: elaboration of the authors

3 CONCLUSIONS

The presence of marine protected areas brings, in the territory, benefits from the socio-economic point of view (Rosales, 2018). However, in the world, biodiversity in the marine-coastal systems is in continuous decline as a result of uncoordinated and unsustainable human activities (Douvere & Ehler, 2009). Planning approaches of marine-coastal contexts, characterised by overlapping government tools and different levels of protection, have to be effectively addressed towards environmental sustainability objectives, through operative paradigms, characterising decision-making processes and integrating it with management aimed at the responsible use of resources. In this paper, the crucial importance of the environmental analysis framework is highlighted, including the physical, chemical, ecological, cultural, socio-economic and development aspects, and aimed at the contextual formulation of environmental sustainability objectives. In particular, the proposed methodology to assess a marine context is proposed by the implementation of a knowledge framework declined in environmental elements, themes, aspects and indicators.

This implementation of basic knowledge, organised in an environmental analysis framework, in addition of a preliminary planning phase, supports the assessment of the environmental effects, eventually determined by the implementation of the planning system, by defining environmental sustainability objectives.

The proposed evaluation scheme aims to ensure that human activities are compatible with sustainable development, respecting the regenerative capacities of ecosystems and resources, safeguarding biodiversity and a socio-economic growth perspective.

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AUTHOR’S PROFILE

Ignazio Cannas, environmental engineer specialized in spatial planning, PhD in Civil Engineering and Architecture, University of Cagliari. Currently, he is a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari. His research focuses on ecological networks into spatial planning, in particular, the implementation of ecological corridors in the Natura 2000 Network. His research interests concern spatial planning, strategic environmental assessment, environmental issues and GIS.

Daniela Ruggeri, environmental engineer specialized in spatial planning, PhD in Civil Engineering and Architecture, University of Cagliari. Currently, he is a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari. Her research focuses on ecosystem services into spatial planning, in particular, the water purification in the Natura 2000 Network. Her research interests concern spatial planning, strategic environmental assessment and environmental issues in planning.

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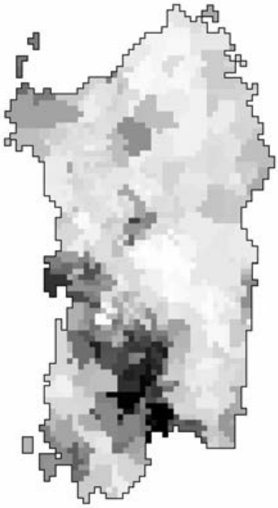

AN EXPERIMENTAL METHODOLOGY FOR THE MANAGEMENT OF MARINE PROTECTED AREAS

MADDALENA FLORIS, FEDERICA ISOLA
CHETI PIRA

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: maddalena.floris@unica.it
federica.isola@unica.it; chetipira@unica.it

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ABSTRACT

Sustainability poses several important questions concerning the knowledge and interpretation of the coastal area. This means that management and planning instruments are required in order to balance trade-offs between environmental conservation and economy grow. The use and protection of the coastal areas have a dual relationship: the use has an environmental impact on the coastal system and the protection limits the coastal system use. Therefore, the environmental systems need conceptual models which are able to join the ecological sensitivity with the anthropic pressure. The methodological approach proposed here aims to provide the definition of an experimental protocol in order to integrate the protection and the management plans for coastal natural heritage. This study describes the results of the research experiments carried out on the experimental protocol application for developing the Marine Protected Area Regulations of the "Isola dell'Asinara" and "Tavolara - Punta Coda Cavallo". This planning approach should support the integration of decision-making procedures to achieve inclusiveness, interactivity, and repeatability of the planning processes.

KEYWORDS
Integrated Management; Natura 2000 Sites; Marine Protected Areas; Planning

1 INTRODUCTION

Marine coastal ecosystems represent an important resource for both the environment (Norse, 1993; Parsons, 1992) and the economy. On the one hand, management and conservation are necessary requirements/prerequisites to support ecological and economic values (Potts et al., 2014). Sustainable coastal and marine tourism development is essential to maintain high-quality marine water, great biodiversity and a healthy ecosystem (European Commission, 2015). However, marine biodiversity is threatened by species overexploitation, habitat destruction, environmental changes and increasing pollution of marine waters (Smith et al., 1999). Indeed, industrial tourism may involve the degradation of the coastal ecosystem (Marinho, 2018). New management strategies are needed to promote sustainable resource use so that coastal and marine areas would be included in larger strategies of coastal planning based on the integrated approach to coastal management (Cicin-Sainm & Belfiore, 2005). This approach was formalized by the Integrated coastal zone management (ICZM) Protocol. The Protocol defines integrated coastal management not only as a continuous and dynamic process but also as a process to promote sustainability, development, and protection of coastal and marine resources (Cicin-Sain et al., 2000).

Marine Protected Areas (MPAs) are recognized as an effective tool for the management and improvement of marine ecosystems (European Commission, 2015). According to the World Conservation Union (IUCN), a protected area is defined as "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means". In terms of integrated management, the initiatives concerning the Protocol must be unified with those implemented by the MPAs.

The European Environment Agency Report[1] defines three different types of European protected areas: Natura 2000 marine sites, MPAs designated at the Regional Maritime Conventions and the individual national MPAs. Frequently, these areas overlap in terms of administrative limits and in terms of multiple regulations (European Commission, 2015).

Referring to the national Italian context, there are two protection regulation levels of the MPAs. The first level is represented by the Ministerial Decree, under the Laws n. 979 of 1982 and n. 394 of 1991. According to the Ministerial Decree, the MPA institution is characterized by significant environmental, historical, archaeological and cultural value of

[1] http://www.eea.europa.eu/soer-2015/europe/marine-and-coastal

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the marine site. However, the primary role of the MPAs is biodiversity conservation by means of sustainable management of the territory (Kelleher, 1999).
These territories are geographically delimited marine and coastal systems. With respect to the environmental values they are legally subject to different levels of protection: the A Zones to the integral reserve, the B Zones to general reserve and the C Zones to partial reserve (Marino, 2011).
The second level of protection is the management plans of the Natura 2000 (N2K) network, these sites often overlap the MPAs. In particular, the N2K network is composed of Sites of Community Importance (SCIs), destined to become Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). This network represents marine and terrestrial system areas to safeguard biodiversity through natural, semi-natural habitats, wild flora and fauna conservation.
However, this stratified framework, composed of different environmental protection regulations, represents an obstacle to the management of the territory. In other words, this overlapping of the regulatory and management instruments brings about a fragmentation of administrative responsibility. One of the most significant impacts of this fragmentation is the negative effects on environmental protection.
This study shows the innovative and multidisciplinary approach used to overcome the current fragmentation of the system regulation related to the context of the MPA "Isola dell'Asinara".
The study is articulated in five sections. The second section describes the context, regulatory and management instrument related to the case study. The third section shows the methodological approach to the analysis and the assessment of the objectives refers to a Logical Framework (LF) in order to develop the MPA Regulation (MPAR). The outcomes derived from those methodologies are presented in the fourth section. The concluding section presents some suggestions based on the results and proposes some reflections related to planning policies in the coastal and marine areas.

2 CASE STUDY: CONTEXT, REGULATORY AND MANAGEMENT INSTRUMENTS

This study focuses on "Isola dell'Asinara" MPA, in the north-west region of Sardinia in Italy, extending about 108 square kilometres around the "Asinara" National Park. The island had been a maximum-security prison for many years until in 2002 the Italian Ministry of the Environment and of the Land Protection instituted a National Park and the MPA. Both of them include two Natura 2000 sites, the Special Protection Areas (SPA) "ITB010001 Isola

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Asinara" and the Special Areas of Conservation (SAC) "ITB010082 Isola dell'Asinara". Moreover, there is a third site SPA "ITB013011 Isola Piana di Porto Torres" outside the limits of the AMP and the Park, as Fig. 1 shows.

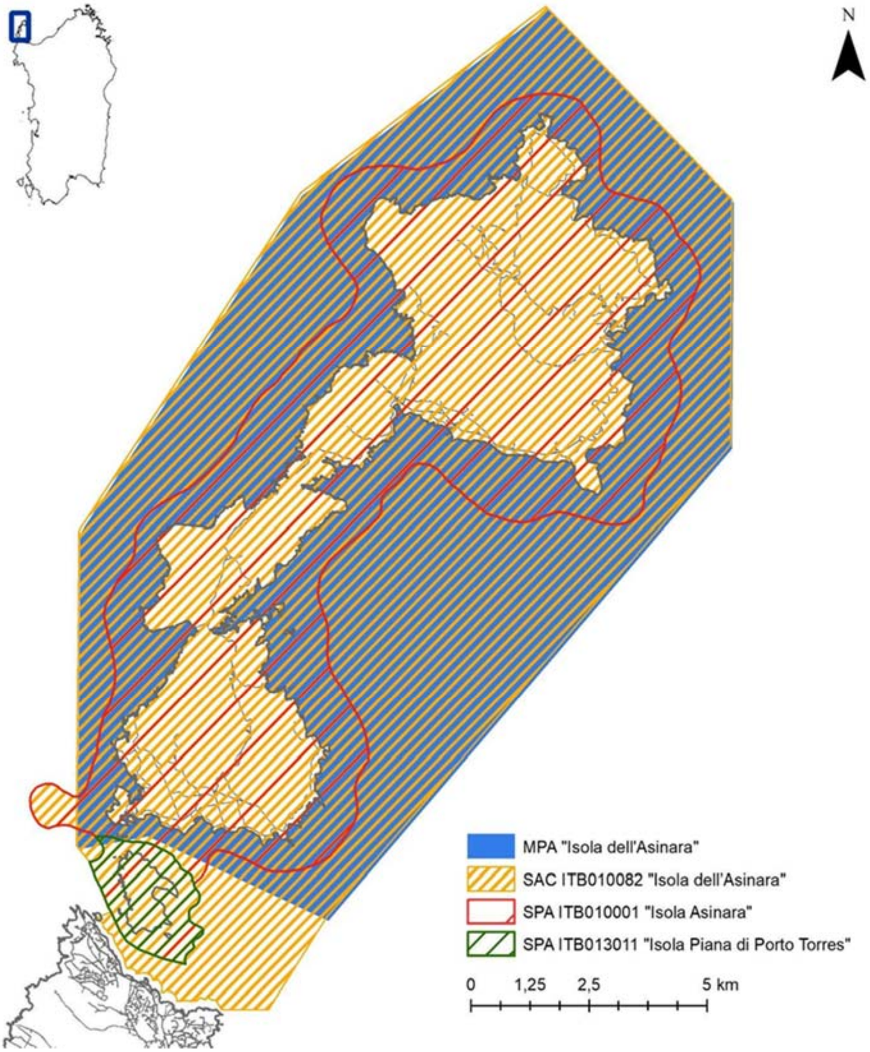

Fig. 1 The study area

Planning and policy include a wide range of regulatory and management instruments: the Regulation of MPA (MPAR), the Management plan (MPs) of the Natura 2000 sites, the Integrated Coastal Zone Management (ICZM) Protocol and the Standardized Management Interventions effective in marine protected areas (SIEA) Project.

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3 METHODOLOGY

An incremental and inclusive method to integrate the conservation measures regarding the regulatory and management instruments into the MPARs are proposed. This article focuses on a technical procedure, Experimental Protocol (EP), which draws its inspiration from the SEA, to improve decision making and to foster sustainable use of the marine environment. The methodological approach, based on sustainable development and environmental protection of the marine ecosystem, can be described with a double evaluation carried out with progressive steps and continuous feedback compared to previous measures to implement the drafting of the MPARs.

3.1 FIRST EVALUATION: A LOGICAL FRAMEWORK

The first evaluation can be schematized in a LF organized on four levels to identify the conceptual relationships between aims inferred by the territorial context, policy landscape, and Regulation actions.

The first level can be identified as the sustainability objectives inferred by SWOT analysis; this consist in a qualitative examination that helps in understanding the environment status by means of the environmental components referred to the territorial context (Kajanus et al., 2012). The second objectives level were identified by analyzing regional, provincial and local plans and programs which could have a potential effect on the MPA.

The third level can be identified as the structural part of the EP, this is certainly fundamental in the definition and implementation of MPs. The specific objectives, inferred by the different protection instruments of the MPA: the MPAs for N2K, the ICZM Protocol and the SIEA Project, represent the objectives of MPA Regulation. The last level of the LF represents the operability of the MPAR. The actions were identified within the different protection instruments of the MPA and from the implications of the SWOT analysis in order to implement the LF into the definition of MPAR. These actions provide a framework for the second evaluation of the EP.

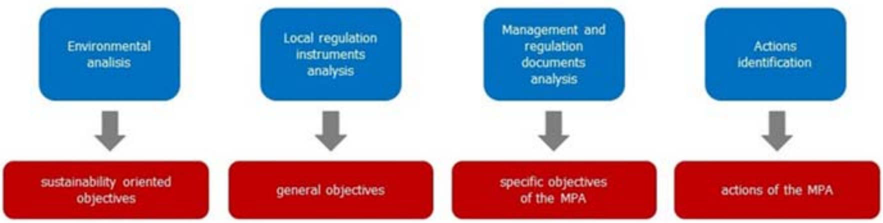

Fig. 2 The Logical Framework

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3.2 SECOND EVALUATION: A REGULATION UPDATING

The second evaluation consists of the examination of the current RAMPs in order to define the actions for the LF and is characterized by two levels.

This evaluation is a crucial phase to improve the RAMP; through an integrated approach, the indications of the current planning system in the context of the MPA and the rules will be applied. Specifically, the methodological approach to develop RAMP "Isola dell'Asinara" is based on a double order of coherence evaluation in order to implement the phase to apply the EP. The first level consists of the evaluation of actions through the articles of the Regulation in force. The second level consists of the comparison between the Regulation in force and the recently approved Regulations in other MPAs of the Sardinia Region. The criteria of the first level of assessment are based on the consistency of the actions EP with respect to the articles of the Regulation in force. The model is based on evaluation results represented by three different colors, which are associated with some proposed changes, as follows:

- if the action is fully integrated within the analyzed standard, then the article of the Regulation, does not change (in green);
- if the action is partially integrated or some aspects are not exhaustive, the article of the Regulation is modified (in yellow);
- if the action or the subject of the action are not integrated in the Regulation in force, the inclusion of new articles or its integrations are applied (in red).

TITLE

REGULATION IN FORCE	FIRST LEVEL OF EVALUATION			SECOND LEVEL OF EVALUATION	REGULATION UPDATING
paragraph	action	evaluation article/action	observations evaluation article/action	article of recently MPARs	proposal paragraph updating

Tab. 1 Double order of evaluation

4 FINDINGS

The final output of this empirical work is a proposal to improve MPAR of the "Isola dell'Asinara" MPA; actions Regulation and recently MPARs contribute to this implementation. The EP approach proposes to update the MPAR has an important effect on its organization system. In general, the base structure of Regulation (titles) remained unchanged, improvement regards articles, paragraph, and letters; for simplicity, in this section, only the articles are discussed. Regulation has been increased by 13 articles (from 30 to 43)

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interesting all titles. Tab. 2 shows the comparison between the glossary MPAR in force and MPAR updating.

The integration can be divided into two categories: the first one includes the articles that are totally new; indeed, this subject is not including in the recent MPARs. The second category complies the "Isola dell'Asinara" Regulation in force with recently MPARs. In particular, article 4 "Biodiversity protection", article 5 "Land protection", article 9 "Inter-institutional collaboration", article 38 "Risk assessment" are included under the first category and article 43 "Referral rules". Article 4 is related to conservation action by SIEA Project and N2K sites, emphasize the protection measures of the Regulation in order to improve the conservation performance management. Article 5 meets the needs of the SIEA Project and environmental analysis on soil protection. Article 9 introduces the cooperation concept according to the ICZM Protocol targets. The article 38, according to the N2K direction, integrated the prevention, mitigation, and adaptation concepts in order to limit the consequences of environmental emergencies. The article 43 stems to avoid a regulatory gap. On the contrary, following articles are included under the second category: articles 11 "Regulation of Maritime domain", article 12 " Regulation of Posidonia banquette", article 13 "Regulation of waste water drains", article 20 "Regulation of sea-watching activities", article 25 "Regulation of rental, lease or occasional rental of boating activities", article 26 "Regulation of whale-watching activities", article 30 "Regulation of sport, play, recreation events", article 31 " Regulation of educational and naturalistic divulgation activities". In particular, article 11 meets the needs of ICZM Protocol and conservation action by N2K sites. Article 12 introduces the concept of policy management in order to promote the benefice from Posidonia. Article 13 addresses the problem of waste complying in the SIEA Project and N2K requirements. Article 20 defines, according to the conservation measures by N2K, the policy management to avoid negative impacts resulting from Sea-watching activities. In particular, article 21 and 25 complies recently MPARs concerning pleasure boating activities. Article 26 define measures for cetacean protection according to the N2K sites actions and the SIEA Project. Article 30 and 31 meets the needs of environmental analysis in order to reduce human pressures.

5 DISCUSSION AND CONCLUSIONS

The outcomes of the Protocol allow for the objective proposed in the introductory section to be achieved. The innovative and multidisciplinary approach proposed has allowed the research group to overcome the current fragmented management territory and to define a new paradigm to create integrated environment policies.

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CURRENT MPAR	PROPOSAL TO UPDATE THE RMPA
Title I **General provisions**	**Title I** **General provisions**
Article 1 *Application*	Article 1 *Application*
Article 2 *Definitions*	Article 2 *Definitions*
Article 3 *Aims, boundaries and not permitted activities in the Marine Protected Area*	Article 3 *Aims, boundaries and not permitted activities in the Marine Protected Area*
	Article 4 *Biodiversity protection*
	Article 5 *Coastal areas protection*
Title II **Organization of Marine Protected Area**	**Title II** **Organization of Marine Protected Area**
Article 4 *Management of Marine Protected Area*	Article 6 *Management of Marine Protected Area*
Article 5 *Authority responsible for the Marine Protected Area*	Article 7 *Authority responsible for the Marine Protected Area*
Article 6 *Reserve commission*	Article 8 *Reserve commission*
	Article 9 *Inter-institutional collaboration*
Title III **Specific provisions and conditions for permitted** **activities**	**Title III** **Specific provisions and conditions for permitted** **Activities**
Article 7 *Zoning and activities permitted in the different zones of the Marine Protected Area*	Article 10 *Zoning and activities permitted in the different zones of the Marine Protected Area*
	Article 11 *State-owned marine areas*
	Article 12 *Posidonia oceanica*
	Article 13 *Water and waste discharges*
Article 8 Relief and surveillance activities	Article 14 Relief and surveillance activities
Article 9 *Scientific research activities*	Article 15 *Scientific research activities*
Article 10 *Professional photographic, cinematographic and television shooting*	Article 16 *Professional photographic, cinematographic and television shooting*
Article 11 *Bathing activities*	Article 17 *Bathing activities*
Article 12 *Scuba diving and freediving*	Article 18 *Scuba diving and freediving*
Article 13 *Underwater guided tour and diving instructions*	Article 19 *Underwater guided tour and diving instructions*
	Article 20 *Sea-watching activities*
Article 14 *Recreational boating*	Article 21 *Recreational boating*
Article 15 *Mooring activities*	Article 22 *Mooring activities*
Article 16 *Anchoring activities*	Article 23 *Anchoring activities*
Article 17 *Passenger transport, sailing charter and guided tour*	Article 24 *Passenger transport, sailing charter and guided tour*
	Article 25 *Pleasure boats rental*
	Article 26 *Whale-watching activities*
Article 18 *Professional fishing activities*	Article 27 *Professional fishing activities*

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Article 19 *Sport fishing*	Article 28 *Sport fishing*
Article 20 *Recreational fishing activities*	Article 29 *Recreational fishing activities*
	Article 30 *Sport and recreational events*
	Article 31 *Education and information activities*
Title IV **Provisions for authorizatization procedures**	**Title IV** **Provisions for authorizatization procedures**
Article 21 *Application*	Article 32 *Application*
Article 22 *Application for authorization*	Article 33 *Application for authorization*
Article 23 *Mandatory documents*	Article 34 *Mandatory documents*
Article 24 *Procedure for examining the applications for authorization*	Article 35 *Procedure for examining the applications for authorization*
Article 25 *Criteria for assessing the applications for authorization*	Article 36 *Criteria for assessing the applications for authorization*
Article 26 *Autorizzation and administrative fee*	Article 37 *Autorizzation and administrative fee*
TITOLO IV **Final provisions**	**Title IV** **Final provisions**
	Article 38 *Risk assessment*
Article 27 *Monitoring and updating*	Article 39 *Monitoring and updating*
Article 28 *Surveillance*	Article 40 *Surveillance*
Article 29 *Publicity*	Article 41 *Publicity*
Article 30 *Penalties*	Article 42 *Penalties*
	Article 43 *Referral rules*

Tab. 2 Comparison between current MPAR and proposal to update the MPAR

In a fragile context such as coastal and marine, the empirical approach of the protocol allows a balance to be found between environmental protection and social-economic impacts. In addition to the fragmentation, a range of critical aspects of the current process of drawing up Regulations and Plans in the coastal marine areas have emerged. The first criticality is due to the overlapping of skills. In particular, this applies to the RAMPs approved by the MATTM and the MPAs for the N2K sites which are drawn up by the municipalities and approved by the regions. In this framework, the protocol aims to integrate the different policies and recommendations and overcome the gap due to the overlapping of skills. In particular, one of the merits of this experimental procedure is the cooperation process between the different entities in charge and stakeholders. The second criticality is the lack of a system of operational objectives that allow defining actions to deal with the environmental and socio-economic territory problems. This criticality of the RMPs is covered by Annual Regulations which lay down detailed rules and conditions for exercising the activities currently permitted in the AMP. In this framework, the protocol does not completely overcome this gap. In other words, due to the complexity or nature of some

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subjects, it is particularly appropriate to tackle them in the Annual Regulations. According to the European Directive 2001/42/EC, the SEA shall be applied to plans and programs which are likely to have significant environmental effects. For this reason, for the update of the MPAR the EP was used. This protocol is inspired by the principles and methodology of the SEA in order to include environment objectives in the decision making.

The environmental objectives, the objectives of the second level, the specific objectives and actions defined in order to update the MPAR were outlined in the LF. An important implication of the results of this empirical procedure for future research could be the definition of the guidelines. For example, the systematic application of the EP could change the regulation and planning of the protected areas. In particular, this concerns the areas characterized by the overlapping of different regulatory regimes which are characterized by multiple management instruments. This application could optimize the biodiversity value and foster development of sustainable tourism, with significant benefits for both human well-being and economic output.

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AUTHOR'S PROFILE

Maddalena Floris, graduated in Architecture at the University of Cagliari, Italy (2013). She is currently a graduate student in the doctoral program in Civil Engineering and Architecture at the University of Cagliari. Her research areas are sustainable urban and regional planning, and environmental policy-making.

Federica Isola, building engineer, is Research Doctor in Environmental Sciences and Engineering (Italy, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Cheti Pira, environmental engineer, is Research Doctor in Land Engineering (Italy, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

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MARINE FORESTS (FUCALES, OCHROPHYTA) IN A LOW IMPACTED MEDITERRANEAN COASTAL AREA: CURRENT KNOWLEDGE AND FUTURE PERSPECTIVES

***DANIELE GRECH[a], LUCA FALLATI[b]**
SIMONE FARINA[a]

[a] IMC - International Marine Centre, Italy
e-mail: d.grech@fondazioneimc.it
URL: https://www.fondazioneimc.it/

[b] Department of Earth and Environmental Sciences - DISAT
Università degli Studi di Milano-Bicocca, Italy
e-mail: l.fallati@campus.unimib.it

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ABSTRACT

Mediterranean seascapes are currently facing massive changes, with the disappearance of sensitive species responding to local anthropogenic disturbances and global climate changes. Mapping and monitoring of marine habitats are crucial tools for highlighting the occurrence of community shift that should be taken into account in coastal management and the implementation of conservation measures. Proper reference baselines are generally lacking, especially for marine forests of brown macroalgae (Fucales, Ochrophyta). They are considered among the most important marine ecosystem-engineers, forming extended stands comparable to land forests. They increase three-dimensional complexity and spatial heterogeneity of rocky bottoms, thus providing directly or indirectly substrate, refuge, shelter and food for a lot of animal and plant species at different life history stages. Despite their ecological importance, sensitiveness to anthropogenic disturbances and conservation interest, in the Sinis Peninsula (Western Sardinia, Italy), Fucales are historically understudied compared to other Mediterranean areas. A review of historical records and current research has been performed in order to shed light on the gaps in our knowledge and to discuss future possibilities for their management and conservation.

KEYWORDS
Sinis Peninsula (Sardinia, Italy); Cystoseira; Habitat Conservation; Coastal Ecosystems; Cutting-edge Technology

* The other authors are: David Cabana, Ivan Guala.

1 INTRODUCTION

In the last decades, Mediterranean seascapes have faced massive changes. Responding to local anthropogenic disturbances and global climate changes, many sensitive species are in decline throughout the basin with some reported cases of local extinction (Thibaut et al., 2015 and references therein). Mapping and monitoring of marine habitats are crucial tools for highlighting the occurring community shift and should be taken into account in coastal management and for the implementation of conservation measures. The lack of proper reference baselines in marine ecosystems is rather common and generally leads to the so called 'Shifting Baseline Syndrome' (Pauly, 1995) which is hampering the proper assessment of the status of an ecosystem. In vegetated sub-littoral systems, the best-known dramatic change is the shift from complex, three-dimensional forests of brown macroalgae (Fucales, Ochrophyta) to turf species. Fucales are considered among the most important marine ecosystem-engineers, forming extended stands comparable to land forests, increasing three-dimensional complexity and spatial heterogeneity of rocky bottoms, thus providing substrate for many other algae and refuge, shelter and food for a lot of species at different life history stages. Reference baselines of marine forests have been described along the most frequented and investigated study areas of the Mediterranean Sea, where the first marine biological stations were located (Ercegovic, 1952; Funk, 1927, 1955; Sauvageau, 1912). Conversely, suitable studies on marine macroalgae in remote areas (or those not easily accessible from the mainland), have been historically complex or absent. This is the case of the Sinis Peninsula, located along the western coast of Sardinia (Italy), an area historically far from both mainstream access and the scientific community. Thus, this area is rarely taken into account by phycological research. At the beginning of the 1900s, the entire Sardinian population was comparable to that of Naples (Italy) (among the biggest cities in Europe, with 600,000 inhabitants). Here the Prussian Zoologist Felix Anton Dohrn founded the visionary project of the 'Stazione Zoologica di Napoli' in 1872. This is a marine station which has hosted thousands of international researchers since its institution. In the following years, other marine stations (i.e. in Banyuls, Roscoff, Endoume, Split, and Rovinj) would be settled close to populated coastlines, where many researchers worked year after year in the continuous study of marine algal flora and fauna. The algal vegetation of the Western Mediterranean was initially studied by dredging near these marine biology research centers. These studies built important baselines for marine ecology, allowing in recent times for the comparison of historical records with current ones and evidencing the abrupt changes (Grech, 2017; Thibaut et al., 2015).

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The Sinis Peninsula is currently one of the less densely populated coastal area of Sardinia. Because of the non-negligible pressure of fisheries (Vandeperre et al., 2008), it cannot be considered a pristine area. However, it could be assumed to be low impacted seascape, at least for benthic communities of the intertidal zone. Here, in 1988, the International Marine Centre (IMC) was founded in Torregrande (Oristano, Italy). The aim of this study is to review all the past records concerning the marine forests and to summarize recent findings and achievements. Given the presence of the 'Penisola del Sinis - Isola di Mal di Ventre' Marine Protected Area (MPA), these findings should serve as baseline for future management and conservation perspectives of these communities.

2 METHODOLOGY

A review on *Cystoseira* and *Sargassum* has been conducted for the Sinis Peninsula and the Gulf of Oristano. A frequent problem while studying fucalean forests is the lack of data with enough taxonomic resolution. Therefore, also grey literature as well as peer-reviewed journals was considered for this study. Records have been collected and a geodatabase has been developed (including all the historical and current information) on the basis of past experience of FuCart DB (Fucales Cartography DataBase; Grech, 2017).

3 RESULTS

The first historical records of marine forests in Sardinia are relatively few and sparse, consisting of algal lists (Barbey, 1884). Here, the record of *C. amentacea* in Capo Mannu is the oldest one for the study area. Other historical records for the Sinis Peninsula were published more than 100 years later and are spotted (Cossu et al., 1992; Gueneau et al., 1992; Sales, 2010) with some of them doubtful. Cossu et al., (1992) reported 18 fucalean species (15 *Cystoseira* spp. and 3 *Sargassum* spp.) in Sardinia. Cormaci et al., (2005) afterwards reported the rare *C. squarrosa* in Castelsardo (Northern Sardinia) that is the only place in the Western Mediterranean Sea (another one is in Sicily) where populations of this species are known to occur. In the study area, *C. barbata* was reported by Addis et al., (2004) and Casu et al., (2006) in 'Penisola del Sinis - Isola di Mal di Ventre' MPA. Nonetheless, based on this study we contemplate the possibility that this may be a misidentification of a late summer habitus of *C. amentacea*, which is rather abundant in the area. This uncertainty about the records is also exacerbated by the lack of abundant Herbaria vouchers and samples collection of the area, and by a lack of clear and unequivocal reported sites of presence (GPS coordinates, pictures in references) that could be examined and resurveyed by specialists after decades, i.e. as was properly done by

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Cormaci et al., (2005). Moreover, if C*. barbata* is present in the study area it is considered rare, since we have only collected stranded specimens until now in two sites in the Gulf of Oristano (Mare Morto and Mistras). The most likely source of this species is close to the mouth of the wetland system in the gulf. However, we cannot exclude surface drifting of detached thallus from sites outside the study area. *C. foeniculacea* and *C. compressa* have also been reported in the lagoons of Santa Giusta (Magni et al., 2008) and Curru de S'Ittiri (Provincia di Oristano, 2013), respectively. Their occurrence should be confirmed and checked along the complex wetland systems. The only proper reference baseline of this study area (concerning upper sublittoral species) is the cartography of littoral and upper-sublittoral rocky-shore communities, performed by applying the CARLIT method in 2008 (Guala et al., 2010). Although it is not entirely appropriate to consider this work as a historical baseline, it represents the starting point for our studies, at least for the upper subtidal species. In addition, some punctual records on the lower subtidal species have been reported by ENEA (1990), in the framework of the feasibility study of "Penisola del Sinis - Isola Mal di Ventre" MPA. Nevertheless, it is worth stressing that after Guala et al., (2010), no other studies were performed in the area. Recently, within the GIREPAM project (Integrated Management of Ecological Networks through Parks and Marine Areas, Programme Interreg Maritime Italy-France 2014-20, http://interreg-maritime.eu/), surveys on habitats 1120 (Posidonia beds) and 1170 (Reefs) have been carried out in the MPA to assess possible disturbances from anthropic activities and to define management guidelines. These activities lead to the re-implementation of the CARLIT method during the year 2018 (Grech et al., 2019) and confirmed the high stability of the index after 10 years, testifying even today by a high ecological quality of the upper sublittoral habitats of the Sinis Peninsula, with continuous lush forests of the most sensitive species *C. amentacea* and *C. crinita*. As an integration of the CARLIT index, Unmanned Aerial Vehicles (UAVs) were tested in 2018 (Grech et al., 2019) to map the shallow communities and to compute *Cystoseira* species coverage along the study area.

All the information reviewed and recent achievements are represented in Fig. 1. Moreover, detailed surveys have recently been conducted and the distribution of rare species such as *C. algeriensis* has been mapped extensively along the coastline. Additionally, recently new records have been reported (Grech, 2019). On the basis of this review, along the Sinis Peninsula, 8 *taxa* of *Cystoseira* have been reported in the upper sublittoral fringe, namely: *C. algeriensis*, *C. amentacea*, *C. barbata* (stranded), *C. brachycarpa*, *C. compressa* var. *compressa*, *C. compressa* var. *pustulata*, *C. crinita*, *C.* sp.. Below the water mark 7 *taxa* are reported: *C. algeriensis, C. brachycarpa*, *C. crinita*, *C. foeniculacea*, *C. montagnei*, *C. usneoides*, *C. zosteroides*. Overall, 12 *taxa* occur, 4 of them are Mediterranean endemism.

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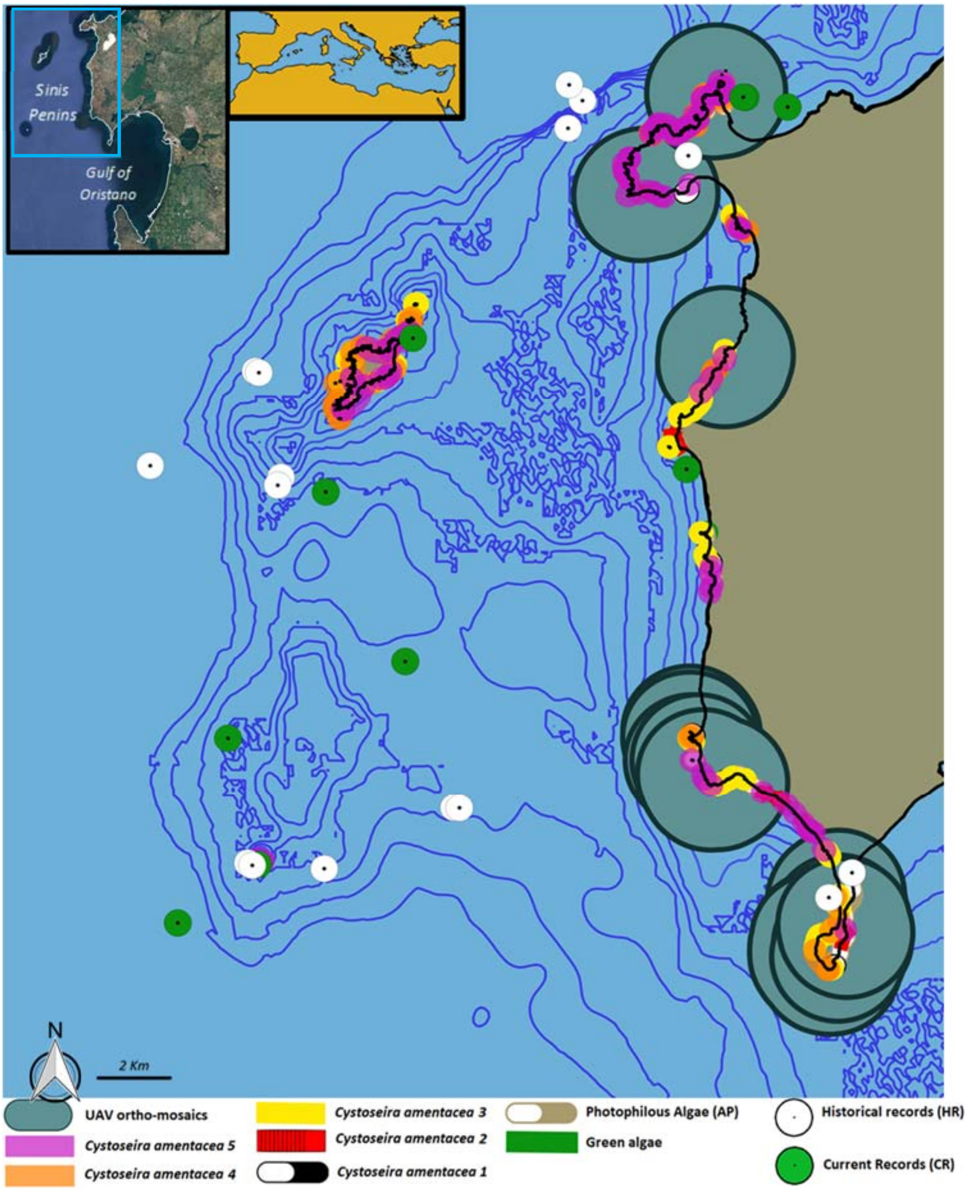

Fig. 1 Marine Forests of the study area. Bathymetry up to a depth of 45 m is represented on the map, with a step of 5 meters (Brambilla et al., 2019). Methodological CARLIT communities (e.g. *C. amentacea* 5 to 1) are based on Guala et al., (2010)

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Further study on marine forests is currently underway within the project 'Amelioration by Benthic habitat-formers under Climate Change' (ABC^2; Bulleri et al., 2018) in order to understand the extent to which marine belts and forests can reduce environmental stress, regulate and maintain associated benthic assemblages, through the establishment of a network of experimental setups along Mediterranean and Atlantic coasts of Europe (Bulleri et al., 2018). Data logging is currently in progress (Fig. 2).

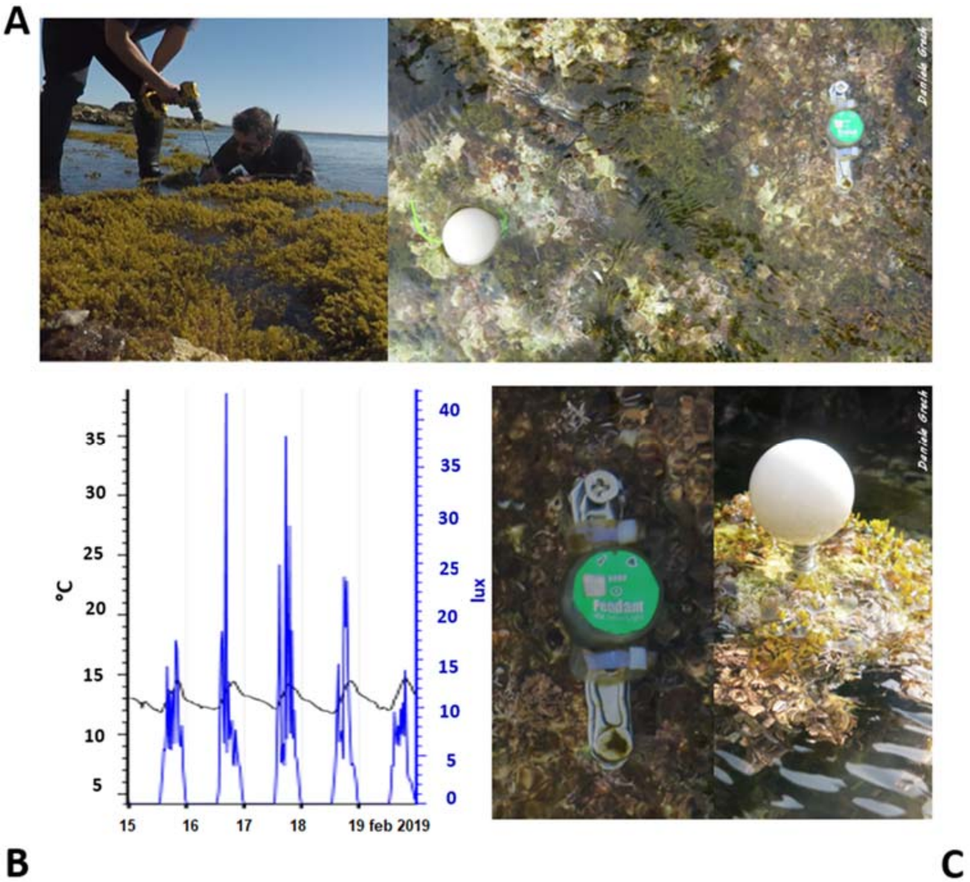

Fig. 2. Amelioration by Benthic habitat-formers under Climate Change (ABC^2) set-up (A), Temperature/Light logging data (B) detail of Hobo data logger and plaster clods for water motion assessment (C)

4 DISCUSSION

Although most marine forests are under protection within the framework of international agreements (Berne Convention, 1979, Barcelona Convention, 1995; Habitats Directive,

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1992) fucalean species are currently not effectively protected on a Mediterranean scale, not even within marine reserve zones. Moreover, there is a lack of knowledge about their distribution, due to the paucity of continuous and widespread data. This contribution sheds light on the marine forests of the Sinis Peninsula and the Gulf of Oristano. Here, the upper subtidal species do not seem to be threatened by local stressors, although some of them (e.g. human trampling) may be increasing in recent years and should be quantified in future. The deep species, on the other hand, are quite vulnerable to fisheries: the branched species can be detached by fishing gears (i.e. trammel nets) that could be one of the main factors of decline (Grech, 2017; Thibaut et al., 2015). The study area, although scarcely studied from an algological point of view, is characterized by a high biodiversity of marine forest (Grech et al., 2019) and deserves further study. Deep species distribution data is lacking in the study areas as in most of the deep Mediterranean habitats (Ballesteros et al., 2009; Capdevila et al., 2016). Moreover, there is paucity of information on how climate change could potentially affect marine forests and how they can cope with these stressors. Recent studies suggested that climate change could influence some critical steps of their life cycle and a create susceptibility of marine forests to climate change, forecasting that up to 94% of originally suitable areas could be lost (Buonomo et al., 2017). Marine forests display clear signs of regression that are still not clearly understood across their distribution range (Thibaut et al., 2015). The risk of losing these forests before gaining awareness about them and their extension is high. There is an urgent need for a detailed mapping all along the Mediterranean Sea. The putatively low local human impact in the study area makes the Sinis Peninsula the ideal candidate to represent a natural laboratory for testing the response of marine forests facing climate change. Therefore, the current research addressed at improving knowledge of distribution, extent, status of these forests and the environmental variables (e.g. temperature, light, water motion) affected by climate change, is crucial. The area, with its high abundance of very sensitive species, can be useful for the scientific community as a source of reproductive stages for *in situ* and *ex situ* pilot restoration projects of degraded habitats, which are recently becoming more common along the Mediterranean Sea (Falace et al., 2018). In-depth knowledge of natural systems and increased awareness of the ecosystem services they provide are crucial for an effective integrated management of coastal and marine areas aimed at reducing biodiversity loss and ecosystem degradation. As for marine forests, an effective tool can be represented by dissemination and outreach activities through participatory methodologies, e.g. Citizen Science projects (Grech & Buia, 2017) aimed at marine forest reporting (https://www.facebook.com/ProgettoFucales/; http://www.progetto-fucales.it/) and/or to their decline. Reconstructing historical baselines engaging citizens through Local Ecological

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Knowledge (LEK) and Citizen Science is feasible in highly populated zones (i.e. Grech & Buia, 2017) with many stakeholders (e.g. the sharing of old and current photos from underwater photographers), strongly engaged with marine research institute activities. In the context of Sardinia, this approach is still in its infancy and seems complex at the moment, especially because the area is scarcely populated, with relatively low touristic influx and fishermen are generally not prone to collaboration and cooperation.

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AUTHORS' PROFILES

Daniele Grech is a marine biologist and environmental researcher focused on coastal ecology, in the fields of research and monitoring of Mediterranean priority habitats (Posidonia oceanica, Coralligenous assemblage, Fucales marine forests). At present, he has been involved in a range of projects aiming to assess the conservation of marine ecosystems and the management of marine resources through direct in situ observation and cartographic tools, with emphasis on not destructive sampling methods. He also has experience in fishing technology (by-catch assessment, turtle excluder devices – TEDs) and artificial barrier monitoring. He is currently working as a research fellow at the IMC - International Marine Centre, Oristano (Italy) on the conservation of coastal ecosystems and the management of marine bio-resources with expertise in macroalgae, invertebrates, fish identification and ecology.

Luca Fallati is a PhD student at Università degli Studi di Milano-Bicocca - Department of Earth and Environmental Sciences - DISAT, Italy. He uses remote sensing techniques, including Unmanned Aerial Vehicles (drones), photogrammetric techniques and GIS technology for the mapping of benthic systems and environmental and land-use management.

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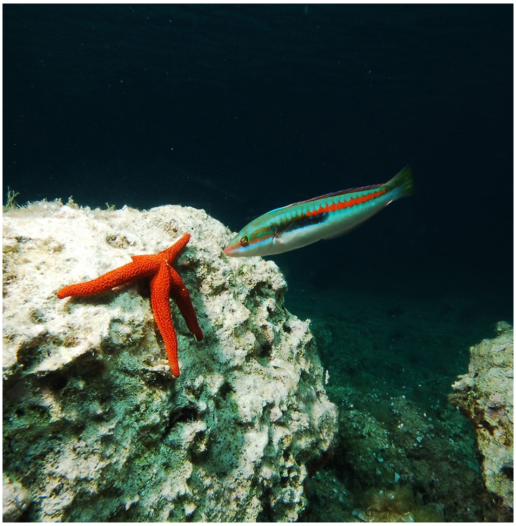

+ASSESSING THE POTENTIAL MARINE NATURA 2000 SITES TO PRODUCE ECOSYSTEM-WIDE EFFECTS IN ROCKY REEFS: A CASE STUDY FROM SARDINIA ISLAND (ITALY)

***PAOLO GUIDETTI[a], PIERANTONIO ADDIS[b]**
FABRIZIO ATZORI[c]

[a] Université Côte d'Azur, CNRS, France
e-mail: guidetti@unice.fr

[b] Dipartimento di Scienze della Vita e dell'Ambiente, University of Cagliari, Italy

[c] Marine Protected Area "Capo Carbonara", Italy

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ABSTRACT
Sustainability poses several important questions concerning the knowledge and interpretation of the coastal area. This means that management and planning instruments are required in order to balance trade-offs between environmental conservation and economy grow. The use and protection of the coastal areas have a dual relationship: the use has an environmental impact on the coastal system and the protection limits the coastal system use. Therefore, the environmental systems need conceptual models which are able to join the ecological sensitivity with the anthropic pressure. The methodological approach proposed here aims to provide the definition of an experimental protocol in order to integrate the protection and the management plans for coastal natural heritage. This study describes the results of the research experiments carried out on the experimental protocol application for developing the Marine Protected Area Regulations of the "Isola dell'Asinara" and "Tavolara - Punta Coda Cavallo". This planning approach should support the integration of decision-making procedures to achieve inclusiveness, interactivity, and repeatability of the planning processes.

KEYWORDS
Integrated Management; Natura 2000 Sites; Marine Protected Areas; Planning

* The other authors are: Simona Bussotti; Antonio Calò; Alessandro Cau; Jean-Michel Culioli; Giuseppe De Lucia; Antonio Di Franco; Manfredi Di Lorenzo; Maria Cristina Follesa; Vittorio Gazale; Giorgio Massaro; Francesco Mura; Augusto Navone; David Pala; Pier Augusto Panzalis; Antonio Pusceddu; Alberto Ruiu; Angelo Cau.

1 INTRODUCTION

A considerable body of literature published in the last decades has reported an alarming decline of marine biodiversity worldwide (MEA, 2005; McCauley et al. 2015; Worm et al., 2006). Future scenarios appear quite negative as well, especially in coastal areas, as a consequence of multiple and unsustainable human activities and multiple additional stressors responsible for current ocean degradation (Bopp et al., 2013; Halpern et al., 2008, 2015; Micheli et al., 2013; Worm et al., 2006). Within this negative picture, countries worldwide are becoming increasingly aware of the fact that the mankind holds the power to reverse this negative trend (Guidetti & Danovaro, 2018). Multiple scale actions as well as inter-sectoral and international cooperation, accompanied by the adoption of an ecosystem approach, are thus more and more recommended (Douvere & Ehler, 2009; Guidetti & Danovaro, 2018). Pairing large-scale initiatives (e.g. the transnational implementation of SDG, Sustainable Development Goals, targets; see https://oceanconference.un.org/call-foraction) and regional-local actions (e.g. the creation of effective networks of Marine Protected Area) seems to be the most effective strategy to reverse the ongoing ocean health decline. Marine Protected Areas (MPAs) have been proven to be a valuable tool capable of alleviating the impact of a number of anthropogenic stressors at sea. They can be effective at local and large scales (in the case MPAs are structured in effective networks), and capable of delivering many ecological effects and socio-economic benefits (Gaines et al., 2010; Giakoumi et al., 2017; Sumaila et al., 2000; Sala et al., 2013). In the last decades the number of MPAs – considering all types of MPAs – has considerably increased worldwide (Lubchenco & Grorud-Colvert, 2015). Natura 2000 sites (hereinafter Nat2000) are the core of the biodiversity conservation strategy of the EU (Evans, 2012). They are based on the Habitats and Birds Directives (EC, 1992; EC, 2009) and they do not usually include strictly protected zones (e.g. no-take areas). Their main aim is to regulate and manage human activities in order to protect core breeding and resting sites for rare and threatened species, and some specific and fragile habitats (http://ec.europa.eu/environment/nature/natura2000/index_en.htm). Considering the EU marine waters, the 28 EU state members have until now declared >3,000 marine Nat2000 sites, covering >30,000 km2 and representing the largest coordinated system of MPAs in the world (http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm). Besides the formal framework, nevertheless, marine Nat2000 sites are more and more the object of critical voices that 1) question their actual role and effectiveness in protecting marine biodiversity, and 2) suggest the need for a proper integration into the wider conservation and environmental EU and international policies. Meinesz and Blanfuné (2015), for instance,

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reported that Nat2000 sites along the Mediterranean French coasts do not include any regulation of fishing activities potentially impacting marine coastal biodiversity, or any specific regulation regarding the protection of a species or biotope, except for the seagrass *Posidonia oceanica*. The same authors (Meinesz & Blanfuné 2015) stated that P. oceanica is in any case already and may be better protected thanks to a national law, both within and outside Nat2000 sites. Mazaris et al. (2017), also, reported that the Nat2000 system substantially fails to meet several CBD (Convention on Biological Diversity, 2011) targets: the relative percentage of marine surface covered is extremely variable among member states, deep/offshore marine ecosystems are underrepresented, and ecological connectivity is not guaranteed at all. Also, <40% of Nat2000 sites have a management plan and shared Nat2000 sites between member states are limited (Mazaris et al., 2017). Finally, in spite of the evident implications related to the implementation of the Nat2000 sites for fisheries (Pedersen et al., 2009), the initiatives to develop fisheries management measures in Nat2000 sites are quite rare. These elements are in clear contrast with the more and more evident ambition of the Commission for larger scopes of the Nat2000 system, beyond the Birds and Habitats Directives (Fock, 2011). Nowadays, for the reasons exposed above, marine Nat2000 sites do not seem to have the potential to effectively contribute to the ecosystem-wide marine protection policy of the EU, to properly integrate e.g. the Marine Strategy Framework Directive (MSFD) and Common Fishery Policy (CFP) objectives, or the CBD targets. Until now, a number of studies have been published on marine Nat2000 sites (Mazaris et al., 2017; Pedersen et al., 2009). However, their effectiveness in preserving and/or restoring marine biodiversity has never been investigated. Going beyond the Habitat and Birds Directives and having in mind the possibility to re-think and widen the scope of marine Nat2000 sites within the wider international conservation policy framework, it is crucial and timely to better understand whether or not marine Nat2000 sites can contribute to ecosystem-wide conservation.

In the marine context, fish assemblages have been largely used as indicators of ecosystem health (being linked to the provision of crucial ecosystem goods and services; Leenhardt et al., 2015; Micheli et al., 2004; Pauly et al., 1998) and for evaluating the effectiveness of any type of MPA, for a number of reasons: i) fish can be easily assessed using non-destructive methods (Caldwell et al., 2016; Harmelin-Vivien et al., 1985); ii) fish clearly respond to the implementation of protection measures (Giakoumi et al., 2017; Guidetti et al., 2008; Guidetti et al., 2014); iii) fish are effective indicators of socio-economic MPA benefits, e.g. those related to fisheries (Di Franco et al., 2016; Gill et al., 2017; Kerwath et al., 2013; Sala et al., 2016). Being the EU waters subjected to multiple anthropogenic sources of stress and impacts capable of producing ecosystem-wide alterations (Coll et al., 2012; Fenberg et al.,

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2012; Katsanevakis et al., 2015; Micheli et al., 2013;), it becomes urgent to know whether marine Nat2000 sites, in combination with other EU or national initiatives (e.g. MSFD, CFP, nationally established MPAs), have the potential to provide an adequate protection to natural marine assemblages and ecosystems, while safeguarding the sustainability of fisheries and other human activities. The present study, therefore, aims at evaluating the potential of marine Nat2000 along the coasts of Sardinia Island (Mediterranean Sea, Italy), used here as a case study area, in contributing to ecosystem-wide conservation targets beyond those established by the Habitat and Birds Directives.

Considering the pivotal and ecosystem-wide roles of fish, this was done by assessing and comparing the status of coastal fish assemblages in fully protected (i.e. no-take) national MPAs, in Nat2000 sites and in adjacent control (unprotected) stations.

2 MATERIALS AND METHODS

2.1 SAMPLING AREA E METHODS

Fish assemblages were assessed at 18 locations situated along the coasts of Sardinia Island (Italy; Mediterranean Sea; Fig. 1). Each location included two protected and two unprotected control stations. Protected stations are included in six fully protected (i.e. no-take) nationally established MPAs, and 12 marine Nat2000 sites (Fig. 1). Control (unprotected) stations are open to fishing (regulated by national/regional laws) and adjacent to each FP-MPA or Nat2000 site. With "Nat2000" we mean here Nat2000 sites that do not overlap with other MPA types. On the whole, a total of 72 stations have been surveyed. At each station 3 fish visual assessments were performed underwater on rocky reefs at 5-12 m depth, along strip transects of 25×5 m, for a total of 216 visual censuses (i.e. replicates). Sampling was done between mid-June and mid-August 2016 for most locations. Data from the Maddalena, Capo Caccia and Asinara MPAs were gathered in August-September 2011, 2015 and 2017, respectively. Visual census were performed on rocky substrates where other substrate types, like sand or seagrasses, represented less than 15% in cover (both within and around transects). Along each transect, the diver swam one way at constant speed (approximately 4 meters/min.), identifying, recording the number and estimating the size of all fish encountered. Fish density was estimated by counting single specimens to a maximum of ten individuals, whereas classes of abundance (11–30, 31–50, 51–100, 101–200, 201–500, >500 individuals) were used for larger schools. Fish size (total length: TL) was recorded within 2-cm size classes for most of the species, and within 5-cm size classes for large-sized species such as the dusky grouper Epinephelus marginatus.

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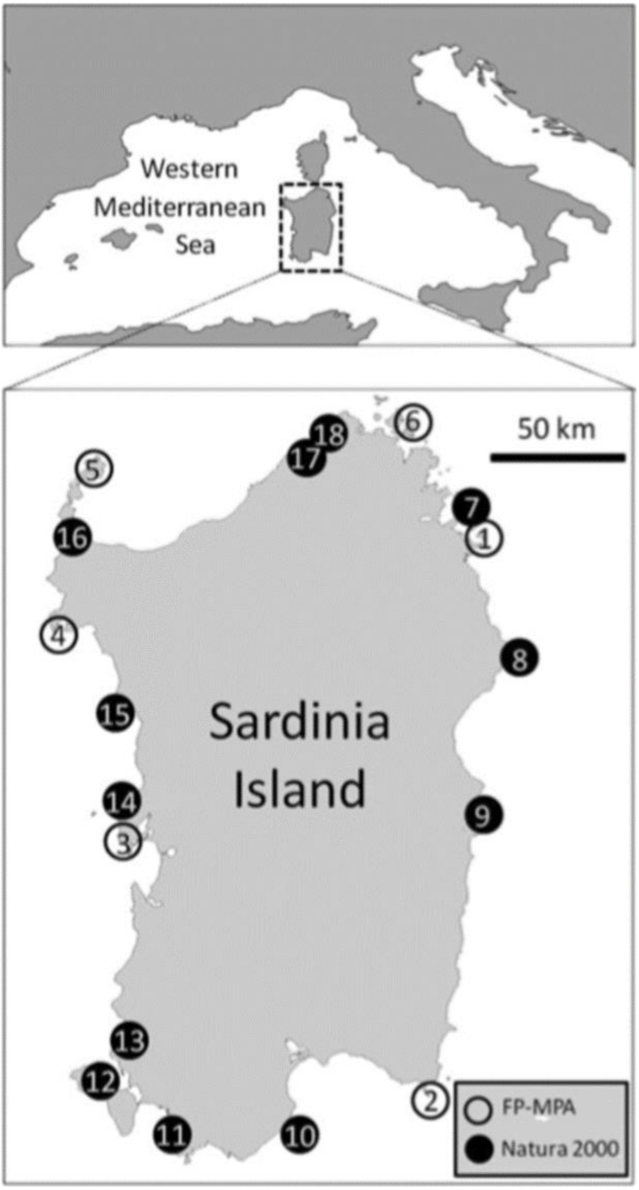

Fig. 1 Locations around Sardinia Island of the six fully protected marine protected areas (FP-MPAs) and 12 marine Natura 2000 sites sampled in this study. FP-MPA sites: (1) 'Tavolara-Punta Coda Cavallo'; (2) 'Capo Carbonara'; (3) 'Penisola del Sinis–Isola di Mal di Ventre'; (4) 'Capo Caccia–Isola Piana'; (5) 'Isola dell'Asinara'; (6) 'Parco Nazionale dell'Arcipelago di La Maddalena'. Marine Natura 2000 sites: (7) 'Capo Figari ed Isola Figarolo'; (8) 'Berchida e Bidderosa'; (9) 'Golfo di Orosei'; (10) 'Capo di Pula'; (11) 'Promontorio, dune e zona umida di Porto Pino'; (12) 'Isola di San Pietro'; (13) 'Costa di Nebida'; (14) 'Stagno di Putzu Idu'; (15) 'Entroterra e zona costiera tra Bosa, Capo Marangiu e PortoTangone'; (16) 'Coste e Isolette a Nord-Ovest della Sardegna'; (17) 'Monte Russu'; (18) 'CapoTesta'

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Fish wet mass (hereafter called biomass) was estimated from size data by means of length-weight relationships from the available literature (Froese & Pauly, 2012). We focused on biomass data of fish associated with rocky reefs because: (1) fish biomass is recognized as the most responsive indicator of the conservation status of fish assemblages as it inherently integrates both density and size (Guidetti et al., 2014; Sandin et al. 2008); (2) rocky reefs are the most common habitat protected within coastal MPAs in the Mediterranean Sea; (3) previous studies showed that rocky reefs host the most of fish targeted by fishing and therefore these fish assemblages more clearly respond to protection from fishing than others (Guidetti et al., 2008).

2.2 DATA ANALYSES

The effects of different protection levels on fish biomass variables were analyzed using univariate techniques. 'Protection' (PR) was considered as a fixed factor (with 3 levels: FP-MPA, Nat2000, unprotected control), and 'Station' (ST) was a random factor (2 levels) nested in each level of PR. The 6 variables taken into consideration are: total fish biomass, that of most relevant categories (High and Low-Null Commercial Importance fishes; indicated hereinafter as H CI and L-N CI, following Guidetti et al., 2014) and that of some fish species ecologically important and targeted by commercial and recreational fishing (the dusky grouper Epinephelus marginatus, the brown meager Sciaena umbra, the sea breams Diplodus spp (Diplodus sargus and D. vulgaris). This selection of relevant variables is in agreement with the available literature about the potential of fishery targeted fishes to respond to the effectiveness of management measures (Guidetti et al., 2014). Univariate PERMANOVA based on Euclidean distance measure (Terlizzi et al., 2007) was used in order to avoid any assumption about the distribution of the variables (Anderson, 2001). In this analysis P-values associated with F statistics are obtained by permutation. The PRIMER 6 and Permanova + B20 package (Plymouth Marine Laboratory) was used to perform the analyses (Clarke & Gorley, 2006). Methods derived from meta-analysis were used to examine and summarize the general response of fish to protection. As visual census were done at several protected (FP-MPA and Nat2000) and unprotected (control) stations, mean values were used to approximate average conditions in space (Guidetti & Sala, 2007). We examined the response to protection on the 6 abovementioned fish biomass variables. We quantified the effects of protection versus control conditions as the natural logarithm of the ratio between the values of each response variable (i.e. total fish biomass) in protected and control conditions (lnRR; Hedges & Olkin, 1985; Micheli et al., 2004). By this approach, the observed effect is independent from the absolute biomass at each location. As estimations of average values can be affected by sampling effort, we calculated weighted means using

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the natural logarithm of the total area covered by the censuses from which the estimates were obtained (Mosquera et al., 2000). Positive RRs indicate greater biomass in protected than in control conditions, whereas negative values indicate greater values in control conditions compared to protected ones. A ratio of zero, instead, means that the biomass is similar between protected and control conditions. Averages of the mean RRs were considered significantly different from zero (i.e. there is a significant protection effect) when the 95% confidence limits around the mean do not overlap with zero (Micheli, 1999).

3 RESULTS

Total fish biomass, that of H CI and L-N CI fishes, and that of target species (E. marginatus, S. umbra, Diplodus spp.) were generally highest in FP-MPAs, followed by Nat2000 sites, and lowest at controls (Fig. 2). Total fish biomass, that of H CI fish, and that of E. marginatus and Diplodus spp. varied significantly between protection levels, whereas biomass of L-N CI fish and S. umbra did not (Tab. 1). More in details, pair-wise post-hoc tests showed that total fish biomass and that of E. marginatus were statistically highest at FP-MPAs, followed by Nat2000, and control sites. Biomass of H CI and Diplodus spp. were significantly higher at FP-MPAs than at Nat2000 and control sites, with no statistical difference between Nat2000 sites and controls. None of the 6 fish biomass variables varied significantly at the spatial scale of stations (Tab. 1).

VARIABLES	PR	ST(PR)	Pairwise tests (PR)
Total biomass	0.004	0.572	FP-MPA > N2000 > C
High commercial importance	0.000	0.800	FP-MPA > N2000 = C
Low-null commercial importance	0.091	0.394	NA
Epinephelus marginatus	0.000	0.985	FP-MPA > N2000 > C
Sciaena umbra	0.278	0.159	NA
Diplodus spp.	0.002	0.620	FP-MPA > N2000 = C

Tab. 1 Summaries of permutational multivariate analyses of variance and pairwise analyses testing for differences among protection levels (PR: Protection, fixed factor, three levels; MPA: fully protected marine protected area; N2000: Natura 2000 site; C: control open to fishing) and over the spatial scale of stations (ST: Station, random factor nested in PR, two levels). NA: not applicable. P-values calculated using Monte Carlo permutations. Values in bold are statistically significant

In terms of lnRR, one important point to stress is the non-negligible variability observed among FP-MPAs and among Nat2000 sites. Just as an example, lnRRs of the total fish biomass greatly varied among FP-MPAs, with even one negative value, while lnRRs calculated for Nat2000 sites were approximately equally distributed around zero (Fig. 3).

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Across all FP-MPAs combined, average lnRRs for all 6 fish biomass variables showed positive values (ranging from 0.6 to 4.8) (Fig. 4).

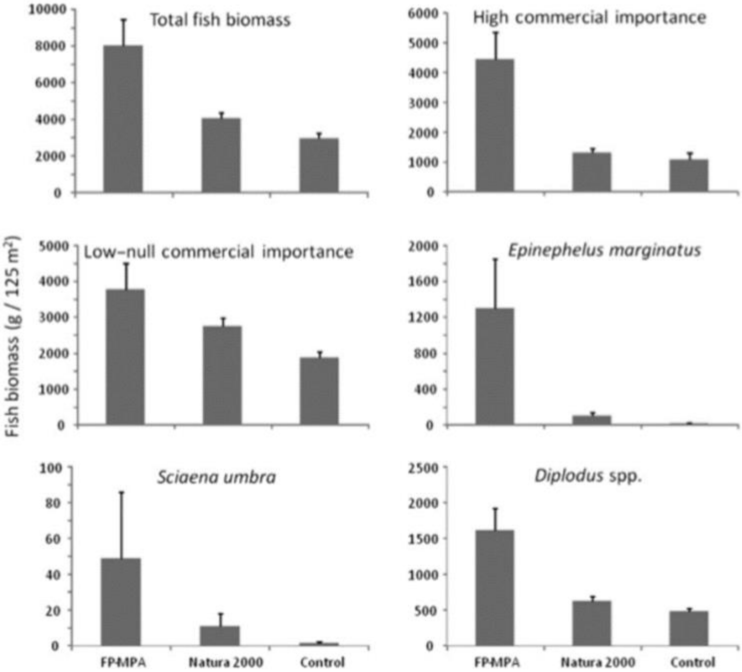

Fig. 2 Fish biomass (mean ± SE) assessed at the sampling stations under different conditions of protection at the fully protected marine protected areas (FP-MPAs) and Natura 2000 sites; control: stations open to fishing

The confidence intervals (95% CI) for all of the 6 variables did not overlap the zero value, which means that differences in fish biomass between protected and unprotected stations were statistically significant. In Nat2000 sites, only the biomass of E. marginatus was significantly higher in compared to control sites (lnRR=2.19±1.76; 95% CI), whereas for the 5 other fish biomass variables, though a general tendency seems to emerge showing larger values in protected than in control stations, the confidence intervals (95% CI) overlap the zero value, indicating no significant effects of protection.

4 DISCUSSION AND CONCLUSION

In this study we compared the biomass of (a) whole fish assemblages, (b) fish of high commercial importance, and (c) a few important target species (the dusky grouper E. marginatus and the sea breams D. sargus and D. vulgaris, with these species playing crucial ecological roles at ecosystem-wide level in Mediterranean rocky reefs) in FP-MPAs, marine

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Nat2000 sites, and unprotected controls around Sardinia. Results show, in short, that (a) Nat2000 sites display a slight but not statistically significant tendency for higher biomass values compared to control sites, and (b) FP-MPAs effectively protect fish assemblages and target species.

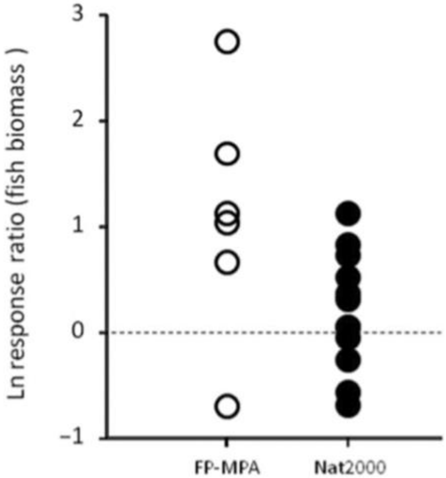

Fig. 3 Variability in the response of total fish biomass (measured as the natural log ratio) observed in the six fully protected marine protected areas (FP-MPAs; represented with empty circles) and 12 Natura 2000 sites (Nat2000; represented with filled black circles) considered in this study, compared with their respective controls (stations open to fishing)

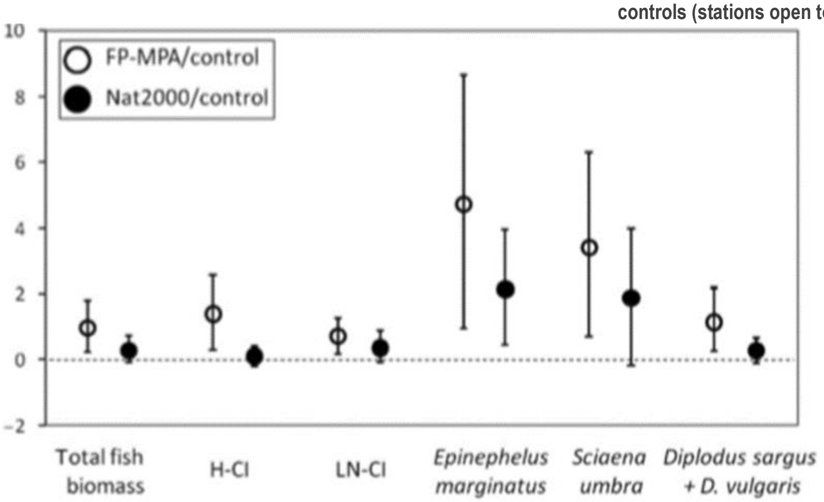

Fig. 4 Fish response to protection of fish biomass, measured as the natural log ratio, observed in the six fully protected marine protected areas (FP-MPAs) and 12 Natura 2000 sites (Nat2000) considered in this study, compared with controls (stations open to fishing). Bars indicate 95% confidence intervals; H-CI: high commercial importance; LN-CI: low–null commercial importance. See Section 2 for more details

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The fact that in the FP-MPAs studied we observed, on average, higher fish biomass than in fished sites is consistent with what is observed in other (enforced) Mediterranean MPAs (Giakoumi et al., 2017; Guidetti et al., 2014; Sala et al., 2012). This means that the management at the MPAs studied in Sardinia is at least sufficient to obtain, on average, measurable effects on fish. Another non-negligible aspect that emerged from this study is the wide variability observed among FP-MPAs. This variability may be the result of multiple local factors, such as, among others, the design, organization, management, rule enforcement, and the time that the different sites have had the protection. Even though the relative effect of each of these factors cannot be distilled based on our data, their (often intermingled) effects have been reported in other studies carried out at the Mediterranean scale (Di Franco et al., 2016; Giakoumi et al., 2017; Guidetti et al., 2008; Sala et al., 2012; Scianna et al., 2018).

Concerning the patterns we observed at marine Nat2000 sites, it is important to stress, as already mentioned in Section 1, that Nat2000 sites do not have 'fish assemblage protection' among their formal objectives. Marine Nat2000 sites are, in fact, established to manage the sources of disturbance possibly impacting species and habitats listed in the Habitat and Birds Directives. Our data suggest that, today, the rules in force at the marine Nat2000 sites investigated in this study do not produce significant effects on fish assemblages and, therefore, do not seem to have the potential to significantly contribute to coastal ecosystem-wide conservation. This statement, however, should not be taken negatively. We do not say here that Nat2000 sites do not work relative to the aims for which they have been established, but that their present mission and objectives (and so the current rules in force) do not allow them to express their potential to significantly contribute to the ecosystem-wide conservation.

In the light of the these issues, it might be of interest to integrate the present objectives of the Nat2000 network with others' ecosystem-wide objectives that are more in phase with more recent and comprehensive EU initiatives, principally the MSFD and the CFP. The main aim of the MSFD is to achieve the so-called 'Good Environmental Status' (GES) in EU marine waters by 2020. The CFP aims at achieving a good status for all commercial stocks exploited in EU waters by 2020. Both MSFD and CFP aim to contribute to achieving GES and fisheries sustainability via an ecosystem-based approach (Garcia et al., 2003), where MPAs (all types) are considered as pivotal tools (Fenberg et al., 2012). To date, any consideration regarding fishing regulations at marine Nat2000 sites has been done taking into consideration their potential impact on species and habitats included in the EU Birds and Habitats Directives. The results of our study highlight the need to hopefully integrate and widen this view,

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making it possible for marine Nat2000 sites to contribute more to ecosystem-wide conservation in EU waters. Provided that they are effectively and equitably managed, Nat2000 sites could also convincingly contribute to achieving CBD and UN Sustainable Development Goals coverage targets (Guidetti & Danovaro, 2018). All types of MPAs, in fact, could provide a basis for building an effective MPA network covering at least 10% of national waters, possibly adding some more ambitious targets, such as the 2% cover of fully protected areas in the Mediterranean, as recommended by researchers and conservation practitioners (Tangier Declaration; http://www.medmpaforum. org/en/no-de/6882), and supported by recent scientific evidence (Di Franco et al., 2018).

Rethinking and broadening the scope of the Nat2000 system can be considered of vital importance. To do that properly, it would be desirable for the site selection, organization, management, and monitoring of Nat2000 sites to be better harmonized and standardized at the EU level. Nat2000 sites, for instance, should be properly equipped, funded, and staffed, and management bodies should be provided with more resources and decisional power to be more effective (Meinesz & Blanfuné, 2015).

This is a crucial step in order to avoid, for instance, what quite often happens to nationally established MPAs in EU waters, where the different countries have created very different MPAs in terms of design, mission, goals, management, infrastructures, staff, funding, regulations and zoning, enforcement, monitoring systems, and so on (Scianna et al., 2018). Today, this situation represents a major limitation to the development of a coherent network of MPAs in EU and Mediterranean waters.

Strictly concerning Nat2000 sites (even though this cannot be generalized to all EU countries), the lack of a systematic planning process, the fact that a non-negligible fraction of Nat2000 sites covering marine surfaces are mere extensions of terrestrial sites into the sea, the lack of management plans in most cases, and the general lack of political will of a number of member states with regard to the real protection of EU marine waters have made these tools poorly effective to date (Mazaris et al., 2017, Meinesz & Blanfuné, 2015, Partnership for Interdisciplinary Studies of Coastal Oceans & University of Nice Sophia Antipolis, 2016). These elements justify, to some extent, the widespread opinion that, in the EU (and Mediterranean) context, (a) we are still a long way from developing a really coherent, well-connected, and effective network of MPAs, and that (b) there is an urgent need for greater consistency and standardization of conservation tools as the MPAs (Mazaris et al., 2017; Nat2000 sites included; Scianna et al., 2018).

In view of the elements discussed in this section, it is clear that, if the establishment of (M)PA networks is a crucial step on the path towards the conservation of ecological mechanisms and the support of ecosystem functions, focusing solely on coverage targets

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(e.g. formally protecting 10% of marine waters by 2020) is likely to lead to failure. Marine Nat2000 sites should thus evolve towards embodying key features and achieving high quality criteria constituting a solid base for the development of an effective network of MPAs capable of producing ecosystem-wide benefits.

To achieve effective and wider conservation outcomes, policy decision makers should above all guarantee the effective management of the currently designated Nat2000 sites by integrating them in the wider EU and international policies, rather than keep enlarging the declared 'protected' surfaces.

Once this change of perspective is accepted, then management measures at Nat2000 sites could be extended to fisheries regulations and to other human activities representing a potential risk to marine ecosystems as a whole.

Even though marine Nat2000 sites, like any other MPA type, cannot be a panacea against any form of marine ecosystem degradation, they could play multiple roles, aside from and together with other MPA types; for example, in limiting anthropogenic impacts (Micheli et al., 2013) and the spread of invasive species (Gallardo et al., 2017).

Marine Nat2000 sites established in the EU waters, from this perspective, could represent a potentially extraordinary network of sentinel sites for setting up large-scale ecosystem-wide monitoring, provided that a proper standardized monitoring system is adopted.

These issues confirm the increasing need to integrate the Habitats and Birds Directives' objectives within other more recent EU initiatives (such as MSFD and CFP), which could together significantly increase the chances of achieving a good environmental and fishery status in EU waters in the future.

NOTES

[+]This article is extracted from: Guidetti, P., Addis, P., Atzori, F., et al. (2019). Assessing the potential of marine Natura 2000 sites to produce ecosystem wide effects in rocky reefs: A case study from Sardinia Island (Italy). Aquatic Conservation: Marine and Freshwater Ecosystems, 2019;1-9. doi: https://doi.org/10.1002/aqc.3026

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BOTTLENECKS IN FULLY IMPLEMENTING THE NATURA 2000 NETWORK IN ITALY

AN ANALYSIS OF PROCESSES LEADING TO THE DESIGNATION OF SPECIAL AREAS OF CONSERVATION

SABRINA LAI

Assessorato della Difesa dell'Ambiente
Regione Autonoma della Sardegna, Italy
e-mail: slai@regione.sardegna.it

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ABSTRACT

Biodiversity protection in the European Union has its legal foundations in two directives (Directive 92/43/EEC of 21 May 1992, the so-called "Habitats Directive", and Directive 2009/147/EC, the so-called "Birds Directive"), which establish an international, coordinated network of protected areas known as "Natura 2000". In this article, the implementation of the network is qualitatively analyzed by looking at the processes whereby Special Areas of Conservation are currently being designated in Italy, following a preliminary and required establishment of site-specific conservation measures which can optionally be included within appropriate management plans. Through a thorough documental analysis, four topics were examined as follows: integration of conservation measures in ordinary spatial plans; institutions and tiers of government involved in the management and planning of Natura 2000 sites; stakeholders' inclusion in the identification of conservation measures; nature and role of conservation measures in the Italian planning framework. The key outcome of the analysis is that processes greatly differ among regions, and a variety of approaches, more or less scientific and technocratic, more or less democratic and inclusive, emerge.

KEYWORDS
Natura 2000 Network; Natural Protected Areas; Environmental Planning

1 INTRODUCTION

Within the European Union (EU), two main pillars underpin policies aiming at preserving biodiversity and halting biodiversity loss. First, the EU Biodiversity Strategy, which envisions biodiversity and ecosystem services "protected, valued and appropriately restored" by 2050 in the EU and aims at halting biodiversity loss and the degradation of ecosystems by 2020 (European Commission, 2011). Second, a legal framework whose main pillars are Directive 92/43/EEC ("Habitats Directive") and Directive 2009/147/EC ("Birds Directive", codified version of Directive 79/409/EEC). The two directives establish a strict protection regime for wildlife and natural and seminatural habitats, and a coordinated network of terrestrial and marine protected areas that should ensure biodiversity maintenance or restoration at a favorable conservation status.

This network, which stretches over an impressive 800,000 km^2 inland (i.e., more than 18.2% of the European Union in size) and over 530,000 km^2 of sea waters (European Environmental Agency, 2018), is termed "Natura 2000 network" and comprises Sites of Community Importance (SCIs), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). It is regarded as one of the most prominent international networks of protected areas (Lockwood, 2006; Kukkala, 2016) and as a successful example of spatial policies aiming at preserving biodiversity (Popescu et al., 2014). As argued by Rauschmayer et al. (2009), the effectiveness of biodiversity conservation policies can be assessed either by evaluating their outcomes or by analyzing their definition or implementation processes. As for the first type of assessment methods, numerous studies assess Natura 2000 performances by looking at species' and habitats' conservation status improvements since the establishment of the network with reference to specific areas, species, or *taxa*.

As for the second type, because of the environmental and social consequences of the establishment of such a widespread network, the implementation of the Habitats Directive has been the subject of a number of interdisciplinary studies, focusing on site designations and the establishment of the network (Alphandéry & Fortier, 2001; Haumont, 2003), management (Enengel et al., 2014), conflicts (Bryan, 2012; Gallo et al., 2018) concerning the definition and implementation of conservation measures required by the Directive, and participation processes (Beunen et al., 2013; Cent et al., 2014). Several studies, among the latter group, regard plan-making processes as the way forward to mitigate conflicts (Kamphorst at al., 2017; Krott et al., 2000) and the optimal tool to include stakeholders' participation in setting conservation goals and defining conservation measures at the site level (Alphandéry & Fortier, 2001; Paavola, 2004; Rauschmayer et al., 2009; Young et al., 2013); inclusive planning processes are thus regarded as a proper counterbalance to the purely

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technical process that led to selection and designation of Natura 2000 sites. In fact, the Habitats Directive requires that SCIs (which must be identified by member states on scientific grounds only) must be designated as SACs within six years from their establishment. A SAC designation process must be preceded with the establishment of site-specific conservation measures, which may involve appropriate site-specific management plans while also taking account of socio-cultural-economic requirements. So far, a very limited number of studies have analyzed institutional processes leading to the establishment of conservation measures (optionally including plan-making processes); among these, Gil et al.'s (2011), Kovacs et al.'s (2017), Cortina and Boggia's (2014). Building upon the above literature, this study aims at identifying governance and inclusion processes in the management of the Italian Natura 2000 network, by scrutinizing the ongoing process whereby SACs are being designated through an analysis of official documents that establish Natura 2000 conservation measures (hereinafter, CMs) or approve management plans (hereinafter, MPs).

The following section introduces the case study and provides the reader with some information on Natura 2000 in Italy and a brief presentation of the roles played by the various tiers of government involved in the designation process. In the third section, the results of the analysis are summarized, while in the fourth section the results are discussed and perspectives for future research are presented.

2 MATERIALS AND METHODS

2.1. CASE STUDY: THE NATURA 2000 NETWORK IN ITALY

Natura 2000 network in Italy stretches over approximately 19% of the national territory, while its marine area amounts to nearly 7,000 km^2 (European Environmental Agency, 2018). The national network is currently comprised of 2,613 sites, of which 2,335 are SCIs designated under the Habitats Directive; as of September 2018, only 82% SCIs for which the six-year deadline for their designation as SACs has expired had been established as SACs. The preliminary selection of Natura 2000 sites in Italy was carried out between 1994 and 1998 by the Ministry for the Environment, supported by scientific societies (Postiglione, 2006); Regions and the Autonomous Provinces of Trento and Bolzano were involved, as well (Amirante, 2003). On purely scientific bases, around 2,800 sites (Blasi, 1998) were identified, which led to conflicts and oppositions, both from stakeholders and local authorities (Neven et al., 2005) which felt excluded from the process. In April 2000, the Minister for the Environment issued a decree that approved two lists:

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- the first list of SPAs, for which the State identification is sufficient to formally designate the sites;
- the preliminary list of proposed SCIs to be forwarded to the European Commission for the next designation steps.

The lists of SCIs for the Alpine and Continental biogeographic regions were adopted by the European Commission in 2004, whereas the list for the Mediterranean region was adopted in 2006. Starting from these dates, each Member state had to define the necessary CMs so as to designate the SCIs as SACs within six years from the lists being adopted. In Italy, the State (with which the responsibility for implementing the Habitats Directive lies) delegated the definition and approval of both CMs and MPs to its 19 regions and 2 autonomous provinces, while retaining control over SAC designation. Roles and responsibilities concerning the implementation of the Habitats Directive in Italy are therefore structured into three levels: first, the European Commission, which adopts the lists of SCIs; second, the State, which proposes the lists of SCIs to the European Commission and designates the SACs; third, the regions and autonomous provinces, which must define and approve CMs and MPs as a prerequisite to the SACs designation, and are responsible for the management of the sites.

2.2 METHODOLOGY

Official documents on the ongoing SACs designation process were retrieved from the website of the Italian Ministry for the Environment and Land and Sea Protection in June 2018. Many of the official acts were only available as scanned documents, hence text mining techniques could not be applied. Therefore, each single official act (i.e., at the state level: ministerial decrees concerning SAC's designations; at the regional/provincial level: regional deliberations or decrees approving site-specific CMs or MPs) was examined in order to retrieve information on the following items:

- institution in charge of defining CMs and MPs;
- stakeholders' involvement (if any) in the definition of CMs and MPs;
- implications on spatial planning (at the urban or regional level) entailed by CMs and MPs.

3 RESULTS

The SAC designation process, still ongoing in Italy, started in 2013 for sites belonging to the Aosta Valley region, and, as of today, has not started yet in Campania. Moreover, SACs in Abruzzo, Veneto and Emilia Romagna were designated after June 2018 (respectively, July 2018, December 2018, March 2019), when the document analysis was performed, hence the results here presented concern the remaining 15 regions and two autonomous provinces

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(Trento and Bolzano) in Trentino-South Tirol. Because of space constraints, quantitative and qualitative results are not extensively presented in this article, but only summarized in Fig. 1, which provides, for each region: total number of SACs designated as of June 2018; progress towards designation completion; whether MPs or CMs (or both) were approved; type of institution responsible for MP or CM preparation (their approval always lies with the region, or with the autonomous province in case of Trentino South Tirol); type of participation processes implemented, if any; whether any planning implication is entailed by MPs or CMs.

REGIONS	no. SACs	% SACs	MPs	CMs	ORGANIZATION IN CHARGE OF CM IDENTIFICATION / MP PREPARATION	PARTICI-PATION*	PLANNING CONTENT
Aosta Valley	27	96.4		X	Region	1	
Apulia	56	70	X		Provinces, Municipalities, Mountain districts	2, 4	
Basilicata	54	96.4	X	X	Region	3	No
Calabria	178	100		X	Protected areas, Provinces	---	
Friuli V.G.	56	100	X	X	Region	2, 4	X
Lazio	180	99.5	X	X	Region	2, 4	
Liguria	126	100		X	Region, Regional environmental agency	2	
Lombardy	193	100	X	X	Region, SCIs management bodies	2	
Marche	76	100	X	X	Region, Provinces, Protected areas	2, 4	
Molise	60	70.6	X		Region, Mountain districts	2, 4	X
Piedmont	122	100	X	X	Region	2, 4	
Sardinia	56	62.9	X		Protected areas, Provinces, Municipalities	2, 4	X
Sicily	203	92.7	X		Protected areas, Provinces, Forestry agency	---	
Trentino S.T.	175	97.2		X	Province, Protected areas, Municipalities	2, 4	
Tuscany	134	100		X	Region	1	
Umbria	97	100		X	Districts, Protected areas, Municipalities	2, 3	

Key: 4. Meetings during the CM/MP drafting (both informative and participative meetings, either open to the public or involving only selected stakeholder groups); 3. Informative public meetings after the CM/MP elaboration or adoption; 2. Possibility to present written comments on CM/MP after its adoption and publication; 1. Limited consultation (institutions only).

Fig. 1 SAC designation process in Italy. (Author's elaboration on data retrieved from ftp://ftp.minambiente.it/PNM/Natura2000/Materiale%20Designazione%20ZSC in June 2018)

4 DISCUSSION AND CONCLUSIONS

A first outcome of the analysis is that striking differences exist among Italian regions as to the role they play in the SAC designation process, the consideration of socio-cultural-economic requirements invoked by the Habitats Directive, the very same nature and function of CMs and MPs. First, as for the type of tool, six regions have made use of both CMs and MPs; seven have approved only CMs and four only MPs.

This is consistent with the Habitats Directive: while site-specific CMs are mandatory, they can optionally be integrated within MPs. Contrary to what happens in other EU member states, where MPs are compulsory (Beunen & Van Asche, 2013; Bouwma et al., 2008; Evans, 2012; Ferranti et al., 2010; Neven et al., 2005), Italy has retained the optional character envisioned in the directive. Moreover, the analysis of official documents suggests an interpretation quite different to that offered by Ferranti et al. (2010), who argue that most Italian regions chose to integrate Natura 2000 measures within other development plans, rather than preparing ad

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hoc, site-specific MPs. Indeed, official acts record only a very few instances in which CMs were integrated in sectoral or territorial plans other than MPs; when such integration occurs, it is restricted to plans for natural protected areas (national parks or nature reserves) or to marine protected areas' regulations only.
This extremely low level of integration is most likely due to the limited consideration of nature and biodiversity within territorial plans, which in turns is linked to low awareness of the role played by biodiversity to sustain natural processes required for human life and development, and to widespread perception of conflicts between biodiversity preservation and socio-economic growth.
In this regards, current debates on ecosystem services provided by protected areas (Castro et al., 2014; Bastian et al., 2013), on their inclusion within planning processes (de Groot et al., 2010; Geneletti, 2013; Gómez-Baggethun & Barton, 2013), on the ecosystem approach to spatial planning (Vasishth, 2008; Yigitcanlar & Teriman, 2014) are promising research fields. Second, as for institutional tiers of government involved in managing and planning Natura 2000 sites, both the European Commission's and member states' competences are clearly defined in the Habitats Directive with reference to site identification and SAC designation. However, in Italy the state has devolved a number of competences (e.g., site management, surveillance, monitoring) to regions and autonomous provinces, leaving room for interpretations that differ across regions. For instance, while some regions have retained their planning and decisional role granted by the state (in that they have not only approved, but also defined CMs and prepared MPs), others have delegated this task to lower tiers of government; closer to local communities, the latter are probably considered as the most appropriate level to take account of social and economic needs and expectations. Further research is therefore needed so as to investigate whether the (higher or lower) level of government makes any difference in regard to CM and MP effectiveness, by looking at whether the choice of institutional level impacts on habitats' and species' conservation status, and, ultimately, on the integrity of the Natura 2000 network.
Third, participation in the establishment of CMs and MPs greatly varies among regions, both for categories of institutional actors and stakeholders involved, and for types of processes carried out and their timing.
For two regions (Calabria and Sicily) official acts do not mention any participatory or consultative process; for two further regions (Tuscany and Aosta Valley) official acts suggest that consultation was restricted to institutions only. For the remaining regions, documented participatory processes were indeed carried out and took different forms, among which consultation after adoption is the most common, while truly participative processes (for instance including the forestry or farming sector, or environmental associations, or hunting

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associations), which can in principle result in agreed-upon conservation measures, are rarer. In this article, only the documented development of participatory processes was analyzed, without further investigating their effectiveness in shaping CMs and MPs.

Two recent works (De Meo et al., 2016; Paletto et al., 2017) attempt to assess participatory processes Natura 2000 planning and management in some Italian regions by looking at inclusiveness, democracy, and conflicts on the basis of surveys of a small group of stakeholders; the authors conclude that participation often took the form of mere information, that only in a few regions did participation allow planners to integrate local knowledge within MPs, and, finally, that only selected stakeholder categories were involved. Further research could therefore complement the documental analysis here carried out with a territorially systematic survey of stakeholders involved in participatory processes concerning CMs and MPs, so as to assess the effectiveness of such processes by comparing stakeholders' perceptions with the outcomes of the official, documental, narrative. Finally, implications on spatial and territorial planning only emerge in a limited number of regions.

In the Autonomous Province of Bolzano CMs are subject to the local planning law, similarly to what happens in Friuli Venezia Giulia, where, in addition, the official acts approving CMs state that, in case of differences or contradictions, CMs prevail over land use plans and regulations. In such cases, CMs (and MPs as well) are regarded as territorial planning tools. Conversely, Basilicata Region's official acts explicitly state that MPs are not subject to either the Strategic Environmental Assessment under Directive 2001/42/EC, because they are not regarded by the regional administration as territorial plans, or the Appropriate Assessment under the Habitats Directive, because only aimed at preserving habitats and species.

To the contrary, an Appropriate Assessment and a Strategic Environmental Assessment (which also provides a framework for structured stakeholders' participation) must be carried out, in Sardinia, for each MP because MPs comprise not only conservation measures, but also material and non-material interventions aiming, for instance, at enhancing local assets and resources, or at supporting local sustainable economies. Such differences concerning the very essence of CMs and MPs (as well as their binding or non-binding character) signal that an in-depth analysis of administrative and urban planning laws is required, possibly leading to a unified (national) legal framework across the regions. Ferranti et al. (2014) argue that nature conservation in the EU has historically evolved following a cycle: from initial technocracy (concerning, for instance, site designations only on scientific ground) to limited inclusiveness (e.g., farmers or hunters) in the management of the sites, to wider inclusiveness (e.g. tourism businesses), back to technocracy in the current phase (e.g., environmental economists, due to emphasis on natural capital, ecosystem services, and economic value of biodiversity), hence again marginalizing local communities.

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The fragmented and varied Italian experience concerning SAC designation suggests that, rather than a sequence of historical phases, the coexistence of various approaches, some more technocratic and some more democratic and inclusive, can be observed depending on the region.

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AUTHOR'S PROFILE

Sabrina Lai is a civil engineer, Sabrina Lai is Research Doctor in Land Engineering (Italy, 2009), and MSc in International Planning and Development (UK, 2008). She is currently an officer at the Regional Administration of Sardinia, Department for the Environment, Division for Nature Protection.

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URBAN PRESSURE SCENARIO ON THE PROTECTED AREAS SYSTEMS

THE CASE STUDY OF TEATINA ADRIATIC COAST

ALESSANDRO MARUCCI, LORENA FIORINI
CARMEN ULISSE

Department of Civil, Construction-Architectural
and Environmental Engineering (DICEAA)
University of L'Aquila, Italy
e-mail: alessandro.marucci@univaq.it
lorena.fiorini@univaq.it, carmen.ulisse@libero.it
URL: http://diceaa.univaq.it/en/

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ABSTRACT
In recent years, land planning has been increasingly oriented towards the integration of the environmental issues into the prospects for territorial development. In a historical and cultural context where the perception of the protected areas has changed, they are no longer understood as "islands of biodiversity" to be preserved from the aggression of urban development, but as sinks for ecosystem services indispensable for local populations and therefore as opportunities for Sustainable Development. The actions through which all this could be done are several and these should not be linked to simple protection, through regulatory constraints, but they must be the expression of more proactive activities, such as the planning and design of Green and Blue Infrastructures. An interesting challenge is to investigate if the local administrations are able to transpose these new concepts and to harmonize them with the existing legislation, considering that the innovative drive compared to the green and blue infrastructure is opposed to the incompleteness condition of the consolidated environmental policies. Therefore, one of the main aims of this work was to analyze the interaction between local planning and the overarching one, in relation to the future establishment of the Costa Teatina National Park (CTNP). This research evaluated how the municipalities plan examined could interact with the actual network of protected areas in terms of urban occlusion and whether the new National Park could take on the role of coordinator of future development prospects.

KEYWORDS
Urban Pressure; Coast Monitoring; Integrated Management; Land Planning

1 INTRODUCTION

This work aims to analyze the interaction between local and superordinate planning (Ciabò, 2010), in relation to the establishment of the new Costa Teatina National Park (CTNP). Taking into consideration the Municipal Planning Instruments (MPIs) of the individual municipalities and their current state of implementation, their potential for residual transformation and the roles that the National Park could fill in a complex and delicate territorial context was examined (Romano & Zullo, 2014; Sargolini, 2010).
Moreover, the residual urban potentialities, contained in the considered MPIs, have been analysed for evaluate the future development of the territory in terms of transformations. This aspect is increasingly fundamental for implementing sustainable planning processes that must be applied according to the international environmental policies (EEA, 2010; European Commission, 2012; European Commission, 2016; United Nations, 2015). The study was conducted taking into account the presence of different levels of protection and the complexity that determine the area of the study.

2 STUDY AREA

The study area, located in the Adriatic Coast of the Abruzzo Region, was identified as a group of 8 municipalities (Ortona, San Vito Chietino, Rocca San Giovanni, Fossacesia, Torino di Sangro, Casalbordino, Vasto and San Salvo) that have part of their territory within the boundaries of the future establishment of the Costa Teatina National Park (Fig.1).

Fig. 1 Location map of the study area

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Tab. 1 shows the general features of these municipalities and it highlights than almost half of the whole surface considered (about 309 ha) is composed only of the municipalities of Ortona and Vasto (about 142 ha). In addition, the 8 municipalities analyzed are characterized by a different demographic consistency: Ortona, San Salvo and Vasto are medium-large municipalities, with population between 20,000 and 40,000 units, while the other 5 municipalities are medium-small, with a population in the range of 2,000 – 6,000 units (ISTAT, 2018).

Although, especially in the summer period, in these coastal areas there is a high population fluctuation linked precisely to tourism activities. This is a phenomenon that the administrations must not neglect for good governance of the territory. The last data in table (Tab.1) concerns population density which is also very varied, with values ranging from 1024.62 inh/kmq (San Salvo) to 97.91 inh/kmq (Torino di Sangro).

MUNICIPALITIES	TOTAL AREA (kmq)	INHABITANTS (2018)	POPULATION DENSITY (inh/kmq)
Ortona	70.88	23034	324.97
San Vito Chietino	17.00	5246	308.59
Rocca San Giovanni	21.70	2322	107.00
Fossacesia	30.14	6345	210.52
Torino di Sangro	32.12	3145	97.91
Casalbordino	46.02	6046	131.38
Vasto	71.35	41496	581.58
San Salvo	19.70	20185	1024.62

Tab. 1 General features of the considered municipalities

Tourism, as already mentioned, has an important role for this area. However, from the socio-economic point of view, the presence of industrial areas such as commercial ports in the Ortona and Vasto municipalities should not be neglected. The first port, in fact, is the largest in Abruzzo and also plays a central role in the naval industry, while the second is a commercial port where many types of goods arrive, including biodiesel, diesel and various vegetable oils.

2.1 THE PROTECTED AREAS SYSTEMS

Another aspect concerns the environmental value of these territories (Fig.2), which was central to the research conducted. Actually, in this area there are 6 Regional Nature Reserves (Tab.2), with a total extension of about 1,080 ha, and 6 Sites of Community Interest (Tab.3), with a total extension of about 3.312 ha. The proposal for the establishment of the CTNP must therefore be inserted in this context that appears to be complex from various points of

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view, such as environmental, social, urban and economical. The Costa Teatina National Park was planned by the law n.93 of 23 March 2001 (article 8, paragraph 3) even if, after 18 years, it is not in force because the founding process is not finished. With the creation of the Park, the Nature Reserves will be abolished with a relative decision-making power to the ministerial body.

CODE	PROTECTED AREA	SURFACE (ha)	MUNICIPALITIES
EUAP1206	Ripari di Giobbe	35	Ortona
EUAP1205	Punta dell'acquabella	28	Ortona
EUAP1204	Grotta delle farfalle	510	San Vito Chietino, Rocca San Giovanni
EUAP1165	Lecceta di Torino di Sangro	164.69	Torino di Sangro
EUAP1090	Punta Aderci	285	Vasto
EUAP1207	Marina di Vasto	57	Vasto

Tab. 2 Protected areas included in the boundaries of the CTNP

CODE	NAME	SURFACE (ha)	MUNICIPALITIES
IT7140106	Fosso delle farfalle (sublitorale chietino)	793	San Vito Chietino, Rocca San Giovanni
IT7140107	Lecceta litoranea di Torino di Sangro e foce del Fiume Sangro	553	Fossacesia, Torino di Sangro
IT7140111	Boschi ripariali sul Fiume Osento	596	Torino di Sangro, Villalfonsina, Casalbordino
IT7140108	Punta Aderci-Punta della Penna	317	Vasto
IT7140109	Marina di Vasto	57	Vasto
IT7140127	Fiume Trigno (medio e basso corso)	996	San Salvo, Celenza sul Trigno, Cupello, Dogliola, Fresagrandinaria, Lentella, Tufillo

Tab. 3 Sites of Community Interest included in the boundaries of the CTNP

Furthermore, the subdivision inside the Park given the variety of elements present in it, both environmental and anthropic, was organized as following:

- ZONE 1: area of significant naturalistic, landscape and historical-cultural interest with limited or non-existent degree of anthropization;
- ZONE 2: area of naturalistic, landscape and historical-cultural value with greater degree of anthropization;
- ZONE 3: area with a high degree of anthropization.

Starting from these databases, it was necessary to standardize the type of areas present in the individual MPIs, for the composition of the unique shapefile. Inside this database a new

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field called "Hom_zone" has been introduced in which the zones have been recalled such as the "homogeneous areas" of the Italian Ministerial Decree n.1444/1968 (A, B, C, D and F) and another zone "Q" which represents a kind of class that contains everything that does not belong to the other areas.

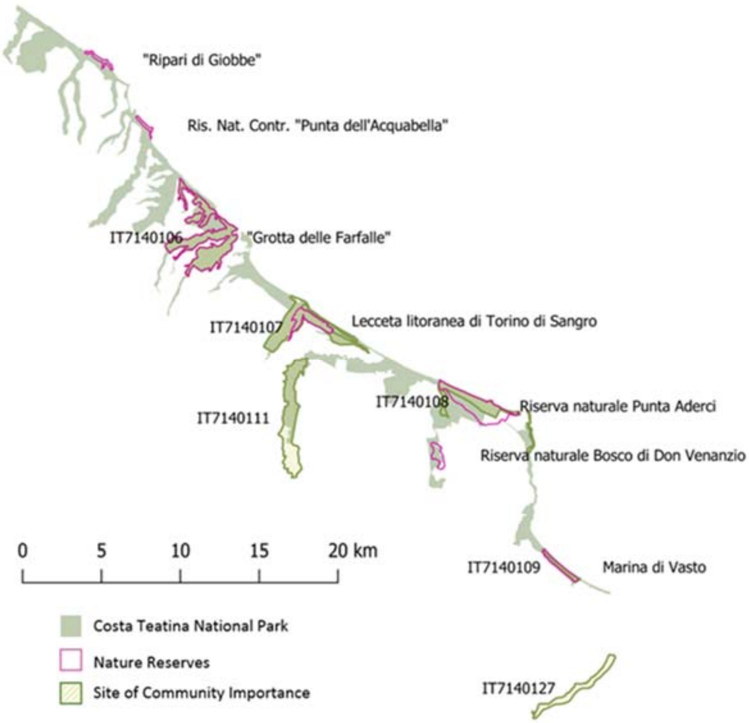

Fig. 2 The Costa Teatina National Park boundaries and the protected areas system

MUNICIPALITIES	YEAR	TYPE OF DATA	TIS WEB SITES
Ortona	1994	RASTER (.pdf)	unavailable
San Vito Chietino	2002	VECTOR (.shp)	http://sit.sangroaventino.it/
Rocca San Giovanni	2011	RASTER (.pdf)	unavailable
Fossacesia	1998	RASTER (.pdf)	http://sit.sangroaventino.it/
Torino di Sangro	2016	RASTER (.pdf)	unavailable
Casalbordino	2018	RASTER (.pdf)	http://sit.trignosinello.it/
Vasto	2013	RASTER (.tif)	http://sit.trignosinello.it/
San Salvo	2002	RASTER (.pdf)	http://sit.trignosinello.it/

Tab. 4 MPIs different format

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In addition to the unification and standardization of the type of zone, it was necessary to make choices on the set of urban indicators most useful to describe the scenarios of the urban potential transformations.
This standardization of the data was a fundamental step for the evaluating the state of implementation of the plans was carried out through a comparative analysis of the already transformed soils and of the areas still free, to evaluate the residual capacity of the plans. It was therefore possible to estimate how many and what kind of surfaces (B, C, D or F) are still really available among the forecasts of the plan and therefore evaluate the residual capacity of the plans, with the use of ISPRA dataset about the land use change (ISPRA, 2018) beyond the unique dataset obtained by this mosaicking of the MPIs. And a further check was carried out through a Google Earth photo-interpretation (Fig.3). Moreover, zones F have been previously selected in order to remove all the areas not coherent with the conversion of the soils, such as areas of road respect, green areas, parks and reserves.
In this way it was possible to divide the areas into:

- free Urban Areas (FUA);
- saturated Urban Areas (SUA);
- partially Saturated Urban Areas (PSUA), which were further classified according to the actual saturation value in the 30%, 50% or 80% ranges.

4 RESULTS

The mosaicking of the municipal planning instruments (MPIs) of the Costa Teatina has produced an interesting diagnostic analysis of the potential urban settlements. The diagrams (Fig.4) represent the transformative scenarios of each Municipality.
The light grey area of the graph is the representation of the potential of the MPIs, if it were completely implemented, while the dark grey internal area indicates the parts of the Plan already built, therefore the state of art. In order to make a qualitative comparison between the results obtained for all the municipalities considered, the values in the radar graphs are expressed on a logarithmic scale (Fig.4).
It is possible to divide the MPIs into two large groups: those adopted before 2002 and those after 2011; the first group, in particular, includes Ortona (1994), Fossacesia (1998), San Vito Chietino and San Salvo (both 2002).
The comparative analysis of the results highlights repetitive trends in the planning dynamics of this area: a good saturation of homogeneous areas B and a very low saturation of homogeneous areas C. So it follows that the expectations of local planning some twenty years ago have been disregarded. Furthermore, it is evident that these areas have not been

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attractive both in terms of residency and in terms of attractiveness for external investments; with the exception of Ortona, Vasto and San Salvo but only for the productive areas.

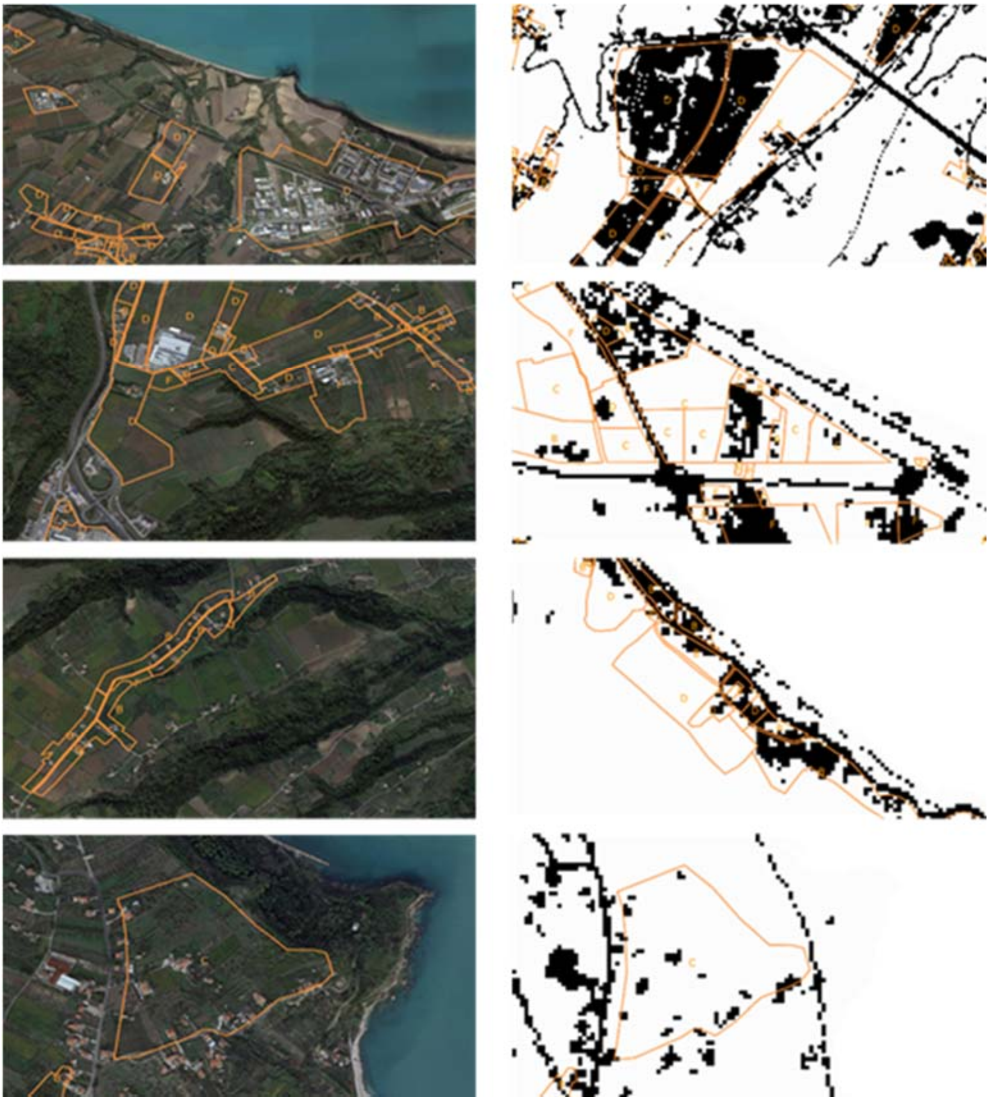

Fig. 3 Google Earth photo-interpretation

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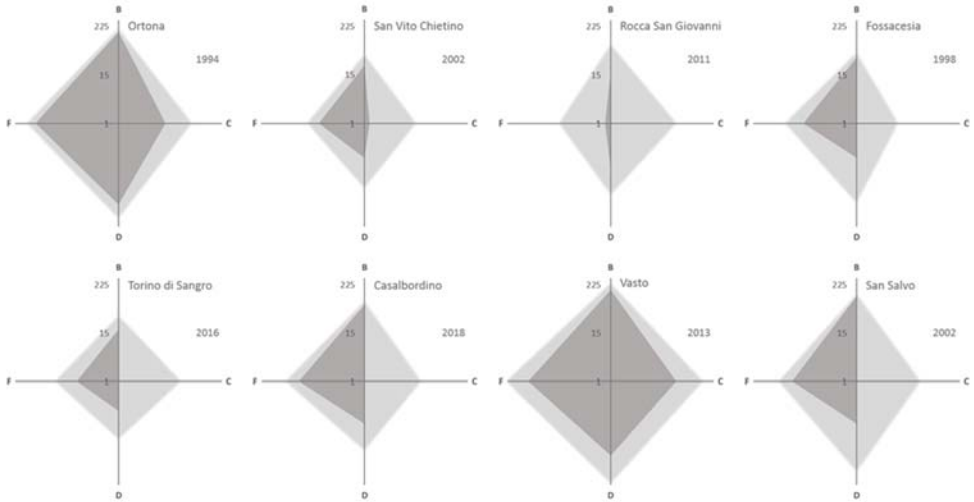

Fig. 4 Diagrams of the transformative scenarios

Moreover, the MPIs after 2011 can be defined as "new generation plans" because they have been in force for less than a decade or have been drawn up in recent years. In this case, the low degree of saturation of the same is certainly due to their recent adoption and therefore not yet able to express their compliance with the socio-economic development trends of the territory.

In this case, their low degree of saturation is certainly due to their recent adoption and consequently to their incomplete expression of the socio-economic development trends of the territory.

The general results obtained highlight how the local administrations prefer a broad planning which leaves room to all the possibilities of development in a non-selective way, not taking into account the territorial dynamics and the demographic flows. The tendency therefore is to allocate all possible territories to future urban development, regardless of the demographic and socio-economic dynamics that can be established. This is because the MPIs are not dynamic government instruments, and then hardly resilient.

It must be considered, however, that a considerable reorganization of homogeneous areas in a more sustainable and effective development scenario would significantly alter the system of land rents. This condition is therefore an impediment to the changing of approach in territorial planning.

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MPIs

TYPE	FUA	PSUA 30%	PSUA 50%	PSUA 80%	SUA	FUA Tot	MPI AREA	SI (%)
B	39	98	85	68	615	290	905	67.99
C	259	59	13	14	54	345	400	13.61
D	244	222	71	170	206	707	913	22.60
F	378	63	41	16	319	499	818	38.98
Tot (ha)	919	443	210	269	1194	1841	3035	39.35

SCIs BUFFER 1 KM

TYPE	FUA	PSUA 30%	PSUA 50%	PSUA 80%	SUA	FUA Tot	MPI AREA	SI (%)
B	10	50	27	13	65	100	165	39.37
C	92	8	2	1	4	102	106	3.42
D	162	48	24	47	81	282	363	22.37
F	127	37	23	9	96	196	292	32.87
Tot (ha)	391	143	76	70	246	680	926	26.55

CTNP BUFFER 1 KM

TYPE	FUA	PSUA 30%	PSUA 50%	PSUA 80%	SUA	FUA Tot	MPI AREA	SI (%)
B	20	71	53	34	325	178	503	64.57
C	165	42	4	12	27	224	251	10.84
D	169	83	46	55	132	353	485	27.23
F	145	18	13	8	185	184	369	50.12
Tot (ha)	499	214	117	110	669	939	1608	41.62

Tab. 5 Table of results obtained for the entire MPIs mosaicking, the SCIs buffer of 1 km and the CTNP buffer of 1 km

A system based on private property and linked to land rents determines a conflict as regards an integrated management of the territory and natural heritage, for example related with the Natura 2000 Network and the of the CTNP (Angel et al., 2012; Bennet & Saunders, 2010; Girvetz et al., 2008; Irwin & Bockstael 2007).

The CTNP concerned 8 different Municipalities and is subject to differential pressures and behaviours with respect to individual local realities.

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Tab. 5 shows the value of saturation index (SI) obtained for the all homogeneous areas belonging of: the entire MPIs mosaicking, the SCIs buffer of 1 km and the CTNP buffer of 1 km. Considering the SCIs buffer of 1 km, the saturation index (SI) is about 26,5% and, in particular, the free urban areas (FUA) are about 680 hectares (three times the current areas).

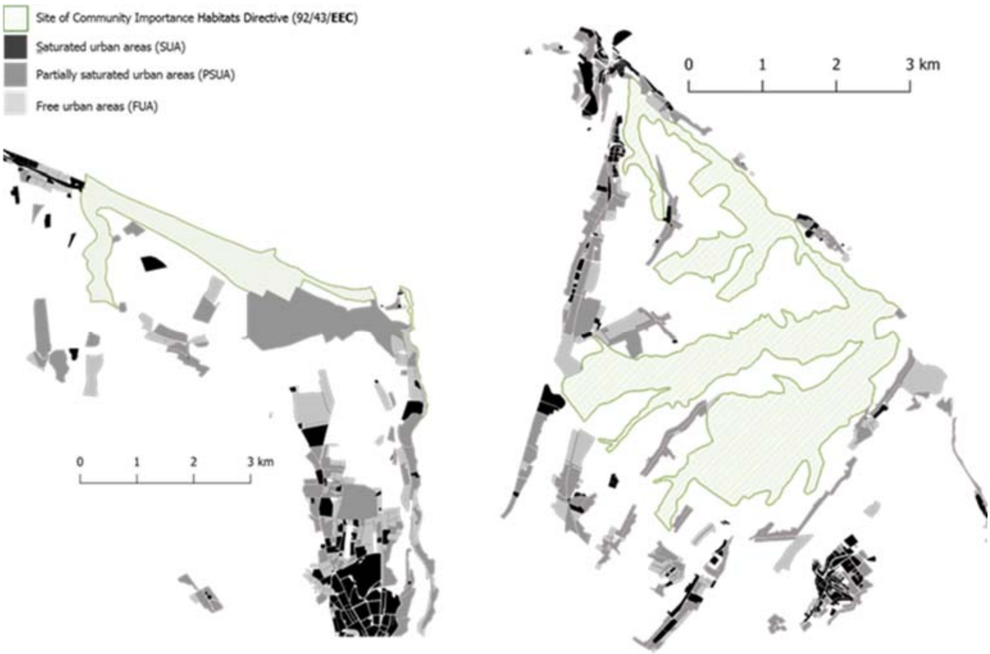

Fig. 5 Maps of potential isolation of the SCIs by the MPIs

Moreover, the particular location of these areas causes a condition of potential isolation of the SCIs by the MPIs (Fig.5). In the same way, the value of the SI is about 41,6% for the CTNP buffer of 1 km, with a potential of around 939 hectares, which has not yet been realized.
The results obtained shown that the CTNP is planned in a territorial context characterized by a still very high urban transformation potential.
This fact, however, is in contrast with the main objective of the park, which is to connect the existing system of protected areas, present on the territory of the Theatine coast. Therefore, the sustainability of the actions on these territories and the integration between the various planning levels is not a shared strategy but is determined by the sensitivity of each MPIs.

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5 DISCUSSION AND CONCLUSION

In this work, the residual urban potentialities of each Municipalities have been analyzed, highlighting how much they are oversized compared to the current needs and how they take into account the forecasts of the previous local planning instruments. From the analysis developed it is shown that the interaction, between the municipal planning instruments and the CTNP proposed Plan, has contradictory aspects with the real objective of protection and safeguard of the identified protected area.

All of this is in disagreement with the declared policy orientation and planning strategies of the various Administrations involved that have signed the zonal proposal of the aforementioned Park Plan. The MPIs have a total amount of transformable areas of around 1841 hectares, which corresponds to a residual urban potentiality of around 61%. In particular, within the boundary of the CTNP, these areas are around 545 ha and they correspond 30 % of the total free urban areas (FUA Tot).

Examining both the transformable areas present within the boundary and those falling within a 1 kilometer buffer from the perimeter, it turned out that the existing protected areas and the proposed Park are surrounded by areas potentially subject to transformation of a residential and productive type. From the draft of the Park degree it is foreseen, as well as by the Law n.394/91, that its realization will cause the abolition of the existing Regional Reserves with the transfer of power to the Ministry for Environment, Land and Sea Protection.

Moreover, in the articles of the safeguard measures relating to the authorization regime (from Art. 6 to Art. 9), it showed that in the CTNP territory all the provisions, contained in the actual MPIs, are reserved until the entry into force of the CTNP Plan.

The MPIs examined are prior to the Park Plan, so it is clear that the scenarios expected are probably achievable. In conclusion, even if the CTNP is perceived as an opportunity and a model for the development and relaunching of the territory by local communities, in reality this may not be the most suitable, or at least, the most necessary planning instrument in this area. The analysis of the MPIs highlighted a composite situation where a common feature is the lack of opportunities and possibilities for the development of the territory in terms of transformations and industrializations. In particular, the large surfaces of C, D and F zones are still almost completely unexpressed.

Therefore, it is believed that it would be appropriate to reorganize the local planning tools with a single device capable of reading, analyzing and interpreting the real needs and possibilities of the Costa Teatina growth, before identifying in the CTNP the most suitable structure for the promotion of the territory.

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WEB SITES

http://fossacesia.gov.it; www.casalbordino.gov.it/; www.comuneortona.ch.it/: www.comunerocca sangiovanni.gov.it/; www.comunesanvitochietino.gov.it/; www.comune.torinodisangro.ch.it/; www.comune.sansalvo.gov.it/; www.comune.vasto.ch.it/; www.isprambiente.gov.it/it; www.minambiente.it/; www.pcn.minambiente.it/; www.istat.it

NOMENCLATURE

CTNP = Costa Teatina National Park
ISPRA = Italian Institute for protection and environmental research
ISTAT = Italian Institute of statistics
MPI = Municipal planning instrument
TIS = Territorial Information System

AUTHOR'S PROFILE

Alessandro Marucci, is a researcher in urban planning at the Department of Civil, Construction-Architectural and Environmental Engineering (DICEAA) - University of L'Aquila. He was graduated in Environmental Science in 2006 and he worked in ecological planning, environmental valuation and GIS techniques. He is author of various papers and other scientific publications.

Lorena Fiorini, Ph.D. in Civil, Construction-Architectural and Environmental Engineering with the thesis in land planning "Land take in Italy: models and trajectories". She is an Environmental Engineer with experience in Land Planning. Currently, she is a Postdoctoral Researcher at the Department of Civil, Construction-Architectural and Environmental Engineering (University of L'Aquila) and her research mainly concerns land use change, sustainable development, environmental assessment techniques and GIS techniques for territorial analysis.

Carmen Ulisse, is doing a Master Degree in Environmental Engineering at the University of L'Aquila.

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POSIDONIA BANQUETTES ON THE MEDITERRANEAN BEACHES: TO WHAT EXTENT DO LOCAL ADMINISTRATORS' AND USERS' PERCEPTIONS CORRESPOND?

PAOLO MOSSONE[a], IVAN GUALA[a]
SIMONE SIMEONE[b]

[a] IMC - International Marine Centre, Italy
e-mail: direzione@fondazioneimc.it
URL: https://www.fondazioneimc.it/

[b] IAS - Istituto per lo studio degli impatti Antropici e Sostenibilità in ambiente marino - C.N.R., Italy
e-mail: simone.simeone@cnr.it
URL: http://marinedata.cnr.it/

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ABSTRACT

In the Mediterranean Sea, the removal of P. oceanica leaf litter (banquettes) from beaches is often required by the stakeholders for mainly aesthetic reasons, despite the key role that seagrasses play in the coastal environment and the ecosystem services they provide. Since removal operations can have a sedimentological, geomorphological and ecological impact, the POSBEMED project analyzed the possible strategies for the management of banquettes and beach systems. The present study aims to analyze perception and expectations of beachgoers and public and private stakeholders in relation to the presence and removal of banquettes from the beaches. The opinions of those who use the beach for recreational purposes, those who exploit the beach economically and those responsible for managing it were all considered on the questionnaires. A cost-benefit appraisal was carried out to assess the value attributed by beachgoers to banquettes as an integral part of a natural beach as well as the loss of value that the community suffers following a decision to leave the beach in its natural state. Results showed that the public strategies for beach management and banquette removal are mainly made in response to tourists' requests, usually mediated by economic operators. However, differences in perception have been detected between stakeholders and beachgoers, both in attitude towards the presence of banquettes on the beach and the evaluation of the impact generated by this presence. The economic analysis, considering only the hedonic use of a natural beach, indicates that the cost resulting from the loss of tourists is higher than the benefit perceived by the tourist. For the economists, this paradox raises the issue of the limits of using methods based on individual preferences for the evaluation of public goods, such as environmental ones.

KEYWORDS
Environmental Management; Sustainable Tourism; Posidonia Oceanica; Ecosystem Services

1 INTRODUCTION

Posidonia oceanica (L.) Delile is the most widespread seagrass species of the Mediterranean Sea (Duarte, 2004) where it forms wide meadows all along the coasts. *P. oceanica* loses its leaves in autumn (Romero et al., 1992) and the leaf litter can be found along the shores carried by waves and currents (De Falco et al., 2008). *P. oceanica* cast litter may form wedge structures, which range from a few centimeters to several meters thick, called *banquettes*. Similarly to sediment berms, *banquettes* can be considered features resulting from the accumulation of seagrass litter and sediments at the extreme landward area of wave influence. Short (1999) defined analogous seagrass beach-cast litter along Australian coastline as '*seagrass berm'.* Harvesting of beach-cast litter can be carried out for biomass exploitation (Kirkman & Kendrik, 1997) and to improve the recreational use of beaches for tourism (Ochieng & Erftemeijer, 1999). In the Mediterranean Sea the removal operations are often required by the stakeholder mainly for aesthetic reasons. The majority of *banquettes* is removed for 'beach cleaning' with heavy machinery (De Falco et al., 2008; Mossbauer et al., 2012). Several studies were conducted on the possible impacts of the removal of *banquettes*, from the sedimentological, geomorphological and ecological points of view (De Falco, 2012; De Falco, 2013; Guala et al., 2006; Simeone & Simeone,). At the present time "two main questions" remain unsolved: "Is the perception of *banquette* by beachgoers negative?" and "How should the administration manage the *banquette*?"

POSBEMED (Sustainable management of Posidonia-beaches systems in the Mediterranean region) is a project developed within the Interreg Med Programme, with the aim of analyzing the problems arising from the presence of seagrass *banquettes* on Mediterranean beaches along with possible strategies for their management. In particular, POSBEMED has considered the current policies and practices for the management of Mediterranean beaches, the potential conflicts and opportunities, (even embodying perceptions and expectations of stakeholders), in order to address a shared and integrated management of these systems, potentially applicable throughout the Mediterranean (Mossone et al., 2018; Otero et al., 2018). Since the management of *banquettes* and beach systems cannot ignore the increase in awareness of the ecosystem services that this natural capital can provide, filling the gaps of knowledge could help refine objectives of public action in the governance and planning of coastal marine areas and make management more effective and powerful in the future.

Whereas the POSBEMED project was designed to answer the two aforementioned questions, this work mainly focuses on the analysis of perception and expectations of beachgoers and public and private stakeholders in relation to the presence of *banquettes*. A part of the research is addressed to cost-benefit appraisal (CBA) related to the presence of seagrass

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banquettes on the beaches. It is not a matter of evaluating the cost of their removal, which should also be considered a very important element of evaluation for management purposes. The specific objective is to assess and contrast both the value attributed by beachgoers to *banquettes* as an integral part of a natural beach, and the loss of value that the community undergoes following the decision not to remove the *banquettes*, (thus leaving the beach in a state of naturalness).

Some elements of valuation have been compared, considering the opinions of those who use the beach for recreational purposes, those who exploit the beach economically and those who manage it, in order to derive possible strategies for sustainable management both from an environmental and economic point of view.

2 METHODOLOGY

Two surveys were conducted, one for beachgoers and the other one for public and private stakeholders. The survey addressed to the beachgoers aims to analyze their perception and attitude towards the presence of banquets. The survey addressed to public and private stakeholders aims at assessing their expectations in relation to the behavior and choices of tourists. Both surveys were conducted in Mediterranean seaside resorts in Sardinia, the Italian peninsula, France, Spain, Greece and Cyprus.

Two questionnaires were created. The one for beachgoers was divided between tourists and local users. The other one, addressed to public and private stakeholders, was divided between the representatives of local administrations and economic operators in the tourism sector. For the beachgoers' survey, 200 interviews were collected for each area. For the stakeholders' survey, 20 representatives of Local Government Administrations (LGAs) and 40 tour operators (TOs, including beach services and accommodation facilities) were interviewed for each area.

Part of the research was intended to provide basic data for the assessment of seagrass *banquettes* as an environmental good. Therefore, in order to attribute an economic value to the seagrass *banquettes*, it was necessary to refer to the ecosystem services they provide and, consequently, to investigate the economic value of the service, rather than the good itself. For this purpose, the method of the contingent valuation was used. Despite awareness of the limits often highlighted in critiques of this methodology (Diamond & Hausman, 1994), it is the most widely-used method for 'capturing' total economic value, including the values of use and of non-use (Carson et al., 2001),

It is necessary to take into account the complex and subjective nature of the concept of value (Small et al., 2017), and of the objective difficulties encountered in trying to adopt a homogeneous approach to dealing with the concepts of economic, ecological (de Groot et al., 2010) and socio-cultural value.

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Specifically, the method of contingent valuation consists in requiring consumers to express their willingness, through interviews or questionnaires, to pay (WTP) in all cases where there is no real market for the use of an asset, as in the case of public goods.

The aim of the economic analysis is above all to simulate a demand curve for an environmental good, generally understood as a non-market good. The construction of the demand curve is obtained starting from the distribution of the number of people willing to pay each price, by interpolating the data by means of a logarithmic regression, which is more appropriate than a linear regression (Sellar et al., 1986).

The area under the curve in the interval between the minimum price and the maximum price constitutes the WTP (Randall & Stall, 1980).

Once the value of the WTP has been calculated, this value is multiplied by the conversion factor between the sample and the population, computed on the basis of the carrying capacity of the beaches, in order to compare in a homogeneous way the costs and benefits in conditions of full employment of the beach as a resource.

A section of the beachgoers' questionnaire was reserved for the collection of economic data.

To make it comparable with the value of the benefits which emerged from the contingent assessment, the cost of the presence of seagrass *banquettes* was obtained by calculating the loss of tourists compared to the same conditions of full employment, and then multiplying this value by the average daily expenditure of the tourist and dividing the result for the total surface of the sampled beaches.

3 RESULTS

The analysis of the sample of beachgoers shows a fairly large negative perception (Fig. 1), even if it does not constitute the majority. Those who have a negative perception of the presence of *banquettes* amount to 41%, those who have a positive perception amount to 26%, those that are neutral amount to 33%.

It is worth to note that, for managerial purposes, those with a positive attitude and those who are indifferent can be considered as a single category, as neither of them requires the removal of the *banquettes*.

A very similar percentage (43%) to those who have shown a negative attitude, claim to choose a beach based on the absence of seagrass *banquettes*. Therefore, even among those who are "indifferent" there is still a small percentage (2%) of individuals who, if they have the possibility, choose a beach without seagrass *banquettes*.

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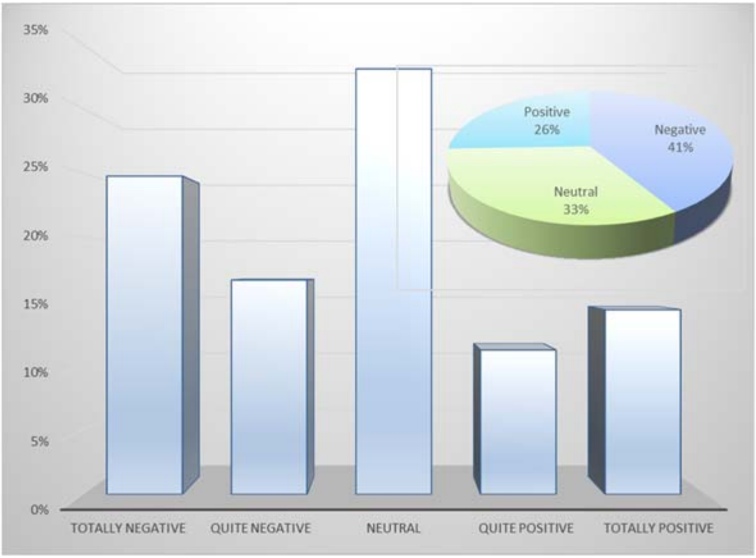

Fig. 1 Perception of presence of *banquettes*: an overview

Among the beachgoers who claim to consider the presence of seagrass *banquettes* as a negative choice factor, as many as 56% are local users, while 44% are tourists.

The data examined only for tourists and broken down by nation show that Greece contributes significantly to the overall negative result, with 71% of tourists declaring that the presence of seagrass *banquettes* is a negative choice factor. In all other countries the same figure is between 34% and 39%. The perception of LGAs and TOs in relation to the influence of *banquettes* on tourists is very similar, to the point of hypothesizing that the two classes tend to influence each other. Since local administrations have few opportunities for contact with tourists, it seems more likely that their perception is influenced by that of TOs, rather than vice versa. To confirm this, the survey conducted on the LGA shows that the public strategies for beach management and seagrass *banquette* removal are mainly made in response to tourists' requests (Fig. 2), likely mediated by economic operators. The comparative data in Fig. 3 show the differences in perception between public and private stakeholders on the one hand and beachgoers on the other, regarding their attitudes towards the presence on the beach of seagrass *banquettes*, and regarding the evaluation of the impact generated by this presence.

In Fig. 3, chart A shows a negative attitude of the stakeholders with respect to beachgoers, while chart B shows an evident disconnect between stakeholders and beachgoers on how the impact of the presence of seagrass *banquettes* on tourism is perceived.

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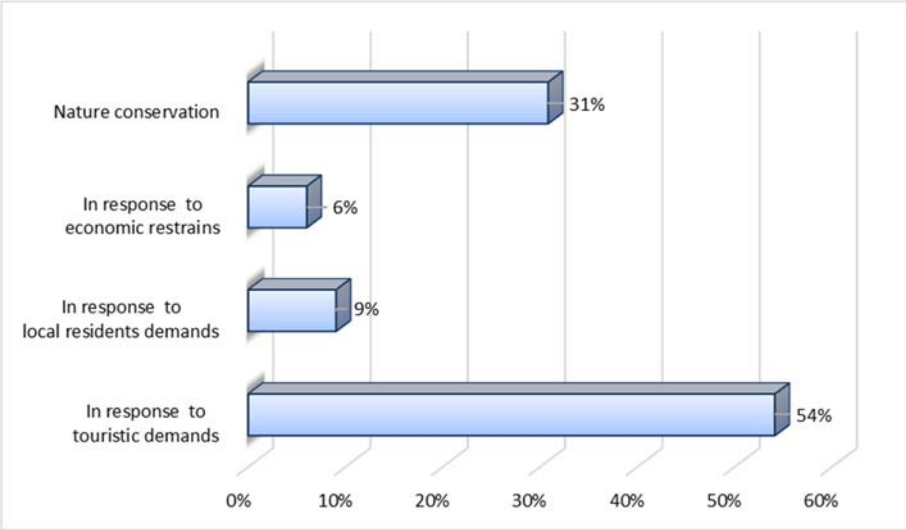

Fig. 2 Drivers of LGA management strategies on *banquettes*

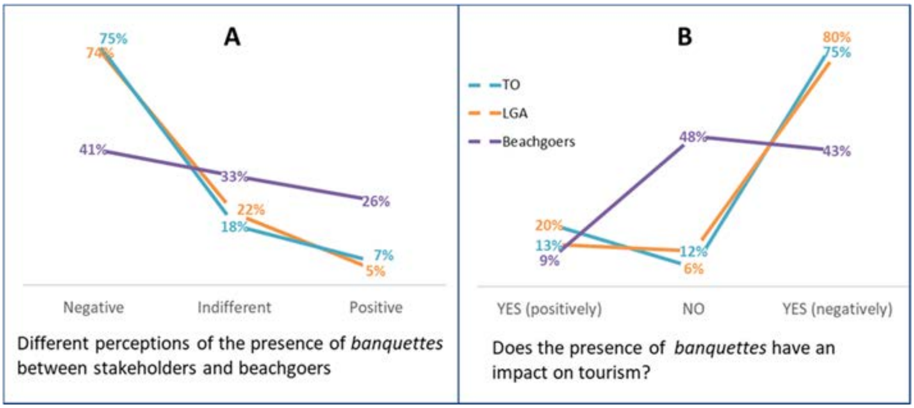

Fig. 3 Differences in perceptions and expectations between beachgoers and stakeholders

By means of the contingent valuation a demand curve has been constructed that expresses, given a certain range of prices, how much the interviewed beachgoers would be willing to pay in order to enjoy a beach in its natural state for recreational purposes, without having the *banquettes* removed. Without considering any costs avoided for the removal and disposal of the *banquettes*, or any costs of beach nourishment in the case of erosion, we set ourselves the task of isolating the only benefit perceived by beachgoers; the hedonic use of a natural beach. Thus, the benefit isolated through the WTP can be considered as the 'value of naturalness' granted by the consumer to the environmental good enjoyed. The total WTP of the sample was obtained through the discrete value method, and was subsequently multiplied

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by the conversion factor and divided by the total surface of the sampled beaches, obtaining a benefit per m^2 equal to 2.08 euros.

VARIABLES	Values
Sample (willing)	475
Population (willing)	236.968
Conversion factor	498,88
Sample WTP	16,099.00€
Population WTP	8,031,496.59€
Economic benefit per m^2	2.08€

Tab. 1 Benefit of the presence of seagrass *banquette* per m^2

Similarly, we can reason for the assessment of the cost determined by the presence of the *banquettes* on the beaches. Since the survey on the perception of beachgoers shows that 43% of the sample excludes the beach from their choices if "cluttered" by the presence of the *banquettes*, the loss of tourists can be considered a good indicator of the costs associated with the presence of *banquettes*. On the contrary, resignation by the resident beachgoers cannot be considered a cost, if we adopt the simplified hypothesis that local consumption simply takes other forms but does not vary in amounts.

VARIABLES	Values
Per capita daily spending	101.42€
Tourists loss	112,067.63€
Total economic loss	11,365.899.54€
Economic loss per m^2	2.95€

Tab. 2 Cost of the presence of seagrass *banquette* per m^2

As a result, considered from the sole point of view of the hedonic consumer, the cost resulting from the loss of tourists due to the decision to leave the beach in a state of naturalness, is higher than the benefit perceived by the tourist.

4 DISCUSSION AND CONCLUSIONS

The full results of the two surveys are reported in Mossone et al. (2018). Here we summarized part of the results in order to emphasize the need to develop appropriate communication and marketing strategies in order to increase the acceptance by tourists and tour operators of the presence of *banquettes* on Mediterranean beaches. The presence of the *P. oceanica*

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banquettes on Mediterranean beaches generates rather different opinions, depending on the point of view from which it is considered. The beach, intended as an environmental good, tends to be considered by both public and private stakeholders as a factor in the service of local income production, based on the exploitation of only hedonic ecosystem services. As a consequence, beach management policies of local administrations are mainly influenced by their perception of tourists' requests. Once again it is highlighted how a short-term, narrow-minded CBA approach can be misleading for policymakers (Turner et al., 2007). The evidence of the coincidence of the opinions of LGAs and TOs can be explained by the fact that LGAs do not have direct contact with tourists, but rather rely on the perception of TOs.

This also explains the radicalization of the evaluations by the stakeholders of the impacts on tourism of the presence of the *banquettes*, compared to the evaluations of the tourists themselves. Public responsibilities for coastal protection from erosive phenomena often conflict with this situation. Therefore, the LGAs often found themselves between two fires; on one side are the tourists who request the removal of the banquettes, and on the other is the increasingly restrictive legislation issued by the institutions responsible for environmental protection, aimed at regulating the removal of banquettes from the beaches.

The CBA, limited to hedonic function alone, confronts us with the consideration that the management choices of public goods cannot be based exclusively on an evaluation of individual choices. This shows not only the failure of the market in the management of public goods, but also the failure of the contingent valuation as a methodology based on the analysis of individual preferences (Mossone, 2019). The survey did not include the analysis of cultural variables, but the cases highlighted by the disaggregated analysis of data from Greece and Sardinia suggest that part of the negative reactions of tourists to the presence of seagrass *banquettes* can be induced by the type of communication present in tourism marketing in those areas: the tendency is to advertise the white sandy beaches typical of the "Caribbean type".

This hypothesis, to be verified, could put marketing communication and cultural training of the hedonic users of ecosystem services at the center of the sustainable management of environmental goods. The results, as part of the POSBEMED project output, are perfectly aligned with the specific objectives of the GIREPAM project (Integrated Management of Ecological Networks through Parks and Marine Areas, Programme Interreg Maritime Italy-France 2014-20). They contribute to: (i) improve the conservation status and enhancement of coastal marine areas and to direct public accessibility to the natural supply; (ii) improve the effectiveness of public action in the governance and planning of coastal marine areas; (iii) increase awareness of the economic value of natural capital and encourage "green & blue" growth. Therefore, their capitalization is recommended through their integration in the

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development of a joint strategy for the sustainable management of the beaches with seagrass *banquettes* in the Mediterranean countries.

The findings provide key elements for developing more effective and powerful management strategies, both from an environmental and an economic point of view, and suggest rethinking and broadening the objectives of public action in the governance and planning of coastal marine areas.

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AUTHOR’S PROFILE

Paolo Mossone, is an economist specialized in the field of local development and sustainability. After a long career as a project manager and consultant for companies and public administrations, he is currently the managing director of the Foundation IMC International Marine Centre, a research center of the Science and Technology Park of Sardinia

Ivan Guala, is a marine ecologist specialized in ecological research on conservation of benthic ecosystems and the management of marine bio-resources. He works on ecological indicators for evaluating the ecological status of the marine environment, priority habitats and species of conservation interest, feasibility studies, management measures and monitoring protocols to test the effectiveness of marine protected areas. He is currently the coordinator of Coastal Ecosystems & Biodiversity research area at the IMC - International Marine Centre, Oristano (Italy).

Simone Simeone, is a researcher of the Italian National Research Council (CNR), he realizes several studies on the impact of the removal of *P. oceanica banquettes* from sandy beaches. Furthermore his research activities are also addressed on the beach morphodynamics, sedimentology and coastal geomorphology, including the adaptation of the coastal system to the climate change.

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THE ECOSYSTEM SERVICES CASCADE PERSPECTIVE IN PRACTICE: A FRAMEWORK FOR COST-BENEFITS ANALYSIS IN MARINE PROTECTED AREAS

***CHIARA PAOLI[ab], PAOLO POVERO[ab]**
GIORGIO FANCIULLI[c]

[a] DISTAV, Department for Earth, Environment and Life Sciences, University of Genoa, Italy
e-mail: chiara.paoli@unige.it,povero@unige.it

[b] CONISMA, Consorzio Nazionale Interuniversitario per le Scienze del Mare, Italy

[c] Portofino Marine Protected Area, Italy
e-mail: direttore@portofinoamp.it

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ABSTRACT
This study represents a first effort to synthesise biophysical, ecologic information with economic measures. The principal aim is to fill the gap between ecology and economy and provide to territorial managers an operational tool able to assess both environmental and economic sustainability in marine protected areas (MPA). At this purpose a specific framework to assess natural capital value and to obtain a modified budget of MPA has been applied to Portofino MPA. The framework has been developed in the context of the EAMPA (Environmental Accounting in Marine Protected Areas) italian national project. The natural capital of Portofino MPA amounts to 4.18E+18 sej (equal to over 4 millions em€) if only benthic organisms are considered and to 9.80E+18 sej (equal to over 10 millions em€) if also fishes are included in the assessment.
The modified balance here proposed includes both financial and biophysical/environmental fluxes. Benefits are significantly greater than costs, assuring that the MPA is able to maintain itself profitably. The results represent one of the first operationalization of the ecosystem theory and, in particular, of the ecosystem services cascade since the framework includes the assessment of the natural capital and the ES and the benefits it generates.

KEYWORDS
Natural Capital; MPA Management, Ecological Economic Budget; Sustainability

* The other authors are: Vittorio Gazale, Patrizio Scarpellini, Martina Armenio, Valentina Cappanera, Barbara Cavalletti, Matteo Corsi, Giulia Dapueto, Costanza Di Fabio, Elena Lagomarsino, Ilaria Lavarello, Francesco Massa, Lorenzo Merotto, Daniela Minetti, Martina Pozzi, Paola Ramassa, Ilaria Rigo, Claudio Valerani, Sara Venturini, Paolo Vassallo.

1 INTRODUCTION

The TEEB initiative (Ring, 2010) calls for a change to the current economic paradigm and encourages the integration between the ecosystems and human activities. TEEB distillates all recent findings by defining Ecosystem Services (ES) as the direct and indirect contributions of ecosystems to human well-being and by creating the so-called "ecosystem services cascade". The cascade is the pathway from ecosystem structure and processes to human well-being, a framework where the ES are the link that joins ecosystems with economics. Even if ecology and economics have failed, until today, to standardize the definition and measurement of ES, several initiatives and policies demand for their assessment (Maes et al., 2013, 2016). This paper seeks to answer the call for the implementation of accounting, reporting and mapping systems focused on ecosystems and ES. A framework integrating economic and ecological accounts and representing the interactions between the environmental and the human domains, according to the cascade theory, is here proposed (Edens & Hein, 2013). Some postulates were taken into account. First, the ES cascade highlights that our economies are constrained by the availability of natural capital (NC) stocks originating the ecosystem services flows (Sukhdev et al., 2010). NC is composed by all biophysical elements and it is an economic metaphor for the limited stocks of physical and biological resources (Costanza & Daly, 1992). Manufactured capital encompasses material goods generated through economic activity and technological change (UNU-IHDP and UNEP, 2012). Under the perspective of strong sustainability, NC is irreplaceable with manufactured capital (de Groot et al., 2002, 2012). Second, it is important to point out the difference between financial and environmental accounting. Financial accounting is mainly designed to convey information to external shareholders and financial authorities by means of standardized procedures that generate comparable data. The main goal of financial accounting is to assess the actual economic performance of the company or institution in accordance with in national laws and international accounting standards (Jasch, 2003). On the contrary, the core part of environmental accounting are material flow budgets. These budgets are realised through the quantification of material and energy flows within a defined system boundary and expressed in physical units. Some authors developed biophysical evaluation methods, complementary to the preferences' based assessments of natural resources (Jørgensen, 2010; Muller & Burkhard, 2012; Odum, 1996; Wackernagel et al., 1999). Biophysical approaches, based on the measurement of physical features, have been identified by several economists as a basis for valuation exercises (de Groot et al., 2012). Biophysical methods usually use a *cost of production* approach or the so-called *donor-side* perspective. If we consider nature as a system it can be described with a simple input-state-output representation (Pulselli et al.,

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2011). A *user-side* approach focuses on outputs and on the identification of users that exploit them. The ES theory is a typical *user-side* approach (Costanza et al., 1997; TEEB, 2010) based on an anthropocentric viewpoint (de Groot et al., 2002) while biophysical methods are founded on the assessment of inputs and then can be classified "donor-side" approaches. To gain a real sustainability, integrating both economic and environmental approaches, it is fundamental to connect the two (donor/user) sides of the coin in order to set up efficient management strategies.

2 METHODOLOGY

2.1 THE EAMPA PROJECT

Haines-Young, Potschin (2011) proposed the first formulation of the cascade, later modified by Spangenberg et al. (2014) to highlight the feedback from socio-economic system on ecosystem. This feedback is due to impacts generated by ES fruition but also to management strategies (Fig. 1). From biophysical components the functions potentially useful for mankind are originated. Ecosystem functions represent the potential to generate ES from NC stock and they exist independently from humans' behaviour (TEEB, 2010). When humans find some utilities in a function, this function enters the ES domain. From ES fruition, benefits are originated.

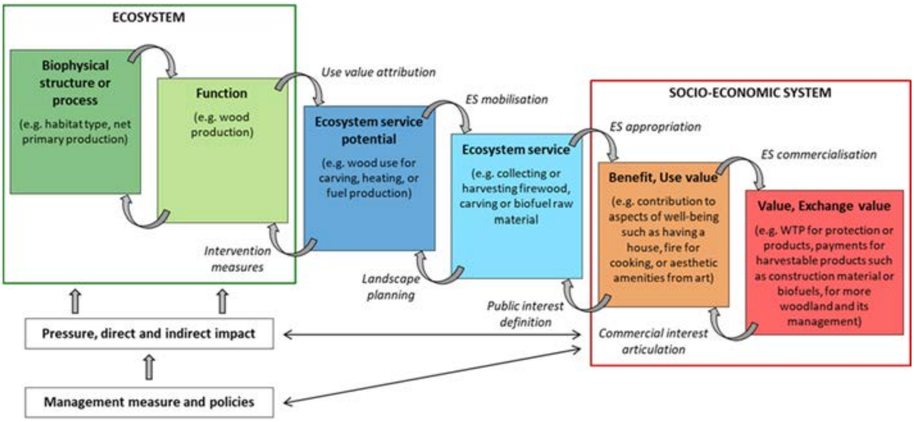

Fig. 1 A schematic representation of the ecosystem services cascade (Spangenberg et al., 2014)

Based on these theoretical foundations, in 2013, the Italian Ministry of the Environment and Protection of Land and Sea financed the Environmental Accounting in Marine Protected Areas (EAMPA) project. EAMPA is a 4-years research programme based on the implementation of

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an environmental accounting system in all Italian Marine Protected Areas (MPAs). The main goal of such a system is the calculation of the ecological and economic value of the MPAs, with particular reference to the ES generated in each protected area (Franzese et al., 2015). The programme foresees the achievement of a standardized assessment of NC as well as environmental costs and benefits in all protected areas by means of two complementary pathways and six operational phases (Fig. 2, Tab.1). The detailed methodology for EAMPA project realisation is described in Franzese et al. (2015) and Vassallo et al. (2017). Here its application to the specific case of Portofino MPA is presented.

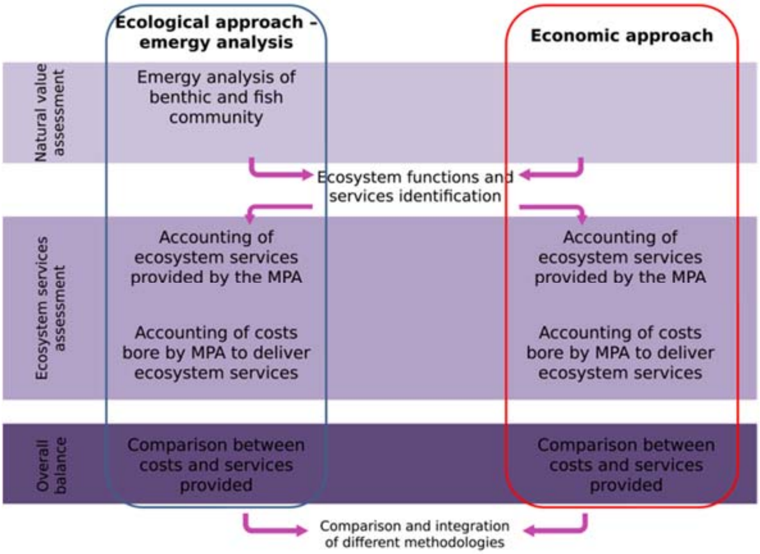

Fig. 2 Flowchart of the EAMPA project: environmental and economic research pathways

2.2 PORTOFINO MPA

The Portofino MPA was established in 1999 in the north-western part of Italy, Liguria Region, with a law from the Department of the Environment.

It occupies 363 ha and is widely recognised as a high natural value area, worldwide known for its emerged and submerged landscape as well as for the rich biodiversity the MPA hosts with endemisms and endangered species. The MPA of Portofino is included in the European Natura 2000 Network as Site of Community Importance (SCI IT1332674: Fondali monte di Portofino). Since 2005 the Portofino MPA is a SPAMI (Specially Protected Area of Mediterranean Interest) according to the decision of the RAC/SPA Office (UNEP, 2005).

Within the MPA many activities such as diving, fishing and also recreational boating are carried out and regulated with different protection levels, from more severe in A zone to less severe

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in C zone. Anyway the access into the MPA is forbidden to the ships longer than 24 meters. Nevertheless activities, mainly tourism oriented, are very common and pressure on local environment is very high: for instance recreational boating reaches even 200 units per days (Venturini et al., 2016) and diving activities count over 30’000 annual dives. The ES considered and evaluated were selected among CICES scheme (Haines-Young & Potschin, 2011) and listed within the National Account for the NC of the Italian ministry and in particular (Comitato Capitale Naturale, 2018): 1) bathing tourism 2) pleasure boating 3) recreational diving 4) recreational fishing 5) commercial fishing.

PHASE	ACTIVITY DESCRIPTION	ECOLOGICAL PATHWAY CALCULATION METHOD	ECONOMIC PATHWAY CALCULATION METHOD
0	Data gathering: analysis of existing data and new data collection		
1	Assessment of the ecological value of the MPAs by means of emergy analysis	Emergy analysis (Odum, 1996; Vassallo et al., 2017; Paoli et al., 2018)	
2	Identification of ecosystem functions and services	Haines-Young & Potschin, 2011	
3	Assessment of environmental and economic costs and environmental impacts	Emergy analysis (Odum, 1996)	Carbon footprint with social cost of carbon (Visintin et al., 2016)
4	Assessment of environmental and economic benefits		Willingness to pay, financial statement analysis, (Visintin et al., 2016)
5	Overall costs-benefits balance		
6	Implementation of an operational GIS platform	Franzese et al., 2015	

Tab. 1 Main steps of the EAMPA project and calculation methods employed for the fulfillment of the different project

In order to complete all project phases different activities for data collection and processing have been realised:

- inventory of MPA’s biocoenosis, their surfaces and their biomasses host through the analysis of previously realised studies about benthos and demersal fishes (Guidetti et al., 2011);
- questionnaires and interviews campaigns for data gathering about users flows’ quantification, users habits and expenses, users and economic operators resources’ consumption;
- bettering of authorisation system for ES fruition by users and economic operators;

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- inventory of resources consumed, detailed revenues and expenditure of the MPA itself;
- creation of a specific data management system and a website for the rationalisation of previous described data (biological data, questionnaires, authorisations) and project results.

All gathered information has been used to obtain the results of different phases through the calculation methods listed in Tab.1. In particular:

- biological data in Phase 1 to assess the NC: all resources required to generate the biomass stocked in the MPA were converted in emergy units. The final unit of measure for NC evaluation are emergy-euros (em€) namely the emergy biophysical units translated in money equivalent by means of appropriate conversion factors (Vassallo et al., 2017);
- information from questionnaires addressed to bathing, boating, diving and recreational fishing users were combined with those collected through interviews to economic operators of the corresponding ES to obtain cost and benefits from these sectors. Specifically costs were represented by resources consumed per presence (e.g. fuels, food) translated in em€ while benefits were represented by WTP and the expenses per presence (in euros). These data have been employed for Phase 3 and 4;
- estimate of users flows, to be multiplied by per presence estimates, have been obtained combing data from questionnaires about users behaviour with the number of authorisations;
- interviews to professional fishermen have led to the balance of the sector. Costs were represented by resources consumed (e.g. fuels, materials) in emergy units, catches, costs and revenues from the sector (Phase 3 and 4).

All these results have been summed up to the MPA financial report in order to obtain a new and modified balance able to take into account also the effort made by nature to assure the fruition of ES by users and highlight the monetary benefits activated on the local territory through the ES fruition provided by the MPA.

3 RESULTS AND DISCUSSION

Three main results have been obtained from the application of the framework: 1) the value of NC in Portofino MPA 2) the evaluation about self-maintenance capacity of MPA’s habitats 3) the modified MPA budget.The value of the MPA NC has been calculated, by emergy, in biophysical units, later translated in monetary equivalent (Tab. 2 and Fig. 2). Habitats with values higher than 6 €/m^2 occupy the 19% of surface but sum up to the 51% of value. More in detail, habitats with values in the top range (9-18 €/m^2), coralligenous and caves, represent

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hot spots in A and B zones where the protection level is more severe: they occupy the 5% of MPA surface representing the 20% of NC value. Habitats in the 6-9€/m^2 range (*P. oceanica* on soft bottom and on rocks) occupy the 14% of surface mainly in the C shallow zone contributing to the overall NC value for the 31%. The 66% of the MPA surface hosts low value habitats (<2 €/m^2) composing overall the 22% of the Portofino MPA value. Comparing resources generated by autotrophs and those consumed by heterotrophs the capacity of habitats to maintain themselves has been assessed. High value habitats are mainly deficit areas, filled by other habitats, concentrating biomass and requiring great productivity fluxes. These habitats are concentrated in a limited surface but their sustenance is assured by the presence of low value, surplus areas, able not only to self-maintain but also to export resources, located in the surroundings (within or outside the MPA).

	BENTHOS		BENTHOS AND FISHES	
	BIOPHYSICAL UNITS	MONETARY UNITS	BIOPHYSICAL UNITS	MONETARY UNITS
	sej	em€	sej	em€
Overall value	4.18E+18	4.34 million	9.80E+18	10.20 million
Value per unit area (m^2)	1.15E+12	1.20	2.70E+12	2.81

Tab. 2 NC values for Portofino MPA

The modified budget of the MPA takes into account four main components that are: 1) environmental benefits from the fruition of MPA ecosystem services 2) revenues: all monetary inputs from national and local administrations and from MPA activities (e.g. licences, sales) 3) environmental and biophysical costs generated by users and MPA management: impacts calculated on the environment calculated with carbon footprint and resources consumptions assessed with emergy 4) expenditures from financial budget. Portofino MPA returns to economy over 11 million of euros generating 68’480 €/ha of environmental benefits and 32’321 €/ha of net benefit. Benefits are 1.8 times greater than costs and are mainly due to environmental benefits (97%). The greatest benefit items are: indirect impact on economy (93% of benefits) and tourism and recreation (7%). Analogously, environmental costs compose the 94% of total costs, with pleasure boating (39%) and diving (36%) being the main contributions. This latter result means that those services are the more critical in term of drawback on the environment, requiring, then, a special effort by the AMP to reduce the impact and the use of resources that they provoke. Even if benefits are greater than costs it must be highlighted that user-side and anthropic benefits are accounted only according to economic and market approaches. It will be necessary, as further elaboration, to include in the budget the benefits generated to the environment and likely depending on the MPA protection regime.

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These benefits are represented by the increase in NC stock and environmental function provisioning associated with MPA management.

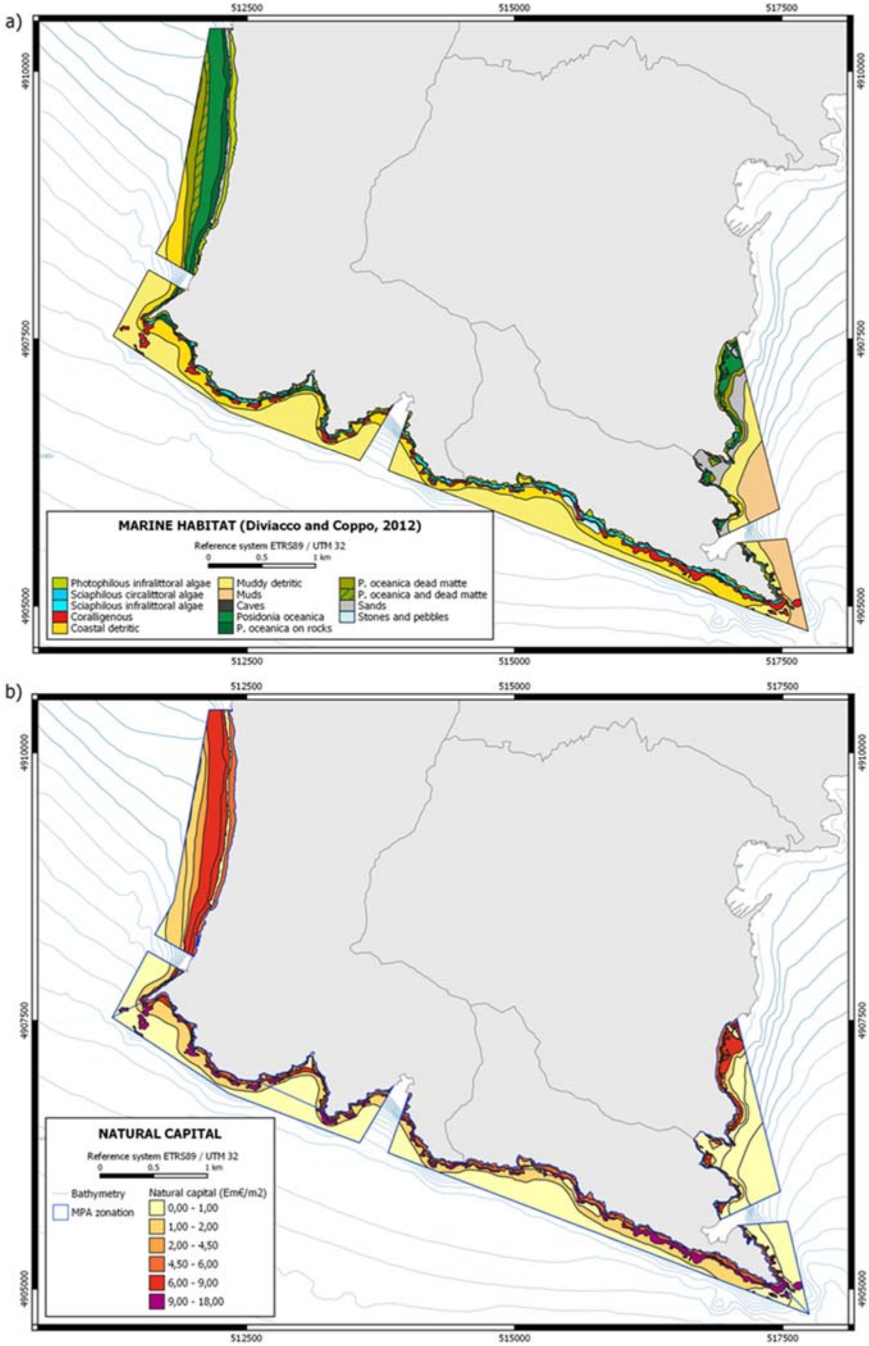

Fig. 3 Maps of a) habitats and b)natural capital in Portofino MPA

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BENEFITS	€	COSTS	€
ENVIRONMENTAL BENEFITS	24’856’843	ENVIRONMENTAL COSTS	13’129’430
Food production	37’174	MPA institutional activity	90’591
Erosion control	n.d.	Artisanal fishing	79’976
Nursery	n.d.	Recreational fishing	119’108
Climate regulation	7’348	Recreational boating	5’126’476
Tourism and recreation	1’756’294	Diving	4’680’290
Indirect impact on economy	23’056’027	Bathing	3’032’989
Scientific activity	(188264)		
Educational activity	(81904)		
REVENUES	843’156	EXPENDITURES	838’738
Routine revenues	617’539	Routine expenditures	653’875
Capital revenues	124’725	Capital expenditures	83’971
Reallocation of funds	100’892	Reallocation of funds	100’892
TOTAL BENEFITS	25’699’999	TOTAL COSTS	13’968’167
NET BENEFIT	11’731’831		

4 CONCLUSION

This study is a first effort to synthesise biophysical information with economic measures. This approach helps overcoming the gap between ecology and economy and provides to territorial managers an operational tool assuring the achievement of environmental and economic sustainability. A specific framework to assess NC value and to obtain a modified budget of MPA has been applied to Portofino MPA. Here, benefits are significantly greater than costs, assuring that the MPA maintains itself profitably. Nonetheless, to guarantee that the ecologic and economic components are managed in a sustainable way, two parallel budgets should be realised, to have a net benefit in both of them. The proposed scheme needs then the inclusion of biophysical benefits to be directly compared with biophysical costs.

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AUTHOR'S PROFILE

Chiara Paoli started her researches in 2005 developing a study aimed at identifying a methodology for administrations and managers to address the choice of sustainable management techniques of water cycle. During 2006 in the context of Alain Vatrican price she realised a research about sustainable management of marinas. In 2010 she got a PhD in Environmental science at the University of Genova performing a study about the development of an integrated methodology for coastal zone sustainability and ecosystem services valuation with system approach. From 2010 to today she had post-doc contracts and grants at the University of Genova in the field of sustainability analysis, ecological economics and natural capital and ecosystem services evaluation. She is author of 28 international scientific publications

Paolo Povero is Associate Professor of Ecology at the Department of Earth, Environment and Life Sciences (DISTAV) of the University of Genoa. He currently teaches Biological Oceanography, Marine environment monitoring course, and Ecology (degree in Sea Sciences, degree in Naval Engineering, TPAL degree). He was a member of the teaching board of the PhD in Marine Sciences of the University of Genoa and a PhD in Polar Sciences from the University of Siena. He has participated and participates, as a researcher and / or scientific director, in numerous national and international projects in South America, the Arctic, Antarctica, the Mediterranean, the Atlantic and Pacific Oceans. He developed researches concerning topics related to oceanography and marine ecology with particular reference to the study of the trophodynamic relationships between the pelagic and benthic compartment. He is also involved in the analysis of environmental historical series and marine ecosystems in relation to climate change and the study, design and development of technologies for oceanographic research and information systems for environmental data management. On these topics he has published numerous papers in national and international scientific journals. As part of the PNRA since 2004 he is the national coordinator of the LTER project - Marine Observatory of the Protected Area of Baia Terra Nova (Ross Sea, Antarctica) and responsible for the LTER Ligurian Sea site. He is a member of the Scientific Committee of the Ligurian District for Marine Technologies (DLTM). Delegate of the Rector in the Assembly of the Management Consortium of the Marine Protected Area of the Portofino Promontory.

Giorgio Fanciulli graduated in Marine Biology and he based his activity on fishing and biology working in acquaculture sector for 25 years. Then in 2005 he became the Director of Portofino Marine Protected Area and a lecturer in acquaculture at the University of Genoa from 2005 to 2013.

Vittorio Gazale born in Sassari on September 23, 1960, he graduated in Natural Sciences with a specialization in Systemic Ecology at the University of Paris VI and in Ecosystem Management at Battelle Ocean Sciences, Duxbury - MA (USA). He participated to various courses organized by the italian Ministry for the Environment and the Protection of the Territory and the Sea addressed to Directors and Managers of Protected Areas. From 2000 to 2010 he was Professor of Conservation of Nature at the University of Sassari. He is the Director of the Marine Protected Area of Asinara and he was Director of the Regional Natural Park of Porto Conte; Director of the La Maddalena Archipelago National Park; Director of the Marine Protected Area of Capo Caccia. He has coordinated several international projects under, for instance, the following financing programmes: Interreg, Equal, Horizon, Life Nature and Po Marittimo, on the topics of nature's conservation. He is the author of over 100 publications, including scientific papers and educational publications on the issues of the environment, protected areas and the conservation of biodiversity in the Mediterranean and Sardinia.

Patrizio Scarpellini graduated in Engineering in 1988. He was technical director of Consorzio di bonifica Padule Fucecchio, consultant for Portovenere Regional Park Director of the Montemarcello Magra Regional park and he is currently Director of Cinque Terre National Park.

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Martina Armeniowas graduated in Sea Sciences at the Genoa University in 2016with the following dissertation: Application of the Delta-GAM Method for the Estimation of the Abundance of Stenella coeruleoalba in the Ligurian Sea. Currently research fellow at the DISTAV of the Genoa University.

Valentina Cappanera graduated in Environmental Marine Sciences, she has been working in Portofino Marine Protected Area since 2006, focusing on the management of the coast and the evaluation of the impact of human activities, specially referred to small scale fishery and diving. In recent years she specialized in the management and coordination of European projects with particular reference to the LIFE, InterregMed and COSME programs. She is also a diving instructor and Chief of Ziguele Cooperative since 2016.

Barbara Cavalletti is an associate professor of Public Finance at the University of Genova, she has been teaching Environmental Economics since 1995 both at undergraduate and graduate level within the School of Economics and the School of Mathematics, Physics and Natural Science. Since 2008, she has been a full member of various PhD Programmes in Economics and Public Finance both at the University of Pavia and at the University of Genova; she has been supervising several PhD Thesis and has been member of PhD Defence Commitees. Since 1988, she has been member of various research teams within different research projects financed both at national and international level and scientific supervisor of 3 European project on environmental valuation and accounting and biodiversity conservation.

Matteo Corsi graduated in Economics in 2003 from the University of Genoa, Italy. Between 2006 and 2012 he worked as project consultant and project manager for Italian NGOs working on socio-economic and environmental planning projects. Since 2007 he has been a consultant for research institutions (Plan Urbanisme Construction Architecture-PUCA, University of Genoa, Liguria Ricerche S.p.A.). Between 2013 and 2015 he held the position of research fellow at the Department of Economics of the University of Genoa working on research projects in social statistics. Between 2015 and 2016 he was a research fellow at the Department of Political and Social Sciences of the University of Pavia working on a research project on multidimensional methods to measure well-being. He was a PhD student at the Department of Economics of the University of Genoa between 2015 and 2018 (PhD Dissertation planned for May 2019). Since December 2018 he is research fellow at the Department of Economics of the University of Genoa, working on a research project on quasi-orderings and partial orderings applications to environmental and social sciences. He has published papers on social statistics and public economics on internationl journals, among which Social Indicators Research, Environment and Planning: B, Papers in Regional Science.

Giulia Dapueto graduated in Marine Science in 2014 and took a PhD in Sciences and Technologies for the Environment and the Territory (Marine Science curriculum) on the research "Environmental spatial decision support system for the management of ecosystem services in marine coastal areas", both at the University of Genoa (Italy). Now she collaborates with the Italian Inter-university Consortium for Marine Science (CoNISMa), in particular with the Genoa's department. She is specialised in spatial analysis; marine environmental data collection and statistical processing; environmental accounting; computerization, management, analysis and publication via web of data and model implementation through information system that integrates the skills of (geo)database management system, software GIS and webGIS and content management system. She had been involved in different national (EAMPA, RIMA, LTER) and international project (FP7-IDREMM, FP7-SCHEMA, INTERREG GIREPAM, INTERREG NEPTUNE).

Costanza Di Fabio is a research fellow in financial accounting at the Department of Economics and Business Studies (DIEC) of the University of Genoa. She is lecturer in 'Business Administration and Accounting' at the Department of Law (DDG) of the same University and has experience in post-graduate teaching. She is currently involved in national and European research projects mainly focused on environmental accounting and corporate performance and she has recently been auditor of reports based on the GRSI format (UCID). In 2017, she completed the Ph.D. in Business Administration and Management cum laude at the University of Pisa (Italy) and, during the Ph.D., she spent a visiting period at the ESSEC Business School (Paris). She got the master's degree in Administration, Finance

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and Control from the University of Genoa. Her research interests include international financial accounting, financial communication and environmental accounting. She has been ad-hoc reviewer for national and international academic journals. Some of her papers have been published in national and international peer-reviewed journals, some are currently under review.

Elena Lagomarsino research fellow at the Department of Economics at the University of Genoa since 2017, she was a awarded a Ph.D. in Economics from the University of Heriot Watt in Edinburgh in 2018. Her research interests include applied econometrics, production function analysis, and environmental economics. She worked research assistant for the Centre of Energy Policy at the University of Strathclyde and contributed in the compilation of the British Petroleum Annual Report in 2015 and 2016. She is actively participating to three European funded projects on environmental themes. She has experience in academic teaching at an undergraduate level.

Ilaria Lavarello got a degree in Environmental Science at the University of Genoa (Italy) in 2006. During 2007 she worked for the MAC project in collaboration with Dip.Te.Ris University of Genoa, CIRSA University of Bologna, DiSmar Polytechnic University of Marche and Cinque Terre National Park. Using underwater sampling techniques, she has been involved in organisms census and monitoring of the coastal marine environment by sports divers.Between December 2007 and January 2009 became the guide of the Cinque Terre National Park and from May 2005 to April 2007 she played the role of diving guide within the Marine Protected Area of Portofino. Until January 2012 she has collaborated with the Cinque Terre National Park and Marine Protected Area of the Cinque Terre at Riomaggiore (SP) in the scientific field, where the main tasks are coordination and management of scientific research, environmental education, monitoring of the marine environment, support to universities and research institutions for data collection by scuba diving. Between July 2011 and December 2011 she was a collaborator of the Leonardo-Irta Institute for the implementation of the strategic project Med Pan North in the Cinque Terre Marine Protected Area for the transnational cooperation programme MED 2007-2013, carrying out assistance at the WAP for innovative aspects of the management of MPA, development of a monitoring system and specific tools for management of NATURA 2000 sites including a management plan for the SCI, study of planning and implementation of diving routes. From March 2013 acts as a collaborator for cataloging and monitoring aimed at conservation and valorization of the Marine Protected Area at the National Park of the Cinque Terre - Marine Protected Area of the Cinque Terre.

Francesco Massa is a post-doc researcher since 2014 at DISTAV (University of Genoa). Since 2005, he has been involved in different studies about information technology connected to the marine environmental science and he has developed a marine information system for environmental data management (MACISTE). In particular he is skilled about geodatabase, remote sensing, GIS and WEBGIS, OGC and INSPIRE standards, geoservices (WMS/WFS/WCS) , Sensors Web (SWE/SOS) and oceanographic instruments (CTD, ADCP) and he is trained to the marine environmental sampling activities . Moreover he is ROV pilot. In 2014 he obtained a PhD in Marine Science. Main interests are the use of new technology in real-time in situ environmental data acquisition with oceanography instruments (CTD, ADCP) and vehicles (AUV/ROV), the development of new sensors for environmental monitoring and data sharing. He had been involved in different national (TYRRMOUNTS09, MIUR RIMA, MIUR-SIR Project BioMount, EAMPA) and international project (FP7-IDREMM, FP7-SCHEMA, INTERREG GIREPAM project).

Lorenzo Merotto graduated in Marine Sciences in 2014 with a thesis on environmental-friendly anti-fouling paints developed at the Genoa CNR-ISMAR laboratories, after a short working period in the sames and at the Genoa Aquarium he started working as a scientific technician in Portofino Marine Protected Area in 2017.He worked on the evaluation of the effects of climate change within Portofino MPA, and on the execution of monitoring activity such visual census, mortality assessment of benthic organisms and landings of the Small Scale Fisheries. He has experience in Interreg-Med, Interegg-Marittimo, Life projects.

Daniela Minettil graduated in Natural Sciences in 1986 she is now a full time official in the Parks and Biodiversity Department of Regione Liguria from 2016. She is involved in impact assessment,

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management plans, monitoring, coordination of the territorial managers, coordination with the Ministry of the Environment, ISPRA and the European Commission, in-depth analysis and projects, ecosystem services and green economy in protected areas and in general on development sustainable, governance processes with local operators, collaborations and community projects in the environmental field in parks and protected areas and in general for the Department, research funds and design, management and facilitation of access to funds for parks and for the managing bodies, budget and physical reporting and project finance, member of the committee for coordinating international planning of valleys on EU funds, of the table of the International Convention of the SAPE ALPS Eusalp, international international Ramoge, of the working group for the UNESCO Application of Alps of the Sea. Previously director of Regione Liguria environmental agency and full-time official at the Departement for technical environmental staff of Regione Liguria.

Martina Pozzi graduated in Environmental Studies at the University of Genoa, where she finished the bachelor degree in December 2013. In Genoa, she also graduated a master degree in Marine Sciences in December 2015. She has been working as math and science teacher in a middle school since September 2016 and, in the meantime, she is collaborating with Conisma (National Consortium of Italian Universities for the Sea Sciences) in the environmental data processing and management field, as well as the natural capital and ecosystem service evaluation field.

Paola Ramassa is an associate professor of Accounting with research and teaching experience in: academic teaching (undergraduate, PhD, and MBA), professional training, post-graduate supervision and examination, participation in international and national research programs. Scientific director of research projects funded by private companies and audit firms; reviewer for several academic journals; member of international and national accounting academic associations, member of the editorial board of "Financial Reporting" (peer-reviewed journal). Academic publications including, among others, 16 articles in peer-reviewed journals; 15 book chapters; 1 book.

Ilaria Rigo bachelor's degree in Science and Tecnology for the Environment and Territory at Milan Bicocca University (Italy), during February 2016. She graduated in Marine Science at Genoa university for master in September 2018, I am now a phD student, dealing with evaluation of natural capital and ecosystem services provided along the Ligurian coast. Doctorate aim is to identify distribution of ecosystem services, quantify and find any possible external forcing.

Claudio Valerani got a degree in Environmental Toxicology at University of Milan in 2003. During years 1998 and 1999 he was a chemical analyst in sampling, control and environmental protection procedures at Creation et Parfurm s.r.l. From 1999 to 2001 he was an analyst employed in a laboratory of pharmaceutical chemical analysis in the Quality Control of sterile antibiotics at ACS Dobfar S.p.A. In 2003 he carried out chemical and environmental analyses on board of an oceanographic boat for the Agenzia Regionale Protezione Ambiente Toscana. From 2005 to 2013 he was responsible for the service at sea for the Cooperative, in agreement with the Park Authority of the Cinque Terre, within the AMP: management and management of nautical means, implementation of environmental protection projects (ecological boat), coordination and preparation of services of surveillance and information. Since 2013, he has been driver of boats belonging to the Park Authority, in order to prepare and carry out sea service of the WAP, territory valorization, operational coordination of technical-scientific and environmental protection projects, management of nautical means, surveillance service and environmental monitoring of the AMP. He is responsible for assessing both direct and indirect aspects of anthropic pressure within the AMP, aimed at carrying out the actions of control and information, monitoring the environmental status, prevention of violations of environmental regulations, support in civil protection operations, fire prevention and first rescue at sea.

Sara Venturini graduated in Marine Environmental Sciences with Master of University Specialization in "Marine Environmental Excellence: management, protection and sustainable use (EAM 2009)", awarded by the University of Genoa. Since 2009 he is part of the technical scientific staff of Portofino MPA.

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Paolo Vassallo got a degree in Environmental Science (specialization in Marine Environment) at the University of Genoa (Italy) in 2002, discussing a thesis about "analysis of the energetic fluxes in benthic marine environments by means of holistic indicators". During 2003 he signed a three months contract with Department of Physics of the University of Genoa and he had a grant in 'Applied Ecology' at the University of Genoa for the application of Exergy and Ascendency to benthic marine environments. From 2004 and 2007 he was PhD student in Environmental science at the University of Genoa while from 2007 to 2009 he signed a two year post-doc grant at the University of Genoa for the analysis of sustainability of coastal zone. From 2009 to 2012 I collaborated with Giardini Botanici Hanbury, to carry out the SUMFLOWER LIFE project. In 2010 he held the chair of "Environmental evaluation" at the University of Genoa. Since June 2013 he is assistant professor in ecology at the the Department for the study of Land, Environment and Health at the University of Genoa where he held the chairs of "Coastal Zone Management" and "Evaluation and management of the Environment". The main research interests are: 1) ecosystem health assessment by means of whole system analyses (e.g. network and exergy analysis); 2) sustainability evaluation of products, services and territories (e.g. ecological footprint, emergy analysis); 3) ecosystem functions and services evaluation; 4) ecosystem modelling and spatial ecology. He is author of more than 40 international scientific publications and participated to more than 40 international scientific conferences

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THE CONTRIBUTION OF THE ASSESSMENT OF POLICY CONSISTENCY AND COHERENCE TO THE DEFINITION OF THE LEGISLATIVE PROVISIONS OF MARINE PROTECTED AREAS

THE EXAMPLES OF THE REGULATIONS OF "TAVOLARA - PUNTA CODA CAVALLO" AND "ISOLA DELL'ASINARA"

SALVATORE PINNA, FRANCESCA LECCIS

Department of Civil, Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: pinna.salvatore@unica.it
francescaleccis@unica
URL: www.unica.it

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ABSTRACT

Nowadays, Marine Protected Areas (MPAs) in Italy face the serious challenge of managing complex territories, where socio-economic interests and nature protection are intimately related at any level. Therefore, spaces cannot be conceived as independent and isolated units, instead a holistic territory government, which organically integrates the numerous planning instruments and governance strategies, is urgently needed. An important example of this approach is the integration of Nature 2000 conservation measures into MPA regulations, as requested by the Italian Ministry of Environment, Land and Sea Protection. With this aim in view, the research team of the Department of Civil, Environmental Engineering and Architecture (in Italian: Dipartimento di Ingegneria Civile, Ambientale e Architettura, DICAAR), in collaboration with two MPA authorities in Italy, is currently writing the new respective Regulations, which integrate the conservation measures of Nature 2000 areas that overlap the respective MPA territories. The complexity of the process requests the definition of an appropriate Experimental Procedure (in Italian Protocollo Sperimentale, PS) to adequately include environmental and socio-economic aspects into the regulations. The DICAAR research is part of the GIREPAM project, whose goal is to define a strategy for an integrated management able to identify efficient actions for the management and development of Mediterranean maritime and coastal areas. This paper presents the contribution of one of the PS phases, namely the assessment of policy consistency and coherence, to the definition of the legislative provisions of the two Italian MPAs.

KEYWORDS
Marine Protected Areas; Policy Consistency and Coherence; Integrated Management

1 INTRODUCTION

Over five decades, marine areas have been provided with protection through a piecemeal legislation, which adopts separate sectoral polices unable to coherently integrate the different sectors (Boyes & Elliot, 2014). Today, there is a need for a harmonisation of local, regional, national and international management tools in force (Ibid.). In order to address this need, the research team of the Department of Civil, Environmental Engineering and Architecture (in Italian: Dipartimento di Ingegneria Civile, Ambientale e Architettura, DICAAR) proposes a pioneering approach to integrate the conservation measures, identified by Natura 2000 network for Special Protection Areas (SPAs), Sites of Community Importance (SCIs) and Special Areas of Conservation (SCAs), as well as the provisions determined by the Integrated Coastal Zone Management (ICZM) protocol and by the Standardised Actions for the Effective Management of MPAs (ISEA) project into the prospective Regulations of the MPAs of "Tavolara – Punta Coda Cavallo" and "Isola dell'Asinara". Due to the complexity of the task, an Experimental Procedure (in Italian Protocollo Sperimentale, PS) has been defined in order to adequately include environmental, economic and social aspects of the areas into the new Regulations. This paper focuses on a specific component of the aforementioned PS, consisting in analysing the contents and objectives of Plans and Programmes in force in the MPAs at the regional, provincial and local level.The study illustrates the role of the assessment of the policy consistency and coherence in the definition of the new MPA regulations, demonstrating an effective enrichment of the legislative provisions that are being drafted with significant elements related to the environmental, social and economic sectorial policies, thus achieving a holistic territorial management, able to efficaciously address the need for an integration among the various sectoral policies, as largely reported in the literature (Boyes & Elliot, 2014; Clark et al., 2000; Gurrutxaga San Vicente & Lozano Valencia, 2009; Kelleher, 1999).
The paper is structured into the following six paragraphs: the introduction, the legislative framework in force, the case studies in Italy, the assessment of policy consistency and coherence in the logical framework, the result discussion and the conclusion.

2 THE LEGISLATIVE FRAMEWORK IN FORCE

The legislative framework for MPAs is constituted by a wide range of treaties, conventions, agreements, directives and laws, aiming at protecting and safeguarding biodiversity. Among these, the UN Convention on Biological Biodiversity (CBD) in 1993 first introduced the need of conservation of biological diversity and its sustainable use (United Nations, 1992) through a legally-binding treaty to date ratified by 193 Parties (United Nations, n.d.). Since then, the

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Parties have been meeting every two years to both monitor the impact of adopted measures and to update the treaty, by setting priorities and committing to work plans. At the tenth meeting of the Conference of the Parties (COP) to the CBD, held in Japan in 2010, governments agreed to the Strategic Plan for Biodiversity 2011-2020. This plan is articulated into the 20 Aichi Biodiversity Targets, of which the eleventh aims at conserving "through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures" at least 10% of coastal and marine areas by 2020 (CBD, 2010.). This objective is fully specified in the Report of the World Summit on Sustainable Development, which promotes the "establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods, proper coastal land use and watershed planning and the integration of marine and coastal areas management into key sectors" (United Nations, 2002). In Italy, designation and management of MPAs are regulated by the laws no. 979/1982 and no. 394/1991. In particular, the former determines that MPAs include marine environments constituted by waters, seabeds and coastlines particularly relevant for marine and coastal flora and fauna due to their natural, geomorphological, physical and biochemical characteristics, and for scientific, ecological, cultural and economic importance. Simultaneously, the latter forbids activities that might compromise environmental protection. Consistently with these intentions and proposals, the Marine Strategy Framework Directive (MSFD, 2008/56/EC) highlights the importance of networking marine protected areas and the SACs designated under the "Habitats Directive" (92/43/EEC) and SPAs designated under the "Birds Directive" (79/409/EEC) to achieve a "good environmental status" (EC, 2008). Moreover, given the coexistence of a large variety of activities that pursue contrasting interests, Maritime Spatial planning (MSP) is considered the most appropriate process "to promote sustainable development and to identify the utilisation of maritime space for different sea uses as well as to manage spatial uses and conflicts in marine areas", while preserving the living environment, dealing with the fragility of marine and littoral ecosystems and preventing coastal erosion (EU, 2014). Nevertheless, many of the legislative instruments implemented to date lack of orderliness and consistency, because they neither are mutually complementary nor establish synergy with the other planning tools in force (Gurrutxaga San Vicente & Lozano Valencia, 2009). This results in fragmentation, spatial isolation and functional independence of protected areas, which exposes them to the consequences of habitat alteration and destruction, pollution and overfishing that might occur outside their boundaries (Clark et al., 2000), because substances and forcing factors are efficiently transmitted throughout the highly connected marine system (Kelleher, 1999). In order to

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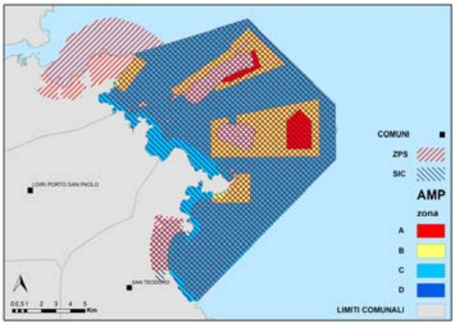
encourage maritime planning processes to adequately consider the interactions among land, sea and human activities, the European Union (EU, 2014) issued the Directive 2014/89/EU, which promotes consultation and coordination among Member States in order to achieve effective cross-border cooperation, and funded numerous projects for the integrated management of Mediterranean resources (EU. n.d.).

3 THE CASE STUDIES IN ITALY

An example of cross-border cooperation is the Interreg Maritime Italy-France Programme, in which the GIREPAM project has been developed with the aim to improve and innovate management tools of marine-coastal areas, coherently with a holistic territory vision in the attempt of balancing the interests related to the numerous activities with marine preservation and protection. Among the various activities of the GIREPAM project, a key role is played by the definition of a PS aiming at formulating new appropriate Regulations for the management and control of the MPAs named "Tavolara – Punta Coda Cavallo" and "Isola dell'Asinara" located in Northern-Eastern and Northern-Western Sardinia, respectively, as shown in Fig. 1 and in Fig. 2.



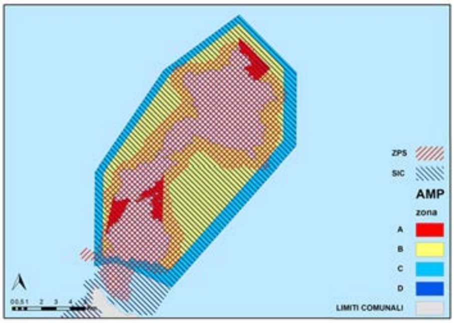


Fig.1 (left) Map of "Tavolara – Punta Coda Cavallo" MPA - Fig. 2 (right) Map of "Isola dell'Asinara" MPA

Various Natura 2000 sites partially overlap with the two MPA territories. In particular, the MPA "Tavolara – Punta Coda Cavallo" overlaps with the SPA "ITB013019 Isole del Nord-Est tra Capo Ceraso e Stagno di San Teodoro" and the SCI "ITB010010 Isola di Tavolara, Molara e Molarotto", while the MPA "Isola dell'Asinara" overlaps with the SPAs "ITB010001 Isola Asinara" and "ITB013011 Isola Piana di Porto Torres", and with the SAC "ITB010082 Isola dell'Asinara". According to the art. 2, subs. 3 and the art. 3, subs. 4 of the Decree of the Ministry of Environment, Land and Sea Protection (In Italian Ministero per l'Ambiente e la Tutela del Territorio e del Mare, MATTM), published on 17th October 2007, the management of the Natura 2000 sites is in charge to MPAs. Consistently, the MATTM demanded the integration of Natura 2000 conservation measures into MPA Regulations, in order to efficiently

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manage the area. In order to fulfil this objective, the research team of the DICAAR of the University of Cagliari, within the framework of the GIREPAM projects and in cooperation with the two MPA authorities, is writing the respective new Regulations which integrate the conservation measures of the SPAs, SCIs and SACs that overlap the MPA territories, as well as the provisions determined by the ICZM protocol and by the ISEA project. Due to the complexity of the task, a PS has been defined in order to adequately include environmental, economic and social aspects of the areas into the new Regulations. The PS defines a set of suggestions, objectives and rules that improve and complete the Regulations in force, thus integrating Nature 2000 conservation measures and promoting inter-institutional cooperation among the MPA authorities, the DICAAR group, local authorities, associations, economic operators and local stakeholders. A key component of the aforementioned PS is the assessment of policy consistency and coherence, which allows to enrich the new Regulations through the objectives drawn from the various plans and programmes, in force at the regional, provincial and local level.

4 THE ASSESSMENT OF POLICY CONSISTENCY AND COHERENCE IN THE LOGICAL FRAMEWORK

The assessment of policy consistency and coherence consists in analysing the contents and objectives of Plans and Programmes in force in the MPAs at the regional, provincial and local level to identify and evaluate interactions among these and the new Regulations (RAS, 2010). In particular, the objectives relevant for the MPAs are drawn from each Plan or Programme and subsequently compared to each other to overcome redundancies and conflicts that might arise. Eventually, a set of objectives are drafted, and they are allocated in a logical framework, in between the objectives drawn from the sustainability-oriented analysis and those drawn from the analysis of the legislative instruments in force in the MPAs and in the relative Natura 2000 sites (Tab. 1).

SUSTAINABILITY-ORIENTED OBJECTIVES	POLICY CONSISTENCY AND COHERENCE OBJECTIVES	OBJECTIVES FROM THE LEGISLATIVE FRAMEWORK IN FORCE	ACTIONS
Objective 1	Objective 1	Objective 1	Action 1 Action k
		Objective j	Action 1 Action k
	Objective i	Objective 1	Action 1 Action k
		Objective j	Action 1 Action k

Tab. 1 The structure of the Logical Framework

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According to this scheme, articulated into four levels, each element is simultaneously objective, whose fulfilment is pursued through the elements of the lower level, and means to achieve an objective of the upper level, so that its configuration is organised "from the general (aims) to the particular (actions)" (Bianco, 2007). In other words, in the logical framework objectives are connected through a "cause-effect relationship, according to which actions conduct to results, results conduct to the aims, and the aims contribute to the achievement of the general objectives" (Bonifazi & Giannetti, 2014).
Subsequently, it is verified whether the actions are already included in the Regulations in force or, in case they are not, either a new article is formulated or new subsections are added to the existing articles. The examples in the following section will illustrate the connection between actions and the articles of the new Regulations.

5 RESULT DISCUSSION

This section presents two examples, where the methodology previously illustrated is applied. In particular, Tab.2 shows an excerpt of the logical framework related to the "Landscape" component of the case study of the MPA "Tavolara – Punta Coda Cavallo".

SUSTAINABILITY-ORIENTED OBJECTIVE	POLICY CONSISTENCY AND COHERENCE OBJECTIVE	OBJECTIVE FROM THE LEGISLATIVE FRAMEWORK IN FORCE	ACTION
To preserve and to promote natural and human landscape heritage of the territory, and to regulate its fruition in order to protect its characteristics.	To preserve and to innovate landscape perceptions through functionality recovery and enhancement of forestry, pre-forestry, littoral and dune systems.	To safeguard coastal and dune systems from erosion.	To adopt adequate measures to rehabilitate dunes and bars (protection, signage and maintenance).

Tab. 2 Excerpt of the logical framework of the "Landscape" component of the MPA of "Tavolara – Punta Coda Cavallo"

Tab. 2 shows the double role of the objective drawn from the policy consistency and coherence as illustrated by Bianco (2007) and Bonifazi and Giannetti (2014).On the one hand, it is the means to pursue the sustainability-oriented objective, on the other hand its fulfilment is ensured through the objective drawn from the legislative framework in force, which is in turn pursued through the associated action. Indeed, the aim of preserving and promoting landscape heritage, expressed in the sustainability-oriented objective, is better defined in the policy consistency and coherence objective with specific reference to forestry, pre-forestry, littoral and dune systems. The objective drawn from the legislative framework in force only focuses on the last two environments listed in the objective of the upper level, namely the

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littoral and the dune system. Finally, adequate measures to rehabilitate dunes and bars are formulated in the last column. In the Regulation in force, no article implements the measures provided for in the action, so that the new subsection 7 of the article 11, which concerns public maritime domain regulation, includes provisions related to coastal rehabilitation, as follows: "in accordance with the MPA authority and the MATTM, it is possible to realise eradication interventions, environmental and habitat restoration, creation of detached breakwaters and anti-trawling artificial reefs, dune-system recovery and beach replenishment, designed in an environment-friendly way". Similarly, Tab. 3 shows an excerpt of the logical framework related to the "Water" component of the case study of the MPA "Isola dell'Asinara", confirming the double role of the objectives drawn from the policy consistency and coherence identified by Bianco (2007) and Bonifazi and Giannetti (2014).

SUSTAINABILITY-ORIENTED OBJECTIVE	POLICY CONSISTENCY AND COHERENCE OBJECTIVE	OBJECTIVE FROM THE LEGISLATIVE FRAMEWORK IN FORCE	ACTION
To improve sea and surface water quality and to promote cautious management of the water resource.	To introduce a rule to prevent or reduce polluting discharge into both surface waters and groundwaters to protect and improve water quality.	To preserve water biochemical characteristics	To introduce a rule concerning wastewater and hydrocarbons discharge into the sea.

Tab. 3 Excerpt of the logical framework of the "Water" component of the MPA of "Isola dell'Asinara"

In this example, the aim of improving sea and surface water quality, expressed in the sustainability-oriented objective, is better defined in the policy consistency and coherence objective with specific reference to polluting discharge into both surface waters and groundwaters to protect and improve water quality. The objective drawn from the legislative framework in force focuses on the preservation of water biochemical characteristics, pursued through the introduction of rules concerning wastewater and hydrocarbons discharge into the sea, as stated in the related actions. In the Regulation in force, no article implements the measures provided for in the action, so that the new subsection 3 of the article 13, which regulates wastewater discharge and waste management, includes provisions related to wastewater and hydrocarbons discharge into the sea, as follows:

"It is strictly forbidden to discharge into the sea:

- naval raw sewage and any toxic and polluting substances, as well as any kind of solid or liquid waste. Discharge of wastewater must be in compliance with the dispositions of the "Naval Waste Collection and Management Plan – Olbia, Golfo Aranci and Porto Torres Harbours";
- hydrocarbons, in compliance with the dispositions of the Law no. 438/1982".

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6 CONCLUSIONS

The paper shows the potential of the pioneering approach elaborated by the DICAAR research group of the University of Cagliari in defining new MPA regulations able to adequately integrate Natura 2000 conservation measures and the provisions determined by the ICZM protocol and by the ISEA project, thus addressing the need of a holistic approach highlighted in the literature (Boyes & Elliot, 2014; Clark et al., 2000; Gurrutxaga San Vicente & Lozano Valencia, 2009; Kelleher, 1999). In particular, the strategic role of the assessment of policy consistency and coherence in enriching the legislative provisions that are being drafted with significant elements related to the environmental, social and economic sectorial policies is illustrated. The logical framework allows to easily visualise the relationships among the sustainability-oriented objectives, the policy consistency and coherence objectives and the objectives of the legislative framework in force according to the model illustrated by Bianco (2007) and Bonifazi and Giannetti (2014), so that a set of actions are consistently formulated. These actions are subsequently compared to the regulations in force, in order to identify any potential integration needed. As shown by the two examples, this process often results in writing new articles or new subsections in existing articles, concerning crucial environmental or socio-economic aspects that were not considered by the regulations in force. In addition, a strong connection between the actions allocated in the logical framework and the legislative provisions of the new regulations is highlighted, thus demonstrating that an efficient integration of different sectorial policies into a comprehensive regulation provides an instrument that ensures the necessary holistic management of the area to effectively face current biodiversity loss. Therefore, the pioneering approach here defined represents an effective procedure, which can be applied in other similar contexts, where the integration of various sectoral policies in a comprehensive legislative instrument is needed in order to promote sustainable development, to manage spatial uses and conflicts in marine areas, while preserving the living environment.

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AUTHOR'S PROFILE

Salvatore Pinna is a Postdoctoral Research Fellow at the Department of Civil and Environmental Engineering and Architecture at the University of Cagliari, where he is currently involved in the GIREPAM project. He graduated in 2012 in Environmental Engineering at the University of Cagliari and he did an MSc in Project Planning for Rural Development and Sustainable Management at the Polytechnic University of Madrid. His areas of interest and research are in sustainable urban and regional planning, which he formalised in his PhD (2017) on the role of Alternative Food Networks in conserving agricultural landscape in Italy and Spain.

Francesca Leccis is a Postdoctoral Research Fellow at the Department of Civil and Environmental Engineering and Architecture at the University of Cagliari, where she is currently involved in the GIREPAM project. She graduated in 2012 in Architecture at the University of Cagliari and she did an MSc in International Real Estate and Planning at the University College of London. Her areas of interest and research are in sustainable urban and regional planning, which she formalised in her PhD (2017) on the impacts of urban regeneration policies implemented in London, Rome and Cagliari

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PASSIVE ACOUSTICS TO MONITOR FLAGSHIP SPECIES NEAR BOAT TRAFFIC IN THE UNESCO WORLD HERITAGE NATURAL RESERVE OF SCANDOLA

***MARION POUPARD[ab], MAXENCE FERRARI[ac]**
JAN SCHLÜTER[a]

[a] Toulon University, Aix-Marseille University
CNRS, LIS, DYNI team
e-mail: poupardmarion@gmail.com

[b] Laboratoire d'Ecologie des hydrosystèmes naturels & anthropisés
CNRS

[c] LAMFA, Université de Picardie Jules Verne
CNRS

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ABSTRACT

The Natural Reserve of Scandola (Corsica, north-western Mediterranean) has been a protected area since 1975, with a well-enforced management system. The increase in recreational activities in Corsica threatens iconic species such as the Osprey (Pandion haliaetus), the conservation of which within the reserve has been one of the main goals for more than 40 years. Within the no-take area, fishing, diving and mooring are strictly forbidden, but a large number of tourist boats come to visit the reserve. The goal of this study is to develop a method to record and monitor marine traffic, close to a nesting site of the osprey, using both terrestrial and marine recording devices. The first set up is a classic microphone set up on the Scandola cliff close to an osprey nest. An automatic algorithm of detection of bird calls was designed to assess the general presence of the birds over time. The marine device is composed of three underwater antennas, with four hydrophones each, that have been set up in the Bay of Elbu. We show the capability to assess boat trajectories according to their noise emissions. The monitoring of noise emissions in the presence of endangered species is essential for an effective management within the Natural Reserve of Scandola. These methods and devices are designed to be used by MPA managers and are applicable to other areas.

KEYWORDS
Boat Traffic; Flagship Species; Bird Detection; Passive Acoustic Tracking

* The other authors are: Patrick Astruch, Thomas Schohn, Elodie Rouanet, Adrien Goujard, Adrien Lyonnet, Pascale Giraudet, Valentin Barchasz, Valentin Giès, Paul Best, Jean-Marie Dominici, Thierry Lengagne, Thierry Soriano, Hervé Glotin.

1 INTRODUCTION

Marine Protected Areas with a high level of protection and conservation are time-honoured and effective tools whose benefits have been proven over many decades within the Mediterranean Sea (Boudouresque et al., 2005; Harmelin-Vivien et al., 2008) and worldwide (Edgar et al., 2014). The increase in tourism activities (Davenport and Davenport, 2006) and Global Change directly threaten the conservation status of coastal ecosystems and communities (Hoegh-Guldberg & Bruno, 2010). New management plans for MPAs must take into account these changes as a major priority, aiming at the implementation and the control of sustainable human activities within their areas. The Natural Reserve of Scandola (Corsica, France) was established in 1975. It is made up of a 70-ha no-take area (NTA) where fishing, diving and mooring are prohibited, and a 680-ha partial reserve (PR), where artisanal fishing and mooring are allowed but restricted. All activities within the terrestrial part of the reserve are prohibited. Since 1987, the reserve is part of the UNESCO world heritage. The conservation and the exceptional topography of Scandola marine and coastal areas have led to the maintenance and the growth of protected and heritage taxa considered as flagship species: (i) the osprey *Pandion haliaetus* (Monti et al., 2018), (ii) fish assemblages, represented by the dusky grouper *Epinephelus marginatus* and the brown meagre *Sciaena umbra,* both protected under French law*,* (iii) a virtually pristine *Posidonia oceanica* meadow hosting one of the densest populations of the Fan mussel *Pinna nobilis* (Butler et al., 1993), (iv) widespread assemblages of the perennial fucales *Cystoseira* spp., constituting a climax association of sublittoral Mediterranean reefs (Hereu et al., 2008). Over the last decade, marine traffic within the Natural Reserve of Scandola has strongly increased, according to the local manager. The typology of visiting boats has evolved from mainly large slow ships to numerous smaller high-speed boats, allowing more visits per boat and per day. The park manager fears the impact of this increasing activity on the more vulnerable communities within the reserve, including the osprey population and fish assemblages. Both the impact and intensity of the noise produced by this traffic within the reserve are unknown. The decline of the osprey population has already been evidenced (Monti et al., 2018) and linked with ecotourism activities. The related impact of the increase in boat traffic is one of the hypotheses highlighted. However, quantitative data are missing to confirm this or otherwise. In addition, a decline in fish assemblage abundance within the no-take area has been highlighted by local managers and unpublished data, particularly the populations of *E. marginatus* and *S. umbra* (M. Harmelin-Vivien comm. pers.). As the reserve is managed with well-enforced protection, the hypothesis of a possible impact of poaching cannot be considered as likely. Diseases

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affecting coastal marine species are known to cause potential high mortality. The dusky grouper among other species is currently affected in other areas within the north-western Mediterranean Sea by a nodavirus (Kara et al., 2014). This phenomenon is assumed to be linked with the warming of the Mediterranean Sea and could probably affect north-western Mediterranean populations of dusky grouper. One last plausible hypothesis that might explain this supposed decline in fish assemblages of the shallow rocky reefs within the NTA, is a vertical or horizontal migration of the most vulnerable demersal and pelagic fish species (i) out of the NTA, or (ii) to greater depth (i.e. below 20 m depth). This migration could be the consequence of the increase in the related boat traffic noise. To date, few studies have focused on monitoring the impact of boat traffic noise on coastal fish assemblages (González Correa et al., 2019). More knowledge is available about the impact on marine mammals. The aim of our work is to provide an innovative method to survey the intensity and the impact of traffic noise on vulnerable communities within the Natural Reserve of Scandola. Both aerial and underwater acoustic devices were used. The methods used are described hereafter as well as their possible implementation in other areas. This project can help the tourism industry to monitor their acoustic impact on the areas which are the habitat of local coastal birds (osprey *Pandion haliaetus,* Least concern according to the IUCN red list; BirdLife International, 2016) and marine communities within the Scandola area. For this purpose, measuring the emitted sound levels both underwater and in the air is relevant.

2 MATERIAL AND METHODS

2.1 STUDY AREA

The Natural Reserve of Scandola (Corsica, France) was set up in 1975. It is constituted of a 70-ha no-take area (NTA) where fishing, diving and mooring are prohibited, and a 680-ha partial reserve (PR), where artisanal fishing and mooring are allowed but restricted. All activities within the terrestrial part of the reserve are prohibited. Since 1987, the reserve is part of the UNESCO world heritage. Underwater devices were installed at three sites located off the Marina d'Elbu (-36 m depth), off the Calanque d'Imbutu (-36 m depth), and close to the Orgues islet (-20 m) (Fig. 1).

2.2 AERIAL ANTENNA

Recordings were made in April and August 2018 with a Zoom® H1 in stereophony within a site combining high boat traffic and the presence of an osprey nest. These two periods were chosen to match anthropogenic presence with the presence of the Osprey couple at nesting

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period (April) and during a high frequentation period (August). The recordings were made in stereo with a sampling frequency of 44 100 Hz. The system was placed on a small natural platform on the cliff. A total of 80 GB of recording has been thus constituted to date.

2.3 SUBMARINE ANTENNA

We used the high-resolution sound card JASON (Fig. 1), designed by the SMIoT (Scientific Microsystems for Internet of Things) platform (Fourniol et al., 2018). It enables the recording of 5 uncompressed channels with a sampling rate (SR) of up to 2 MHz and a resolution of 16 bits. Here, we recorded at 400 kHz x 4 channels, 16 bits, to specify the localization of the sources using a small antenna aperture (70 cm maximum). The hydrophones are the SQ24 (cut-off near 60 kHz). We built and placed three JASON antennas with four hydrophones each (Fig. 1). In the present paper, the station analysed is situated within the Bay of Elbu, by -36 m (Fig. 1), with a thermocline between 20 and 25 m depth and a 20 C° water temperature. The direction of the axis from Hydrophone 1 to Hydrophone 3 is 340°. The distances measured on site between the Hydrophones (in cm) are: d(1 to 2) = 46.0; d(1 to 3) = 71.8; d(2 to 3) = 40.3. Recordings were made in April and August 2018.
This device enables the calculation of the trajectory of a detected boat, as described in the results section.

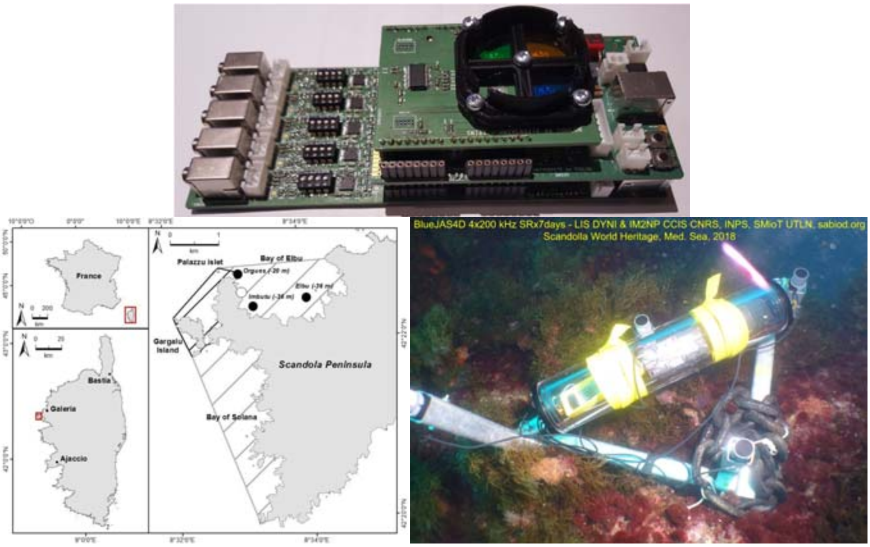

Fig. 1: Top: The JASON sound card (SMIoT), 5 x 2 MHz sampling rate at 16 bits resolution, placed in the tube (bottom left). Location of the Natural Reserve of Scandola (bottom right), the antennas (black circles) and the aerial microphone (white circle). The no-take area is represented in black stripes, the partial reserve in grey stripes

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3 DATA ANALYSIS

3.1 AERIAL MONITORING

We designed an automatic acoustic event extractor (inspired from Lasseck, 2014). The main steps of the algorithm are: (i) calculate the spectrogram (time frequency representation) of the recording; (ii) calculate a binary image by breaking the median by frequency band and time slice. If the value of a pixel is greater than K (K = 3 times the median + 3 times the standard deviation of its row, and 3 times the median + 3 times the standard deviation of its column), then the pixel is set to 1, otherwise to 0; (iii) apply a "closing" filter for each pixel and "dilation" to remove the noise; (iv) label all the pixels connected to each other and remove the isolated pixels; (v) delimitation by corresponding rectangular area of interest. This algorithm enhances and separates bird acoustic emissions even in loud background noise (Fig. 2). It allows to extract the time-frequency patterns of the birds, in order to learn an automatic classifier later on. We also provide bird detections using the algorithm of Grill and Schlüter (2017) (Fig. 2).

In this first study, we simply estimate boat noise by the energy of the audio signal after applying a bandpass filter centred at 50 Hz (Fig. 2). Different examples were analysed and listened to manually in order to verify the detectors (Fig. 2): periods *a*, *b* and *c* contain only boat noise and no birds, period *d* contains only birds, and period *e* contains both birds and boats.

This step confirms that both the bird detector and our boat detection proxy seem to provide reasonable results. As a first attempt to examine if and how birds are influenced by the presence of boats, we calculated the Pearson correlation coefficient (linear correlation only) between bird call detection probabilities and the low-frequency intensity level (in dB). The coefficient was -0.01 (with a p-value of $3.58e^{-28}$), so there was no correlation between our simple boat noise estimate and the bird detector.

The next steps will be to differentiate the different sources, ospreys and others, to automatically calculate the number of acoustically active individuals in the ecosystem, to classify the species, and to correlate the vocalizations and their shapes with the related anthropic pressures on a much larger set of recordings.

3.2 MONITORING OF THE BOAT TRAFFIC

Trajectories of boats were defined using the following steps: (i) estimation of the Time Delay of Arrival (TDoA; Fig. 3) of each event from the cross-correlation between the pairs of the four channels, (ii) and reconstruction of the 3D positions with a nonlinear solver (Giraudet et

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al., 2006; Glotin et al., 2008; Poupard et al., 2019). Here, we simply compute the Longitude and Latitude of the boat, as we already know its altitude (i.e. sea surface).
We show in Fig. 3 that the antenna is monitoring the boat traffic, enabling the description of a boat's displacement at the surface. These moves can then be correlated to the noise measurements, which, for example, would provide a basis to give recommendations to the driver to minimize engine acceleration near the birds' nests.

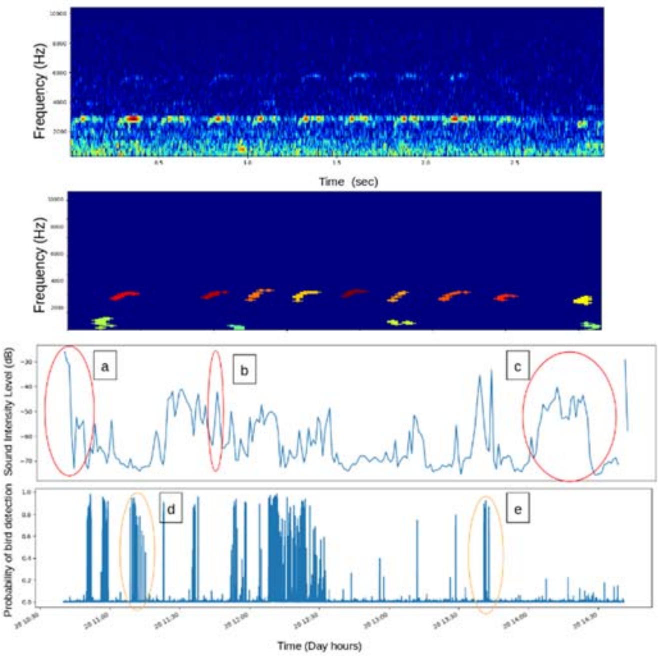

Fig. 2: (Top) : Three-second of raw signal of Osprey's calls. (Middle): The acoustic event detection as time/frequency patches. Osprey calls are clearly extracted, between 2 kHz and 4 kHz. (Bottom): Analysis of 4 hours of the 20th of August 2018. Sound intensity level around 50 Hz, representing boat noise; and the probability of bird detection (Grill & Schlüter, 2017). (a,b,c) show presence of boat noise without birds, (d) shows bird calls without boat noise and (e) bird calls with boat noise. (a-e) where confirmed manually by listening to the recordings

4 DISCUSSION AND CONCLUSION

We have designed a low-cost, efficient tool to help MPAs managers to assess the noise of human activities on coastal and marine ecosystems and consequences on related communities such as the osprey within the Natural Reserve of Scandola. This approach has great potential. For the first time, a 4-channel high sampling rate is available and has been implemented in a natural reserve.

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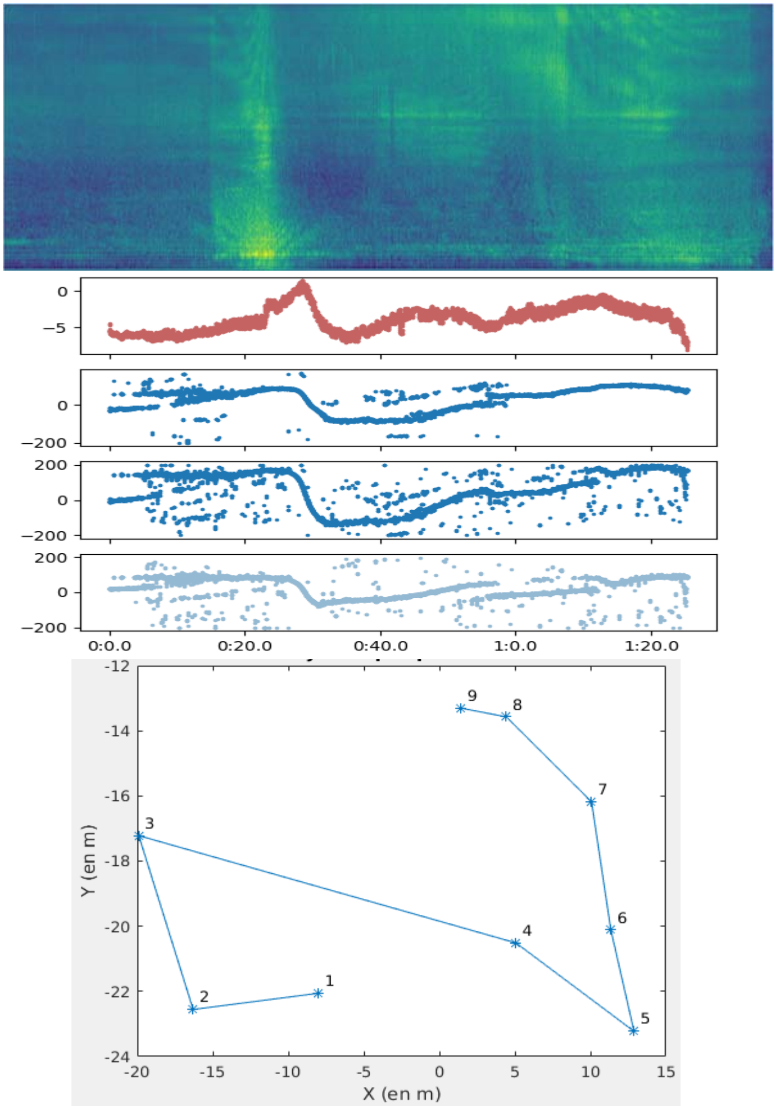

Fig. 3: From top to bottom: The time frequency representation of the boat noise, and the Time Delay of Arrival to each hydrophone. Recording samples at : http://sabiod.univ-tln.fr/scandola_ 2018/20180809_ 080548UTC _V03OS30.ogg. The computed positions of a boat over nearly 2 minutes, from the TDoA, by 10-second step (X is Northing, Y Easting, Z=0, in meter), showing the stationary position of the boat, the moves and accelerations done in order to have the boat stable in front of the area of tourism interest

It has been possible to install an aerial microphone and hydrophones, but not in a less or unfrequented area such as e.g. Caletta (Galeria, north of the Scandola area). We have shown evidence of the boat noise emissions. Several behavioural changes have been studied in marine mammals exposed to such sound pollution.

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One of the main sources of pollution studied is boat traffic. For bottlenose dolphins, for example, the presence of vessels entailed longer inter-breath intervals, and quicker changes of heading, speed, and smaller inter-animal distances (National Marine Fisheries Service, 2016; Nowacek, 2001).

Those behaviours demonstrate that the animals are trying to avoid the vessels. It is crucial to acknowledge that in that area of Sarasota bay (Florida, USA), vessels are encountered at an average interval of 6 minutes during daytime. The dolphins' 'natural' activities are thus heavily disturbed. This might also be the case in the Scandola area for other communities such as coastal fish assemblages. The boats' noise emissions have also been recorded both in the air and underwater. The calls of the ospreys will be assessed with simple counting of the call over time (Fig. 2). This temporal pattern will be correlated with the boat noise, assessing how the ospreys are affected. More refined analyses are in progress to search for variations of the emission of the calls linked with the abundance, the noise level, and the localisation of boats. The underwater soundscape will also be analysed and correlated with the fish assemblage assessment processed by visual census within the frame of the same project (Astruch et al., 2018). A future research will be realize with recordings on all the year in order to compare noise during high season and low season. Moreover, climate change is now one of the most severely impacting factors affecting coastal and marine ecosystems. A well-designed ecosystem-based management system is necessary to enhance the maintenance and the resilience of ecosystems and the quality of related communities. Degraded ecosystems are known to be more vulnerable against impacting factors: (i) non-native species invasion, (ii) human impact (e.g. trawling, anchoring, dredging, pollution, etc.), (iii) mass mortality events linked to the warming of the Mediterranean Sea (Garrabou et al., 2009; Lejeusne et al., 2010). In this context, Marine Protected Areas remain more than ever essential tools that need to be extended and/or better enforced in order to (i) maintain the quality of coastal and marine areas, (ii) enhance their resilience and (iii) provide related ecosystem services. The control of the noise emissions from human activities must be considered as one of the main issues for managers and stakeholders, particularly within MPAs.

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AUTHOR'S PROFILE

Marion Poupard is currently a Phd student supervised by Hervé Glotin, Thierry Soriano and Thierry Lengagne on "Embedded classification of acoustic landscapes incorporating ecosystem data: applications in land and marine watch". Marion has a Master degree "Gestion de l'environnement et écologie littorale ". His Master's internship was a bioacoustic data mining on dolphin whistles and estimation of data using the t-SNE method or clustering. http://sabiod.univ-tln.fr/workspace/poupard/

Maxence Ferrari is currently a Phd student supervised by Hervé Glotin and Mark Ash on "Study of bio-inspired sonar based on modelisation of a complete chain of emission propagation reception. Validation on sperm whales ". Maxence has a Master degree at "Ecole Centrale de Lille.

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Jan Schlüter is spending a postdoc year at the University of Toulon, at LIS lab, as part of the DYNI group. He works on Convolutional neural networks and deep learning, acoustic sequence labeling and event detection, weakly-labeled data and multiple-instance learning, differentiable time-frequency representations.

Patrick Astruch is a research engineer at GIS Posidonie (Marseille, France; NGO working on applied research on marine ecology), he is focused on the monitoring and the understanding of the functioning of marine and coastal ecosystems within the Mediterranean.

Thomas Schohn study engineer in Marine Ecology at GIS Posidonie (Marseille, France; NGO working on applied research on marine ecology), he works on statistical treatment, data base management and GIS to carry out projects about monitoring of the impact of human activities on marine ecosystems.

Elodie Rouanet is a research engineer at GIS Posidonie, she is working on marine ecosystem monitoring. In the frame of this project, she has contributed to field activities and data sampling strategy.

Adrien Goujard study engineer in marine ecology at GIS Posidonie, he developped data management et GIS tools to study Mediterranean ecosystems. He has participated to the whole sampling strategy of the project.

Adrien Lyonnet, Civic Service Volunteer at GIS Posidonie, he has contributed to the field activities related to this project.

Pascale Giraudet is a professor of Biology and neurophysiology at the University of Toulon. She works on signal processing, neural representation of olfactory scenes (http://giraudet.univ-tln.fr/) in the LIS laboratory.

Valentin Barchasz works as engineer on Electronics, digital electronic and analog electronic. He works for the SmioT platform and the design of the sound card.

Valentin Gies is a professor of electronic and robotic, specialist of Multi-Signal Data Acquisition System and Kalman filter (http://www.vgies.com/). He is a part of the SmioT platform, who built the sound card acquisition.

Paul Best is a PhD student in computer sciences. While getting his engineering diploma at ECE Paris, he specialized in applied information technologies, at first for web development, and co-founded PIPLE SAS. He then turned into and specialized in machine learning and data sciences, first applied to music composition at IRCAM, and then to bioacoustics (current PhD).

Jean-Marie Dominici is the manager of the Natural Reserve of Scandola (Corsica, France), he has brought his experience and knowledge of the study area context.

Thierry Lengagne, CNRS researcher at Lyon 1 University, a specialist in communication systems in animals, Thierry Lengagne conducts research in fundamental research to study, for example, the processes involved in training couples in amphibians, as well as the vocal organization of animals, tropical bird communities or interspecific communication among European passerines.

Hervé Glotin is Professor of Computer Sciences, specialist in Data Sciences and Machine Learning at UMR CNRS LIS, Toulon University. He heads the Scaled Acoustic Biodiversity Project, http://sabiod.org, and EADM MADICS CNRS action. He is honorary member of the Institut Universitaire de France for outstanding research. http://glotin.univ-tln.fr

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USE OF ECOLOGICAL INDICES TO ASSESS THE HEALTH STATUS OF POSIDONIA OCEANICA MEADOWS IN EASTERN LIGURIA

INFLUENCE OF ECOLOGICAL STATUS ON NATURAL CAPITAL

***ILARIA RIGO, MONICA MONTEFALCONE CARLA MORRI**

Department of Earth, Environment and Life Sciences
University of Genoa, Italy
e-mail: ilaria.rigo@edu.unige.it
montefalcone@dipteris.unige.it
morric@dispteris.unige.it

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ABSTRACT

Posidonia oceanica (L.) Delile is an endemic Mediterranean seagrass and a key species of coastal marine ecosystems listed among the priority habitats in the European Directive 92/43 / EEC. P. oceanica is a good biological indicator to define the quality of coastal marine ecosystem, because its high sensitivity to environmental conditions changes. The aim of this study is 1) to investigate if the health status of some P.oceanica meadows located in different sites influences the ability of the system to stock natural capital and 2) to quantify changes in natural capital value in both biophysical and monetary terms. Health status of five different meadows along Liguria coast was evaluated by means of different indicators such as: Conservation Index, Substitution Index, Phase Shift Index and Posidonia Rapid Easy Index. Natural capital has been assessed through emergy analysis, a biophysical approach able to account the resources directly and indirectly used up to reach a certain product or mantain a system. Results showed that healthier meadows are located in marine protected areas or far from main sources of anthropic pressures and that higher values of natural capital is stored in healthy seagrass.

KEYWORDS
Posidonia Oceanica; East of Liguria; Ecological Indices; Natural Capital

* The other authors are: Carlo Nike Bianchi, Alice Oprandi, Paolo Vassallo, Chiara Paoli.

1 INTRODUCTION

In the Mediterranean Sea more than two thirds of the coastline is now urbanized. The huge edification causes anthropogenic pressures that generate changes in coastal ecosystems and that could represent a serious threat for natural environment (Montefalcone et al., 2009).

Good coastal management practices, even on a local scale, may lead to restoration of natural conditions and, in turn, increase resistance and resilience of marine habitats. The Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) are the European umbrella regulations for water systems (Van Hoey et al., 2010). In this context, it is a challenge for the scientific community to translate directives principles into operational approaches and to make people aware about the consequences of human activities on marine habitats. Specifically, the main goal of the MSFD is to achieve Good Environmental Status (GES) of EU marine waters by 2020 with the aiming at a sustainable exploitation of marine resources, ensuring their continuity for future generations. Costanza and Daly (1992) presented the concept of natural capital that includes land, air, water, sea and ecosystems therein. The term ecosystem goods and services (ES hereinafter) refers, instead, to the benefits that populations derive, directly or indirectly, from ecosystem functions (Costanza et al., 1997; MEA, 2005). A tight link exists between ES provision and natural capital (NC hereinafter), since only if NC is preserved intact the supply of services in the future and at the current level can be guaranteed (De Groot et al., 2012). The goal is then to achieve GES so that the provision of ES to human population is maintained in the long run. In the last decades the link between ecosystems and human economy became manifest (Vassallo at al., 2017). As a consequence a growing interest for the assessment of ecosystems'value, particularly in ES theory. Efforts were then addressed to the monetisation of ecosystems but also to employ their evaluation to 1) raise general public awareness and to 2) address decisional processes by means of new instruments for policy makers (Beaumont et al., 2008; Brown et al., 2001; Costanza et al., 1997; Odum, 2000). In this context, among marine habitats, seagrasses are considered of main concern since they are able to provide key ES. Moreover to assess the environmental health status, European Community requires use of biological indicators, which allow an ecological characterization of the system, together with chemical-physical analysis. In this context, Posidonia oceanica (L.) Delile is recognised as a bioindicator to study environmental quality (Ferrat et al., 2003). The aim of this study is then to evaluate how the conservation status of meadows affects NC value. To this end, an estimate of P.oceanica health state was carried out in five P.oceanica meadows along the eastern Ligurian coast.

We calculated a set of ecological descriptors and indices able to assess current state of meadows. The Conservation Index (CI), and Phase Shift Index (PSI) were calculated to get

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information about disturbance events and potential recovery ability, evaluating the presence of dead matte and the appearance of substitutes (Cymodocea nodosa and Caulerpa spp.).
Besides, Posidonia Rapid Easy Index (PREI), an integrated index composed by five different descriptors, was calculated to determine the ecological status of water as required by the WFD. NC value was calculated by means of emergy analysis, following Vassallo et al. (2017). Emergy is a methodology able to quantify solar energy directly and indirectly necessary to generate and maintain a system and its functioning. It is thus a donor-side estimate of the value of a system measured as production cost in terms of the resources investment.

2 METHODOLOGY

Study area is located along the eastern Ligurian coast, between cities of Genoa and La Spezia. Analysed meadows are located in Camogli, Punta Pedale, Prelo - San Michele di Pagana, Framura and Monterosso (Fig. 1).

Fig. 1 Study sites along East Liguria

The data gathering was carried out by scuba diving (two transects perpendicular to coast in each site) in the period between May and October 2017. From the lower limit of each meadow, every 10 m, we recorded data about depth and about the percentage of surface covered by live Posidonia oceanica, dead matte, sand, rock and any substitutes (Cymodocea nodosa, Caulerpa prolifera, Caulerpa taxifolia and Caulerpa cylindracea). Contemporarly information about depth and type of the lower limit were collected. Furthermore, leaf density was recorded by means of a 40 x 40 cm2 quadrat where the number of shoots was counted (9 replications at 15 m, following the ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) protocol (www.isprambiente.gov.it/it). Finally, in each transect, 18 orthotropic (vertical) rhizomes were taken in three not contiguous zones. Laboratory activities consisted

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of phenological analyses, lepidocronological analyses and study of associated foliar epiphytes. Phenological analysis was carried out using standardized method (Buia et al., 2004; Giraud, 1977). On each harvested shoot, we obtained leaf number (n_ leaves/shoot), leaf width (cm) and leaf length (cm), necessary to calculate the leaf area for shoot (cm2 shoot-1). Leaf biomass, as grams of dry weight, was estimated after incubation at 70 °C for 48 h. Lepidocronological analysis is a retrospective technique that consists of studying leaves life cycles of seagrass P. oceanica, that allows to define the age of meadows, through the thickness of slivers, and the environmental variability within which it develops. All data collected from the lepidocronological analysis were then examined to obtain the biomass over year, both in terms of rhizome lengthening and leaf production. Epiphytic biomass was taken from each adult and intermediate leaf using the grating method, dried in a stove and weighted separately. Foliar epiphytes are early warning indicators capable of responding to changes in the water column (Giovannetti et al., 2010): an increase in their quantity is linked to a decrease in environmental quality. Data collected were used to calculate P. oceanica descriptors at different levels: individual, population and community. Descriptors were used to obtain ecological indices, such as: CI (Moreno et al., 2001) which compares the cover of alive P. oceanica to dead matte; SI (Montefalcone et al., 2007) which identifies substitutes; PSI (Montefalcone et al., 2009) that measure level of ecosystem change due to regression; PREI (Gobert et al., 2009) that calculates the ecological quality ratio which includes EQR' expressed in the following formula:

$$\boldsymbol{EQR'} = \frac{\left(\boldsymbol{Ndensity} + \boldsymbol{Nleafsurfaceofshoot} + \boldsymbol{N}\dfrac{\boldsymbol{epiphyticbiomass}}{\boldsymbol{leafbiomass}} + \boldsymbol{Nlowerlimit}\right)}{\boldsymbol{3,5}}$$

Indices estimating the health status of meadows are reported in Tab. 1 together with their calculation formulae and reference values. Calculated values of these indices have been then classified in accord with five quality classes (UNEP-MAP-RAC/SPA, 2015) providing information on the health status of the system. The status is classified as: high, good, moderate, poor, bad (Directive 200/60/EC). Furthermore, in order to get the value of meadow's natural capital, emergy analysis was applied. This approach is able to to assess the effort made by natural system (measured as resources, space and time invested) to produce biomass stock. Emergy analysis is a quantitative analysis that standardizes the amount of different resources types in a common unit of measure: solar energy (Brown & Herendeen, 1996), so its units is solar emergy Joules (sej). If the emergy flow required for a process is higher, the amount of solar energy it "consumes" and the environmental cost to maintain it are great.In this work emergy analysis was applied according to the methodology described by Vassallo et al. (2017).

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Total emergy value of natural capital of P.oceanica meadows was finally converted to monetary units by using the emergy-to-money ratio.

	FORMULA	REFERENCE VALUES				
		High	Good	Moderate	Poor	Bad
CI	$CI = P/(P+D)$	≥0.9	0.7-0.9	0.5-0.7	0.3-0.5	<0.3
SI	$SI = S/(P+S)$	<0.1	0.1-0.25	0.25-0.4	0.4-0.7	≥0.7
PSI	PSI = {[(1-CI) · 1] + (SICn · 2) + (SICp · 3) + (SICt · 4) + (SICr · 5)}/6	<0.08	0.08-0.16	0.16-0.25	0.25-0.5	≥0.5
PREI	$EQR = (EQR' + 0{,}11)/(1 + 0{,}10)$	1-0.775	0.774-0.550	0.549-0.325	0.324-0.100	<0.100-0

Tab. 1 Ecological indices formulas and UNEP-MAP-RAC/SPA reference classes

At the end, it was assessed how much of NC been stored in the below-ground component rather than in the above-ground to underline which component holds a greater part of the capital. The whole information flow stemming from field and laboratory activities and leading to data analyses is summarized in Fig. 2.

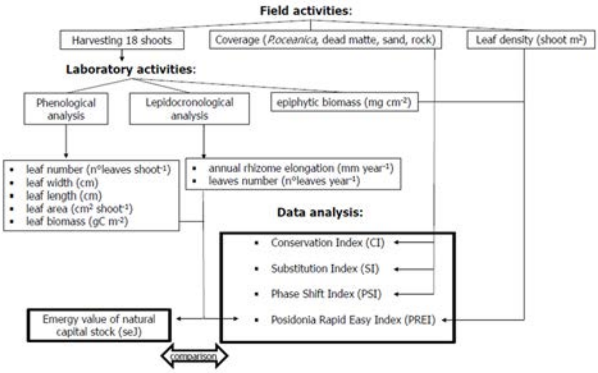

Fig. 2 The phases for the development of the study

3 RESULTS AND DISCUSSIONS

Tab. 2 shows indices and natural capital values obtained for the five meadows and analysis according to identified quality classes. All sites reported a good state of health as no one falls into a status considered "poor" or "bad"; specifically CI denoted a particularly high ecological status for sites of Framura and Monterosso, where, according to the classification in literature (Montefalcone et al., 2009), there is a state of conservation ranging from good to very good. "Good" values were also recorded in Camogli. Only Punta Pedale and Prelo-S.Michele meadows reported a "moderate" conservation status. All investigated seagrasses had PSI values lower than 0.08 that describe an "high" ecological status according to the classification

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reported in the literature (Montefalcone et al., 2009). Therefore PSI seems to be more effective in recording differences in meadows health status and to be then less descriptive. Finally, PREI had highest values at Framura: that is the only site recording a "high" ecological status according to the classification of Gobert et al. (2009). "Good" values have been identified at Camogli and Monterosso; instead lower quality of P.oceanica meadows has been reported for stations of Punta Pedale and Prelo-San Michele, where the ecological status is "moderate". The lower limit is regressive in all stations, exception of Framura, where the excellent state of the lower limit is probably linked to the greater distance from sources of anthropic impact. This is also the case for Camogli and Monterosso transects, located within the protected marine areas of Portofino and Cinque Terre, where many human activities, such as anchorages, diving and fishing, are forbidden. Also the analysis of variance (ANOVA) on epiphytic biomass values (mg ps cm-2) showed significant differences between sites ($p < 0.01$) placed within controlled or urbanized areas. The Tukey test showed that epiphytes were significantly greater at Punta Pedale where transect 1 reported an average biomass of 0.44 mg cm-2 and transect 2 showed 0.69 mg cm-2, instead of all the other sites with average values around 0.20 mg cm-2. Natural capital resulted positively correlated ($n=10$, $p=0.9$) with better ecological status and the highest natural capital value was found in transect T2 of Framura. On the contrary, results identified Punta Pedale and Prelo-S.Michele as meadows with lowest natural capital values. Moreover, it turned out that 65% of natural capital calculated is represented by the below underground part of seagrasses and only 35% instead by the foliar component. Rhizomes tend to grow more slowly, storing biomass for a longer period of time. Therefore considering biomass data and age of rhizomes for emergy evaluation leads to increase capital value.

		CI		PSI		PREI		NATURAL CAPITAL (sej m-2)
CAMOGLI	T1	0.87	good	0.02	high	0.66	good	2.31E+12
	T2	0.83	good	0.03	high	0.67	good	2.96E+12
PUNTA PEDALE	T1	0.70	moderate	0.05	high	0.52	moderate	1.33E+12
	T2	0.88	good	0.02	high	0.50	moderate	2.85E+12
PRELO-S.MICHELE	T1	0.59	moderate	0.07	high	0.54	moderate	3.20E+12
	T2	0.54	moderate	0.08	high	0.53	moderate	1.81E+12
FRAMURA	T1	0.88	good	0.02	high	0.72	good	3.36E+12
	T2	0.99	high	0.00	high	0.78	high	3.97E+12
MONTEROSSO	T1	0.99	high	0.01	high	0.62	good	2.76E+12
	T2	0.89	good	0.02	high	0.62	good	2.75E+12

Tab. 2 Values obtained from calculation of indices and natural capital

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3.1 CONCLUSION

Landscape descriptors (CI, PSI) and the PREI index values were consistent reporting better health state for Framura, Monterosso and Camogli meadows, and worse for Punta Pedale and Prelo-S. Michele. This is probably due to the greater anthropic influence on these meadows, due to coastal urbanization and tourist pressure during the summer period and to the absence of protection measures. In particular, bay of Prelo, at the beginning of the 20th century, was subjected to the presence of a system of catenaries for mooring small pleasure boats, which still forms an underwater network on the seabed colonized by P. oceanica (Montefalcone et al., 2006). The status of Prelo-S.Michele and Punta Pedale meadows is also confirmed at community level by the biomass epiphytic measurement, which shows above-average values. As leaf epiphytes are early warning indicators able to react more quickly than other descriptors to changes in water column (Giovannetti et al., 2010), it is assumed that an increase of their quantity is linked to a decrease of environmental quality. It could be due to pollutants carried by currents from the nearby river and by discharges of many boats that stop in bays during the summer period. Using CI as a synthetic measure of the conservation status of P.oceanica is effective for investigated seagrasses, where observed areas characterized by dead matte represent mainly human-induced impacts (Peirano & Bianchi, 1997). Natural capital evaluation, used as tool to summarize system's complexity, have reported higher values for meadows of Framura, Camogli and Monterosso and lower values for bays of Punta Pedale and Prelo San Michele. So the ability of ecosystems to store natural capital and in turn to provide ecosystem services resulted influenced by meadows ecological status confirming how human disturbance on ecosystems may hamper the functioning of the system and thus reducing the benefits humans may obtain in terms of ecosystem services provisioning.

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AUTHOR'S PROFILE

Ilaria Rigo, Bachelor's degree in Science and Tecnology for the Environment and Territory at Milan Bicocca University (Italy), during February 2016. Graduated in Marine Science at Genoa University for master in September 2018, I am now a phD student in Marine Ecology at the Department of the Earth, Environment and Life Science (DiSTAV) at the University of Genoa, dealing with evaluation of natural capital and ecosystem services provided along the Ligurian coast. Doctorate aim is to identify distribution of ecosystem services, quantify and find any possible external forcings.

Monica Montefalcone is a researcher in Ecology (BIO07) at the Department of the Earth, Environment and Life Science (DiSTAV) at the University of Genoa (Italy) and a professor of Tropical Marine Ecology, of Scientific Diving and of Managing Marine Biodiversity. She started to study seagrasses in 1999, she took her PhD in 2007 on Posidonia oceanica ecology, and today she is working in the field of applied research on coastal marine environment, which includes monitoring, characterization, cartography, biodiversity assessment and evaluation of ecological status and changes over time of coastal habitats, such as seagrasses, rocky reefs and coralligenous, submerged caves, and coral reefs. She is member of several scientific societies, and recently she has been working as a scientific consultant of the RAC-SPA (Regional Activity Centre for Specially Protected Areas).

Carla Morri teaches Ecology and Seascape Ecology at the University of Genoa, School of Science. Has research experience in taxonomy, faunistics and ecology of hydrozoans and scleractinian corals. Synecology of the marine benthos. SCUBA survey methods. Semiotics and diagnostics of underwater seascape. Most familiar ecosystems are submarine caves, rocky reefs, coral reefs, seagrass meadows, lagoons and shallow-water hydrothermal vents. Academic Editor of Mediterranean Marine Sciences and Diversity. More than 300 scientific papers published, including four books and several book chapters. Her papers are frequently cited by other authors, allowing for an H-index of 47 (Google Scholar). Her research touched at various aspects of the ecology of coastal marine and transitional environments, focusing on three main research topics, strictly interconnected: ecology of marine Cnidaria; biodiversity of the marine benthos; biological zonation along ecological gradients.

Carlo Nike Bianchi is Professor of Ecology at the University of Genoa, Faculty of Sciences. Has research experience on biodiversity, bionomics, mapping and biogeography of the marine coastal environment. Special topics include benthic community structure, gradient analysis, bioconstruction,

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effects of climate change on marine ecosystems, ecological complexity, and macroecology. Taxonomical and ecological expertise on serpulid polychaetes and other (sessile) macro-organisms, and reef fish. Most familiar field techniques are visual censuses and photographic surveys by scuba diving. Experience in univariate and multivariate biodiversity data analysis. Academic editor of the following scientific journals: Journal of the Marine Biological Association of the UK; Marine Biodiversity Records; Marine Ecology; Mediterranean Marine Science; Public Library of Science (PLoS) One. More than 400 scientific papers published. His papers are frequently cited by other authors, determining a value of H-index equal to 53 (Google Scholar). His research is essentially transdisciplinary within the Marine Environmental Sciences, but deals principally with four major themes: Mediterranean Sea biodiversity; ecosystem change; anthropogenic impact on the coastal zone; methods for the characterisation of communities and seascapes.

Alice Oprandi is a PhD student in Marine Ecology at the Department of the Earth, Environment and Life Science (DiSTAV) at the University of Genoa (Italy) under the supervision of Carlo Nike Bianchi and Monica Montefalcone. She works on coastal marine ecosystems, in particular, regarding the change and conservation of P. oceanica meadows, coralligenous reef and tropical coral reefs. She got the bachelor degree in Environmental Science (specialization management and conservation of the marine environment) in 2010 and the master degree in Marine Science at the University of Genoa during June 2013 with an experimental thesis titled "Status of Posidonia oceanica meadows between Capo Vado and Capo Noli: diachronic analysis and influence of hydrodynamic constrains through the application of a predictive model".

Paolo Vassallo got a degree in Environmental Science (specialization in Marine Environment) at the University of Genoa (Italy) in 2002, discussing a thesis about "analysis of the energetic fluxes in benthic marine environments by means of holistic indicators". During 2003 he signed a three months contract with Department of Physics of the University of Genoa and he had a grant in 'Applied Ecology' at the University of Genoa for the application of Exergy and Ascendency to benthic marine environments. From 2004 and 2007 he was PhD student in Environmental science at the University of Genoa while from 2007 to 2009 he signed a two year post-doc grant at the University of Genoa for the analysis of sustainability of coastal zone. From 2009 to 2012 I collaborated with Giardini Botanici Hanbury, to carry out the SUMFLOWER LIFE project. In 2010 he held the chair of "Environmental evaluation" at the University of Genoa. Since June 2013 he is assistant professor in ecology at the the Department for the study of Land, Environment and Health at the University of Genoa where he held the chairs of "Coastal Zone Management" and "Evaluation and management of the Environment". The main research interests are: 1) ecosystem health assessment by means of whole system analyses (e.g. network and exergy analysis); 2) sustainability evaluation of products, services and territories (e.g. ecological footprint, emergy analysis); 3) ecosystem functions and services evaluation; 4) ecosystem modelling and spatial ecology. He is author of more than 40 international scientific publications and participated to more than 40 international scientific conferences.

Chiara Paoli got a five years degree in Environmental Science at the University of Genoa (Italy) during April 2005, with an experimental thesis about "environmental sustainability analysis of water cycle" of Genova province. The study was aimed at identifying a methodology for administrations and managers to adress the choice of sustainable management techniques of water cycle.During 2006 she realised a research about sustainable management of marinas and she collaborated with the Univesity of Genova as external expert. In 2010 she had a PhD student in Environmental sciences at the University of Genova with a study about the development of an integrated methodology for coastal zone sustainability and ecosystem services valuation. From 2010 to 2012 she signed a two year post-doc grant at the University of Genova for the analysis of sustainability of coastal zone. During 2013 she collaborated with Giardini Botanici Hanbury, a regional protected area, to carry out a European project (SUMFLOWER) founded under the LIFE founding scheme. At present she is a post-doc at the University of Genova and her main topic are coastal zone sustainability and management, marine protected areas management, natural capital and ecosystem services biophysical and economic evaluation, ecological economics in general, system analyses applied to sustainability, system ecology.

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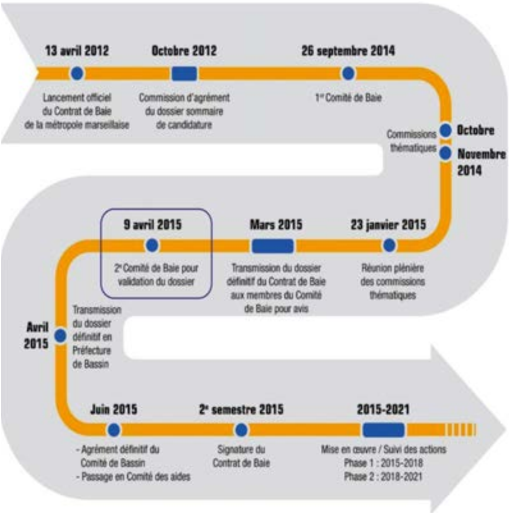

COASTAL GOVERNANCE AND PLANNING AGREEMENTS FOR INTEGRATED MANAGEMENT OF MARINE PROTECTED AREAS IN UE COASTING PROJECT

***SAVERIO SANTANGELO[a]**
PAOLO DE PASCALI[a], MARIA TERESA CUTRÌ[b]

[a] PDTA Department, Sapienza University of Rome, Italy
Interreg MED Coasting
e-mail: saverio.santangelo@uniroma1.it
URL: https://web.uniroma1.it/pdta/

[b] Interreg MED Coasting
e-mail: mariateresa.cutri@gmail.com

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ABSTRACT

The paper starts within the framework of the Interreg MED project Coasting, Coastal Integrated Governance for Sustainable Tourism. Coasting aims at increasing the sustainability of coastal tourism in the UE Med Countries, implementing approaches based on governance among public and private actors involved in the management of tourism development processes. The marine protected areas (MPA) in coastal areas, before having any tourist objectives, are a key environmental element to be protected and enhanced. In this paper, starting from the Contrat de baie of Marseille (CdB)- which is the key reference in the overall Coasting approach to integrated management of coastal areas -, the MPA within the Parc national des Calanques is investigated. Both the CdB and the Parc carry out actions with results on the MPA management. The CdB action aims at improving water quality both on the terrestrial and marine contexts, form an ecological point of view. Otherwise, the Parc action is more directly related to uses regulation. As result, the MPA is object of the joint action of the two actors in terms of integrated management within the framework of a wider governance that interests the whole area of the Communauté Urbaine of Marseille. In addition to examine the multilevel governance approach of the CdB, and its specific related tools in terms of planning agreements (Contrat de rivière in France, and River Contracts in Italy), the paper investigates the relation between the CdB and the management actions implemented in the MPA of the Parc national des Calanques.

KEYWORDS
Coastal Governance; Coasting; Contrat de Baie; Marine Protected Areas Planning Agreements

* The other authors are: Carolina Pozzi, Annamaria Bagaini.

1 INTRODUCTION

This paper constitutes a significant step in a research path whose initial input has been the achievement of funding within the EU Interreg MED Programme at the end of 2017, related to the Coasting project (*Coastal Integrated Governance for Sustainable Tourism*)[1]. The concrete start of the project, in the first half of 2018, motivated us to present a research project on these topics, in parallel with Coasting, also within Sapienza University. The research is now in the initial phase of development.

In the framework of Input aCAdemy 2019, this paper aims to discuss some Coasting topics related to the Call, with the perspectives of the research path development.

The intersection between the problems of Coasting and those inherent to marine protected areas was considered, in fact, since the area of the first reference at the base of this European project (the bay of Marseille)[2] is the marine protected area (MPA) of the *Parc national des Calanques* (PdC). We also considered this situation to be of some interest with respect to the possible mix of conditions and factors that, in coastal areas, can interfere with the presence of a marine protected area. In this case, in fact, the MPA:

- it is located in a metropolitan and touristically attractive area (Marseille / Provence), the subject of an important series of interventions in ecological and environmental terms (*Contrat de Baie*);
- it is part of a park (terrestrial-marine), itself an object of tourist use;
- and, as such, it is itself the object of tourist use (obviously regulated).

Therefore, considering these aspects in relation to the hypothesis that a good sustainability of coastal tourism can be obtained with approaches and tools of collective action governance (planning agreements), as is the Contrat de Baie of Marseille, the research question arises in these terms: how the problems of a marine protected area are inserted into an instrument of integrated environmental governance of a wider urbanized territory in which the same MPA falls (Contrat de Baie); and how effective planning agreements with an environmental value

[1] Sapienza University of Rome is partner in the Coasting project, with a research group of PDTA Department. Funded in the end of 2017, the project was initially coordinated by P. De Pascali. From 2018 S. Santangelo is the responsible for its implementation. The group, including internal and external members of Sapienza PDTA, is composed also of M.T. Cutrì, P. Nicolarea, C. Pozzi, M. Prati. The project involves in its consortium 9 partners from 6 EU-Countries. https://coasting.interreg-med.eu.

[2] This is the area covered by the Contrat de Baie, which includes the Communauté urbaine of Marseille Provence Metropole and other municipalities of Aix-Marseille-Provence Metropole (which is a partner of the Coasting project).

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of a voluntary-contractual nature, such as the CdB or the CdF[3], can include and contribute to addressing the sustainability issues of coastal tourism (and, consequently, protecting marine sensitive areas when present in the interested territories).

2 INTEGRATED MANAGEMENT OF MARINE PROTECTED AREAS IN COMPLEX ENVIROMENTS

The Coasting approach draws on the experience of tools for the implementation of environmental policies and for the management of coastal and marine areas - the Coast/River Contracts -, as the basis for the achievement of the overall sustainability objectives, and specifically, related to coastal tourism. In this framework the primary reference, the Marseille CdB, is an important experience related to integrated management tools implementation, that covers the vast territory of the bay.

We will recognise marine protected areas (MPA) considering the only requirement that they are under protection and addressed by integrated management. In this perspective, the case study of the CdB - and specifically the MPA of the *Parc national des Calanques* which is part of the Contract intervention area - appeared to be representative, considering the different institutional and technical responsibilities and competencies involved in managing the MPA and the Parc.

Firstly, the area interested by the CdB is a vast territory, beyond the limits of the *Communauté Urbaine Marseille Provence Metropole* (CU MPM), intensely urbanized for the central third of its coast. Secondly, this area is the marine zone of the entire Marseille agglomeration and of its inland, and that therefore it is under pressure of the impacts deriving from uses and activities affecting its territory, both of land and maritime. Finally, the third qualifying aspect - and the first motivation of the proposed case study - is the presence, as already mentioned, of the MPA in the PdC, that is a relevant stakeholder involved in the CdB. Moreover, the interested part of sea is significantly extended, and only partly falls within the marine area covered by the CdB, reaching the limit of the French territorial waters for a front width of about 32 nautical miles. It is important to highlight that for its terrestrial part, the *Parc* consists of the peri-urban territory on the hinterland of Marseille, thus confirming the variety of environmental characteristics and urbanization of the context.

The overall framework of this marine area is therefore extremely complex. As well as the different levels of administrative and political, economic-financial and technical management of the area, starting with the highest level, Aix-Marseille-Provence Metropole, one of the 14

[3] Contratti di fiume (River Contracts).

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French metropoles, to the cœur, both marine and terrestrial, of the Parc. Thus, the presence of plans, programs and actions related to the different interested territories, is various and articulated; consequently, also in relation to the strong administrative structure, this could suggest that management of this area is complicated.

3 ON THE NATURE AND RISKS OF GOVERNANCE

In this perspective, the CdB - being a voluntary multilevel governance tool defined as «*fédérateur des démarches contractuelles existantes*» - should have a point in its favour. A governance approach that would have the ambitious task of harmonizing and integrating the pre-existing Contracts and projects and their related objectives[4]. In this framework, it is possible to understand the CdB as the attempt to overcome the difficulties in the implementation of the different Contracts activated at lower levels and characterized by more sectorial approaches; the attempt to achieve the fundamental integration of complex problems related to land-marine management.

In this sense, we are talking about integrated management in the CdB and therefore of processes, formal acts and interventions that also involve the MPA and the PdC of which it is a part.

The CdB is today in the middle of the implementation process (see the scheme on page 1). In order to have initial elements of judgment on its results, also with regard to the presence and management of the MPA, it will be necessary to wait at least two years. Meanwhile, both in the general terms of the research path presented here and with regard to the repercussions in the Coasting context, it seems appropriate to immediately consider some methodological issues, with respect to which to evaluate the results. The reference is to some so-called "illusions", that need attention, in the ICZM context, particularly in some experiences matured up to the early 2000s, detected in general and, in particular, in the Francophone context (Billé, 2006). The first illusion concerns the conception of environmental management as a coordination problem; it is «l'illusion du tour de table comme solution à tous les problèmes». In short, «la recherche consensuelle de coordination par la concertation sous-estime en fait les antagonismes bien réels entre acteurs et usages "non coordonnés", les différences d'intérêts et de représentations» (Billé, 2006), and, more generally, «placer un problème dans

[4] The CdB includes: (i) Contrat d'agglomération aiming at improving the functioning of the sanitation system of the Marseille agglomeration and the quality of the aquatic environment; (ii) Contrat de Rivière de l 'Huveaune aiming at meeting the objectives of the SDAGE (Schéma Directeur d' Aménagement et de Gestion des Eaux) concerning the quality of the aquatic environments of the river basin, of the Huveaune river; (iii) Opération Calypso aiming at enacting actions to prevent the pollution deriving of the port.

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un cadre collectif ne suffit pas à en faire une préoccupation de tous» (Mermet, 1992)5. The fact that contributes to this illusion, especially in environmental management, is that consensual approaches are appreciated, in the medium term, by almost all the actors involved, and therefore also by environmental actors because they, on average, find themselves in a relationship of weakness with respect to the other actors (Mermet, 1998)6, and are therefore convinced that they can better achieve their goals in this way than by explicitly addressing conflicts (Billé, 2006). In the continuation of the research, we intend to investigate from this point of view how we arrived at the definition and regulation of the MPA of the PdC, which is mentioned in the following paragraph.
A second illusion is the "positivist" illusion, that is the consideration of scientific knowledge as «condition nécessaire et suffisante à une bonne gestion des zones côtières» (Billé, 2006). In this sense, it is also possible that this last illusion interests the same concept of governance, especially when it is simply borrowed from the culture of business management and the corporate technique theory, authoritatively validated and assumed as recognized and shared technical know-how (Deneault, 2013). Among other things, this illusion is present, in some ways also according to obvious juridical profiles, also in the relations between (public) government of the economy and the market, where "governance" «legitimizes and favours a direct and priority interlocution between [public] administrative apparatus and market» that somehow transcends «the traditional canons of representative democracy». If it is not a true renunciation of the government of the economy, it is certainly «a sort of downsizing of a portion of [political] discretion in favour of a technical (but not neutral) management of significant economic interests» (Iacovone, 2010).

4 ELEMENTS AND CHARACTERISTICTS OF THE PARC DES CALANQUES AND THE CONTRAT DE BAIE

The *Parc national des Calanques* was established on April 18th 2012, according to the law of April 14th 2006 which provides a governance with local key actors and partnerships between different levels of administration and territorial areas. The law also foresees the articulation between the protection of the *coeur* of the parks and *développement durable* of the surrounding zones; the reference operational tool is a new document, the *Charte*. The area of the *Parc* – terrestrial and marine – is extended for almost 1,600 km^2. Although the *Parc* is explicitly defined as «*à la fois terrestre, marin et périurbain*», most of the surface is actually

[5] Quoted in Billé.

[6] Quoted in Billé.

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marine (141,500 ha). This area is divided according to two categories and two use/protection rules: a *coeur marin* of 43,500 ha; an *Aire Maritime Adjacente* (AMA) of 98,000 ha (Fig.1).

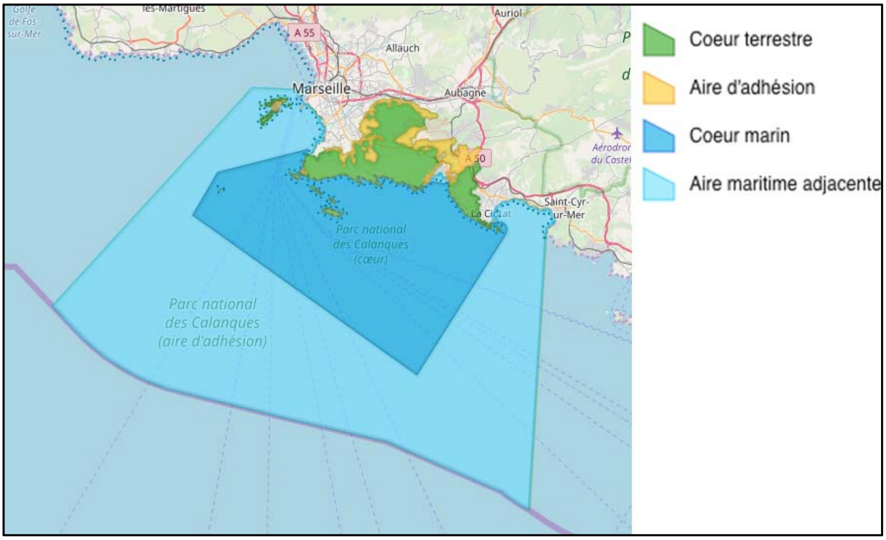

Fig. 1 Protection levels of Parc areas (http://www.calanques-parcnational.fr/en)

The terrestrial part of the Parc completely borders with the coastline of the coeur marin, this means that between coeur marin and coeur terrestre there is a straight and continuous relationship. Moreover, AMA interfaces with the normal coastal area, and also acts as a filter between coeur marin and the sea. The coeur marin is the 27.5% of the total Parc surface. Within this area, a part of around 10% is divided in sub-zones with restrictions or prohibitions of use[7]; and for some narrow and deep bays, also boats access restrictions is applied. In detail, the sub-zones of the coeur with specific limitations are extended for almost 4,000 ha, 2.8% of the entire marine area of the Parc. But, the greater part of the coeur (39,500 ha) and the AMA (98,000) has less severe and rigorous restrictions.

In the context of the CdB, the objectives and actions mainly concern the improvement and recovery of the ecological-environmental quality of water, both terrestrial and marine; specific reference is made to the six coastal «masses of water», that represent the marine area included in the CdB and to the eleven waterways that flow into the bay from the inland. The

[7] (i) Zone de non prélèvement pour la pêche professionnelle et de loisirs; (ii) Zone de protection renforcée - pêche réglementée; (iii) Accès maritime aux Calanques: navire supérieur à 20m hors tout interdit sauf dérogataire; (iv) Accès maritime aux Calanques: embarcation inférieure à 20m uniquement; (v) Accès maritime aux Calanques: embarcation à moteur interdite.

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SDAGE establishes the time limits (2015, 2021 and 2027) within which to reach a «bon état» of the waters (Fig. 2).

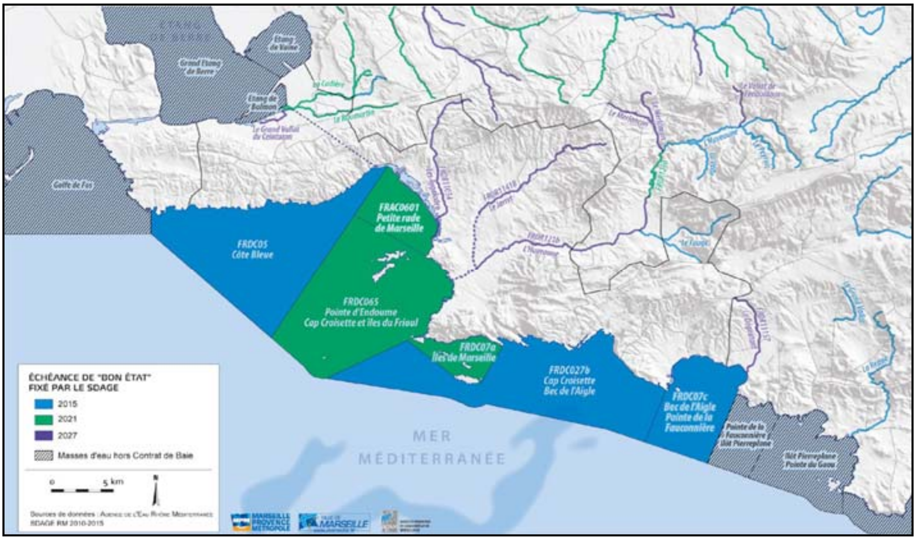

Fig. 2 Terms of "bon état" objective of the SDAGE(http://www.marseille-provence.fr/index.php/competences/developpement-urbain/developpement-durable/le-contrat-de-baie)

Three of the six «masses of water» are part of the *marine coeur*. Therefore, the actions planned aiming at the protection, improvement and recovery of waters in this areas are of two types: related to the terrestrial part of the *Parc* in the framework of the CdB; and related to the use restriction of the areas in the context of the *Parc*. In this perspective, the mutual and integrated action of CdB and *Parc national des Calanques* should reduce both the impacts of the metropolitan context and those caused specifically by marine, beach and coastal areas uses.
The CdB was already contemplated during the phase of the establishment of the *Parc* in 2012, announced as already in discussion among the stakeholders and then signed in 2015. Moreover, the CdB was already clearly related to the short and medium-term *Parc* management strategy, first of all as regards the converging objectives of improving and restoring the ecological quality and functionality of marine waters. To this end, an inter-municipal management structure that involved all the stakeholders of the river basin was envisaged; an integrated project of upstream intervention to improve the water quality of the *Huveaune* and its tributaries, considering that the marine area of the *Parc* as the ending component of the water system. Water quality issues, addressed through partnerships on the whole *bassin versant,* is the key argument in the action of both the *Parc* and the CdB, and therefore is the need for an integrated governance among the actors involved. Since the river

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basin is significantly larger than the territory of the local government community (CU MPM), the territorial area of the CdB is in fact the most important governance/partnership space also for the ecological future of the marine area of *Parc*.
This is one of the main topic addressed by marine protected areas management; the active commitment of territorial public bodies to carry out effective actions for the ecological and environmental quality of marine waters. However, the central matter is the integrated terrestrial-marine approach, as in this case is the relation between the MPA of the *Parc* and the river basin of the *Huveaune*.
In this perspective, the operational tools coherent with the general approach and the management objectives that the *Parc* has adopted, in particular for its marine area, are:

- *Contrat de rivière* for the *Huveaune* river basin, to effectively manage and reduce the contribution of agricultural, domestic and industrial pollutants or those of meteoric origin that are poured into its waters, as well as to restore good ecological functioning and its role in the *trame bleue*;
- *Contrat de baie* at the level of the Marseille bay, to improve the quality of marine waters and environments.

These are the two tools, mentioned at the beginning of this paper, on which the Coasting project draws. Therefore, the main theme of the project are the planning agreements, the contracts among key actors interested in sustainability of coastal tourism issues.

5 COASTAL GOVERNANCE AND SUSTAINABLE TOURISM: FIRST CONSIDERATIONS

Coasting represents an ongoing experience of multilevel governance instruments application for sustainable tourism within the Mediterranean context. In this perspective the central objective of the project is to enhance the effectiveness of planning agreement tools, capitalizing the *Contrat de Baie* of Marseille experience, in particular with regard to its more relevant contents.
Coasting results will be the adaptation of the tool more specifically for sustainable and responsible coastal tourism development, and the mainstreaming of this instrument at regional level within the partners' territories.
The three main objectives of the *Contrat de Baie* of Marseille are: i) reducing marine pollution; ii) preserving the ecological quality of the coasts; iii) organizing a territorial governance through the active participation of stakeholders.
Throughout the elaboration of the *Contrat de Baie*, 70 different key local stakeholders interested in aquatic, coastal and marine environments have been mobilized. This multilevel

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and multi-sectoral dynamic made possible the development of a shared diagnosis, the definition of common issues and objectives, and the co-construction of the action program to achieve the objectives of the SDAGE.
Therefore, tourism is to a limited extent and only indirectly the object of the Contrat de Baie [CdB]. What indications can come then from the governance approach and from the CdB tool? Can this model be effective in being and implementing strategic paths that are useful for increasing the sustainability of coastal tourism and, consequently, for protecting sensitive marine areas when present in the areas concerned? To a certain extent, inside the CdB, the *Parc des Calanques* achieves this, limited to its perimeter, in both terrestrial and marine areas (Cfr. the *Charte du Parc national des Calanques*). However, considering the ecological-environmental objectives and the territorial scope of the CdB of both the terrestrial and aquatic environment, it certainly cannot suffice.
In theory - although with the awareness of the inherent risks in the illusions above, but without taking them into account in this circumstance - the CdB model, as an integrated environmental governance model, should then directly include with at least equal dignity and weight the different problems of tourism, the regulation of uses and the limitation of impacts, as far as the entire territory of its competence is concerned. However, for what has been said above regarding the risks of "illusions" in the ICZM context, this perspective appears problematic. Indeed, the nature of the objectives and the juxtaposition of the interests in the field, in particular in complex areas such as that of the CdB of Marseille, require a more explicit explanation of the conflicts and consequent decisional methods, less consensual and of greater environmental effectiveness over time. This perspective acquires further necessity, then, if we also consider the urbanizing effects of coastal tourism, due to «the "inherently" urbanizing nature of tourism development in the traditional coastal resort context» (Clavé & Wilson, 2017). Therefore, emerges that the priorities of interests of a certain community should be clear, whose expression can only be political and cultural. In many ways it would still seem necessary to resort to the "old" spatial planning, thanks to which a tourism aimed at sensitive areas from an environmental point of view (marine protected areas, Znieff, sensible marine habitats), and inherent to landscape and social and cultural aspects, could better rely on already urbanized parts of that territory (this is the case of the CU MPM), with environmental and economic advantages also regarding the use of accommodation, services and transport.
The experience of the *Parc national des Calanques*, with regard to its protected areas, both terrestrial and marine, addresses the theme of sustainable tourism starting from the objective of finding the right balance between the development of tourism and leisure activities and environmental protection. And it does so, considering that a *tourisme durable* should:

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- respect, maintain and enhance the natural, cultural and social resources of the territory at long term;
- be integrated in processes that assume as responsible elements of production and consumption patterns, as well as equally distributed socio-economic advantages for the population that lives, works or stays in these spaces;
- promote and support integrated organization and management of resources, as well as the participation of local actors, in order to coordinate their use with the needs and capacities of the territory.

In situations of this type, therefore, it seems legitimate to ask what the chances are of achieving significant environmental protection results starting from governance tools, and if the approaches and tools typical of traditional physical planning, of a strictly regulatory nature, are not yet useful. In the case of Marseilles, for example, it would seem appropriate to focus on the recognition of precise roles of cities, territories (including small towns), tourist attraction areas and priority protection areas, as is the case in the marine protected area in the *Parc des Calanques*.

In the attempt of defining a common methodology to be implemented during Coasting and then further widespread at Med level, the first task of the project has been to collect and systematized good practices related on coastal governance and sustainable tourism management. Other good practices, in the future development of research, will be investigated according to the perspective proposed here.

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WEB SITES

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AUTHORS' PROFILE

Paolo De Pascali is a full Professor in Urban Planning (ICAR 21), PDTA Department, Sapienza University of Rome. Chair of Urban Regeneration and Urban Planning Fundamentals. Director of the II level University Master Course URBAM (Urban planning in public administration). Since 1983 he is the Director of research institutes, responsible for research & innovation projects in national and European programs in the fields of energy and settlements. Currently, his studies mainly focus on the relevance of energy-environmental factors in Urban plans to foster urban regeneration and local development.

Saverio Santangelo is an associate professor in Urban Planning, PDTA Department, Sapienza University of Rome. He carries out research on public action issues in urban planning, and on topics of strategic planning, social housing, local sustainable development. Member of PhD Department board in Planning, Design, Technology of Architecture. Scientific coordinator on behalf Sapienza, PDTA Department, in the European funded project Interreg MED Coasting.

Annamaria Bagaini, urban and Environmental Planner, PhD in Planning, Design and Technology of Architecture. She works on increasing awareness related to the relationship between Urban Planning and energy turn, by a better integration between them, also provided by using new technologies and smart tools, able to inform the decision-making process and enhance social inclusion in the energy chain.

Maria Teresa Cutrì, architect, PhD in Architectural design. Her research interests focus on modern architecture and landscape. She is among the founding members of the Center for Studies on the Modern, which gathers the legacy of the Observatory on the modern, Sapienza University of Rome, continuing its research and project direction. Currently, she is involved in some European projects.

Carolina Pozzi, architect. In 2014 she earned a Master degree in Architecture at Sapienza University of Rome. She collaborates with Italian and Maltese companies, working on the fields of EU-funded projects and territorial planning. Technical assistance for PDTA Department in the Interreg MED Coasting project.

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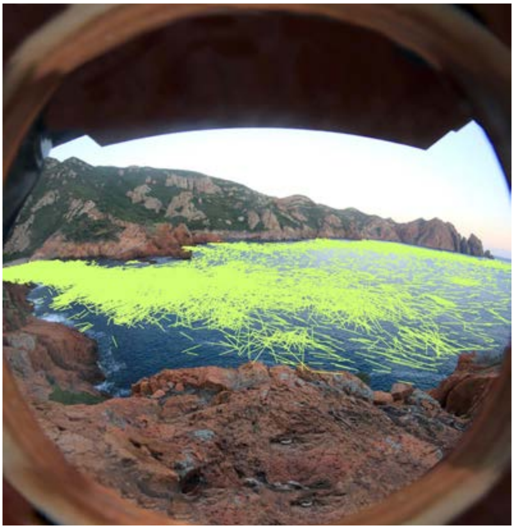

INNOVATIVE MANAGEMENT TOOLS TO SURVEY BOAT TRAFFIC AND ANCHORING ACTIVITIES WITHIN A MARINE PROTECTED AREA

***THOMAS SCHOHN, PATRICK ASTRUCH ELODIE ROUANET**

GIS Posidonie, Mediterranean Insiture of Oceanography (MIO), University of Aix-Marseille, Marseille, France
e-mail: thomas.schohn@univ-amu.fr
URL: https://gisposidonie.osupytheas.fr/

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ABSTRACT

Recreational boating is a major outdoor activity which is very popular in the Mediterranean Sea. One of the main pressures on habitat generated by this activity is anchoring. MPA managers need tools to assess annual frequentation rates and related pressures on their most sensitive marine ecosystems. Methods were tested in the Natural Reserve of Scandola (Corsica, north-western Mediterranean), to monitor anchoring activities in the Bay of Elbu, using a 10-minute Self-Activating Photographic Device (SAPD) and a Geographic Information System (GIS) to localize every observed boat. A total of 827 boats were observed anchoring from April to July 2018, with a peak of 49 boats in July. Wind and time statistically influence daily anchoring rates. Rigid inflatable boats are the most frequently observed type of craft (49%). To reduce the GIS processing time, which is highly time-consuming, we proposed simplifying the data acquisition and reducing the processing time to smooth the daily anchoring frequentation using quadratic rules. This method enables a 90% reduction of the image processing time, with only 12 images to be analysed per day.

KEYWORDS
MPA; Survey; Anchoring; Self-Activating Photographic Device; Geographical Information System

* The other authors are: Adrien Goujard, Chloé Jehl, Lisa Dossmann, Jean-Marie Dominici, Laurence Le Diréach, David Nerini.

1 INTRODUCTION

Marine and coastal ecosystems provide many services that contribute to human needs and well-being (Millennium Ecosystem Assessment, 2005). These features partly explain the massive increase in the coastal urbanisation since the 19th century. At the same time, coastal tourism has steadily increased, particularly since the 1950s (Davenport & Davenport, 2006). Recreational boating is a major outdoor activity, which is very popular in the Mediterranean Sea, particularly in areas of high environmental value (Venturini et al., 2018). These increasingly widespread activities may be the source of conflicts of interest and disturbance for coastal and marine ecosystems (Deter et al., 2017).

Well-enforced Marine Protected Areas (MPAs) have for decades proved to be effective conservation tools for maintaining or enhancing marine biodiversity (Browman et al., 2004; Boudouresque et al., 2005). The maintenance of good quality in coastal and marine ecosystems by means of MPAs enhances the ecosystem services (Pascal et al., 2018). Recreational uses are also constantly on the increase within protected areas (Monti et al., 2018; Widmer & Underwood, 2004), enabling people to enjoy outstanding sites, landscapes and wildlife. These activities can serve a useful purpose for educating users but are potentially harmful for ecosystems if not properly controlled (Das & Chatterjee, 2015). Ecotourism and recreational boating have strongly increased within the Natural Reserve of Scandola (Corsica, France) over the last decade (Tavernier & Dominici, 2014). One of the main pressures generated by these driving forces is anchoring on *Posidonia oceanica* seagrass meadows. *P. oceanica* meadows, which constitute a key ecosystem but are vulnerable, suffer in particular from mechanical damage caused by anchors (Ganteaume et al., 2005; La Manna et al., 2015; Lloret et al., 2008).

The degree of damage is dependent on the size and the type of anchor used by boats (Milazzo et al., 2004). Within the Natural Reserve of Scandola, in the bay of Elbu, it has been shown that the structure of *P. oceanica* meadows relative to hydrodynamic conditions is highly vulnerable to anchoring (Astruch et al., 2008). MPA managers need to survey the typology of the frequentation within their area in order to determine the most appropriate management system. Long-term monitoring is expensive and time-consuming. An automated system could thus provide an appropriate solution for managers. Already used for wildlife monitoring with camera traps (Jumeau et al.,2017), photography or video-based methods have also been used to monitor human frequentation in MPAs (Bonhomme et al., 2013; Corre et al., 2012; Miller et al., 2017).

In this study, our aim was to assess the frequentation by boats within the Natural Reserve of Scandola with regard to both anchoring activities and boat traffic, relying on an automatic

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data acquisition protocol. Trends over time and quantitative information will highlight the current frequentation rates within the Reserve. Then, we propose a method for simplifying the data acquisition and reducing the processing time for assessment of the daily anchoring frequentation rate.

2 METODOLOGY

2.1 STUDY SITE

The Natural Reserve of Scandola (42°22′N, 8°33′E) is a marine and terrestrial reserve, located in the north-west of Corsica Island (France), between Galeria and Porto (Fig. 1). It was set up in 1975 and has had UNESCO world heritage status since 1987. It is constituted of a 70-ha no-take area where fishing, diving and mooring are prohibited, and a 680-ha partial reserve, where artisanal fishing and mooring are allowed but restricted. All activities within the terrestrial part of the reserve are prohibited.

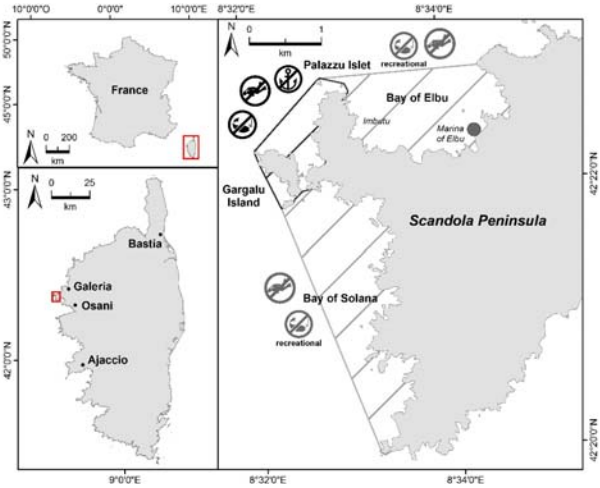

Fig. 1 Localization of the marine part of the Natural Reserve of Scandola. Gray hatch: recreational fishing and diving are prohibited; Black hatch: no-take area. The grey point corresponds to the position of the SAPD on the rocky headland of Elbu

2.2 TEMPORAL FREQUENTATION ASSESSMENT

Boat frequentation the Natural Reserve of Scandola was assessed using a Self-Activating Photographic Device (SAPD). The SAPD is a reflex camera (Canon® EOS 200D, 10 mm fish-eye lens) designed to take still photographs every ten minutes from 6 AM to 9 PM using a 10-minute intervalometer to automatically switch cameras on. The SAPD was positioned on the

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rocky headland of Elbu, allowing the monitoring of anchoring in both Marina d'Elbu and inlet of Imbutu, two of the most frequented sites within the Reserve (Fig. 1). Image processing was carried out on the Geographic Information System (GIS) (ArcGis 10.6®). Each boat in each picture was digitalized as one vector layer. The factors integrated in the attribute table are as follows: boat ID, type of boat (indeterminate, motor boat, rigid inflatable boat, catamaran, motor catamaran or sailboat), its motion (moving or stationary), and whether it is beaching (Yes or No). A boat is considered as anchored when observed in two consecutive pictures at the same location, and a residence time (duration of anchoring period) can be estimated. Data acquisition was started on April 4th and ended on July 31st 2018, corresponding to 8 975 pictures. In total, 227 hours of digitalization on GIS were necessary.

2.3 STATISTICAL ANALYSIS

We fitted a generalized linear model (GLM) for anchoring with Negative Binomial error distribution to test the effect of wind ('No' if daily wind speed $\leqslant$ 5 m.s^{-1}; 'Yes' if daily wind speed > 5 m.s^{-1}), day types (holiday; weekday; weekend) and month (April, May, June, July). Response variables were modelled for dependence on predictor variables using the model selection method based on the Bayesian Information Criterion (BIC) (Schwarz, 1978).

2.4 ESTIMATION OF THE DAILY FREQUENTATION USING LOW-FREQUENCY OBSERVATIONS

The detection and counting of the boats in every picture are time-consuming tasks performed manually. It was necessary to reduce the number of pictures per day. Two questions arise: how many pictures are required to provide a good estimation of the daily frequentation? When should the pictures be taken during the day? The use of numerical integration techniques will help to answer these questions. Let us consider a given day where the number of boats is counted in a sequence of hourly images. The boats are not distinguished from one image to the other and what is of interest is the overall estimation of the daily frequentation at a given site. We dispose of a set of couples composed by the time when the picture was taken and an associated number of boats. If there are no missing data and if the picture shooting times are equally spaced, it is possible to provide a raw estimate of the daily frequentation (number of boats.h-1.d-1) by straightforwardly computing the mean number of boats over the day. Starting from the set of available observations, the concept is here to construct a smooth curve that fits the data by a non-parametric regression (Simonoff, 1996). An estimate of the mean hourly frequentation can then be computed, being proportional to the surface area below the curve (the integral). This area can be computed using classical numerical methods

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(Simpson, trapezoidal rule) with reasonably good accuracy. It is also possible to approximately estimate by using a simple sum of well-suited rectangle surfaces, with the so-called quadrature rule (Gautschi, 2004). A given quadrature rule implies the choice of quadrature points which give the times at which a picture must be taken to give a good approximation of the daily frequentation. Obviously, it is expected that the number of pictures may be as small as possible. Here, the data set is restrained at the June and July counts, to keep a reasonable number of boats a day necessary for daily modelling. Statistical tests and estimating daily frequentation using low-frequency observations have been done with R statistical language (R Core Team, 2018).

3 RESULTS

3.1 FREQUENTATION

A total of 5 560 boats were counted in the Bay of Elbu, including 827 anchored boats. Overall frequentation is weak until June and increases strongly in July, with a peak of 430 boats on 27th July. The anchoring curve is the same shape as that of the overall frequentation, with a marked increase in anchoring during the last ten days of June, with a maximum on 19th July with 49 boats (Fig. 2). Rigid inflatable (RI) boats (43 %), sailboats (26 %) and motor boats (18 %) are mainly observed. Sailboat users remained anchored 2h51 on average. Residence time of '*Motor boat*' and '*RI boat*' are respectively 2h11 and 1h11.

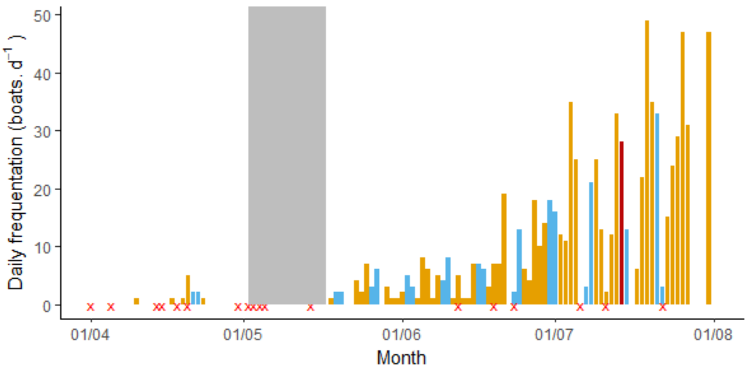

Fig. 2 Daily anchoring frequentation over time. Bank holidays are represented in red, weekdays in yellow and weekends in blue. Red crosses are windy day (speed > 5 m.s^{-1}). Grey area corresponds to a no data period

The most parsimonious model to study the daily anchoring only includes WIND and MONTH variables and their interaction (BIC = 461), TYPES OF DAY is not significant. The terms of reference are 'no wind' and 'July'. Each monthly frequentation rate is significantly lower than the July frequentation rate (negative coefficients, Tab. 1).

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Wind has a negative effect on the frequentation, but terms of interaction show that frequentation is higher on June windy days than July windy days (for the same wind speed and direction).

Estimated coefficients (± s.e.)		z-value	P
Intercept	3.19 (0.12)	27.26	***
WIND (*yes*)	- 2.28 (0.60)	- 3.81	***
MONTH (*April*)	- 2.91 (0.43)	- 6.72	***
MONTH (*May*)	- 2.13 (0.27)	- 7.97	***
MONTH (*June*)	- 1.27 (0.17)	- 7.28	***
WIND (yes) x MONTH (*April*)	3.60 (1.00)	3.57	***
WIND (yes) x MONTH (*May*)	NA	NA	NA
WIND (yes) x MONTH (*June*)	1.89 (0.73)	2.57	*
* ($P \leqslant 0.05$); ** ($P \leqslant 0.01$); *** ($P \leqslant 0.001$)			

Tab. 1 Parameter estimates relative to the best model (BIC) for the response variable Frequentation using a Negative Binomial error distribution

3.2 ESTIMATING DAILY FREQUENTATION USING LOW-FREQUENCY OBSERVATIONS

Daily frequentation estimation quality increase with the number of quadrature points in order to compute the required surface area below the frequentation curve. In this example, only curves with at least 7 boats in a picture have been conserved (19 days from June to July 2018). The absolute deviation measures the absolute value of the difference between the quadrature approximation and the integral computed by a trapezoidal rule. In this sample of curves, taking 12 pictures per day is enough (1% error) to get an accurate estimation of the daily frequentation.

Taking only 5 pictures would also be appropriate if a higher absolute error is accepted. Once a quadrature rule has been chosen, it is interesting to see when pictures must be taken. The shooting time of a picture is provided by the position of the quadrature points (blue points, Fig. 3) will lead to almost the same frequentation estimation as using the whole dataset. We traced the pattern of the average hourly frequentation per day over the summer season, using both estimations based on empirical means and on numerical integrals.

Results show a reasonably good accuracy of the estimations using only 12 pictures per day and enable monitoring of the increase in frequentation over the study period. The estimation method enables the reduction by 90% of the number of pictures to be analysed.

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4 DISCUSSION AND CONCLUSION

Previous management goals of MPAs since the 1970s, such as those of the Natural Reserve of Scandola, were mainly focused on the conservation of heritage and threatened species (Boudouresque et al., 2005). The increase in tourism activities corresponds to activities of economic importance that cannot be ignored in current MPA management plans, despite the related impact on coastal and marine ecosystems. Managers must consider those activities and their impact and determine a balance taking into account both ecosystems functioning and conservation and sustainable human activities. This ecological sustainability is essential for economic activities which rely on the provision of the ecosystem services that its conservation enables.

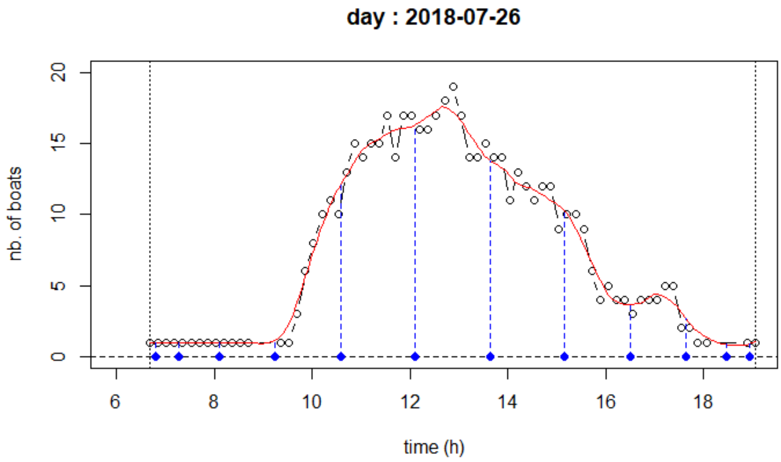

Fig. 3 Pattern of the daytime frequentation on 26th July 2018. The red curve is a non-parametric regression. Blue points represent shooting time of the 12 pictures selected for the daily estimation

The SAPD method is appropriate for the acquisition of continuous data over a long period, especially during windy periods, during which on board counts are not possible. Anchoring increases in June and is at its highest in July. The type of day does not have a significant effect on the daily frequentation. Results show that the site is more frequented by tourists than local inhabitants, who work during the week and use the Reserve area during the weekend. Tourist frequentation is characterized by the expansion of the proportion of RI boats during July. This increase in the number of these small craft could result from day rentals of boats around the Scandola area (Life LINDA, 2008), which corresponds to short-time anchoring users whose behavior pattern is to visit several sites within the MPA. The more seriously harmful impact on the Posidonia meadows can be related to the anchoring of larger

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boats (i.e. over 20 m length). Digitalization of pictures is time-consuming: it took 227 hours to process 8 975 photos, including 156 hours for July data. This protocol allows a very accurate analysis of the temporal daytime frequentation, and fine scale spatial results using GIS. Results of this work have enabled us to reduce the number of pictures to estimate an hourly average daily frequentation rate, while conserving good accuracy. This reduction could affect more significantly the results of spatial assessment or residence time estimation but is a good alternative for assessment of the daily frequentation for a long-term survey. This protocol could be used directly by MPA managers during heavy frequentation periods. To conclude, this automatic frequentation protocol survey in key areas offers the means to assess anchoring pressure based on qualitative (type of boats) and quantitative data (residence time). For a long-term assessment of frequentation, we demonstrate that it is possible to reduce the number of pictures by about 90 % using estimation of the mean daily frequentation by quadrature, which greatly reduces the processing time involved in image digitalization.

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AUTHOR'S PROFILE

Thomas Schohn study engineer in Marine Ecology at GIS Posidonie (Marseille, France; NGO working on applied research on marine ecology), he works on statistical treatment, data base management and GIS to carry out projects about monitoring of the impact of human activities on marine ecosystems. GIS Posidonie is defined as a link between fundamental research in ecology and management.

Patrick Astruch, research engineer at GIS Posidonie, he is focused on the monitoring and the understanding of the functioning of marine and coastal ecosystems within the Mediterranean.

Elodie Rouanet, research engineer at GIS Posidonie, she is focused on the monitoring and the understanding of the functioning of marine and coastal ecosystems within the Mediterranean sea.

Adrien Goujard study engineer in marine ecology at GIS Posidonie, he developped data managment et GIS tools to study Mediterranean ecosystems and more efficiency the bathyal ecosystem.

Chloé Jehl, Civic Service Volunteer at GIS Posidonie, she contributes at the GIS Posidonie communication. More specificly for this project, she worked on photography digitalization on GIS tools.

Lisa Dossmann, Master degrees on Oceanography at Aix-Marseille University and welcomed by GIS Posidonie, she works on analyzed of DPDA datas to study impacts of anchoring on Posidonia oceanica **meadows on Bay of Elbu.**

Jean-Marie Dominici is the conservator of the Scandola Natural Reserve (Corsica, France), he brings his experience and knowledges on the study area context.

Laurence Le Direach, Doctor in Oceanography and researcher at GIS Posidonie, she is specialized in fish ecology and monitoring in brackish and sea water, particularly on fish juveniles and larvae. Indeed, she supervises many programs of frequentation study in MPAs.

David Nerini works at the Mediterranean Institute of Oceanology, part of the Pytheas Institute, and teaches at the Aix-Marseille University. Doctor in bio-statistics, its research topics deal with applied statistics inspired by statistical problems encountered in ecology and marine sciences.

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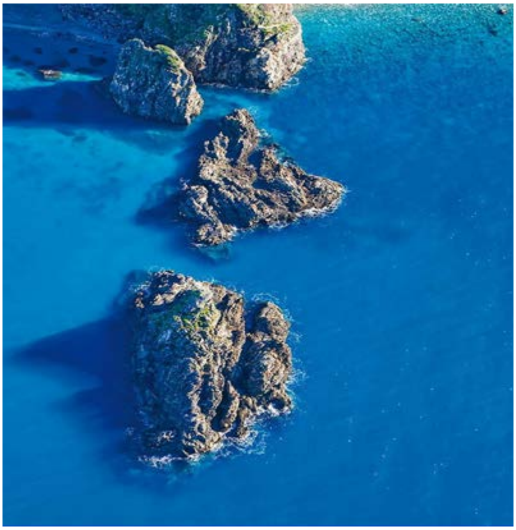

SHADES

SUSTAINABLE AND HOLISTIC APPROACHES TO DEVELOPMENT IN EUROPEAN SEABORDS

FRANCESCO VITA, FORTUNATO COZZUPOLI

Flag dello Stretto, Italy
afranvita@gmail.com
fortunato.cozzupoli@gmail.com

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ABSTRACT

The supranational cooperation project SHADES (Sustainable and Holistic Approaches to Development in European Seabords) has been planned, coordinated and implemented by the Fisheries Local Action Group "dello Stretto" (lead partner) and is part of the Local Development Plan funded by the European Fisheries Fund (EFF) 2007-2013 - Axis IV "Sustainable development of fishing areas". The reason for choosing the Integrated Coastal Zone Management (ICZM) as a tool for the SHADES cooperation project is the established understanding, which is spread at both a European and global level, of the need in coastal areas of: management, integration, ad hoc planning tools.

KEYWORDS
Management; Integration; Planning; Holistic Approach; Multi-scale Relationship

1 INTRODUCTION

The focus on a sustainable management of resources has been growing steadily in the past decades, stemming from an increased global awareness of the progressive depletion of these resources (UNEP, 1972; UNCED, 1992; WCED, 1987). It has been necessary to focus on those "sensitive" areas (Montebello, 2004), such as the coastal zones, where a conflict exists between different types of uses and users (Vallega, 2001; 2003). These are as can be understood as "hyperplaces" where multiple pressure factors coexist (Boscolo, 2011). Such conflicts stem from the underlying characteristics of coastal zones, which make them a multi-resource thanks to their social, environmental and economic components. However, coastal areas are, in fact, a preferred location for urban settlement, for many economic activities (such as the fisheries, tourism and transport sector) as well as a meeting point for varying natural systems that together make up a unique, but fragile, ecosystem. It is well known that the concentration of human activity along the coastal areas can generate risk factors that undermine their carrying capacity1, leading to a series of negative effects including, but not limited to: pollution, depletion of fishing resources and coastal erosion events. As a consequence, at a global as well as at European level, the need has emerged to adopt a management approach defined within research as "Integrated Coastal Zone Management" ICZM) or Integrated Coastal Zone Management (ICZM). This is a not sector-specific planning and management tool and has the capacity to account for the multifunctional characteristics of coastal areas. This tool, however, has not yet been regulated by relevant policies and laws at a European level. The reason for choosing the Integrated Coastal Zone Management (ICZM) as a tool for the SHADES cooperation project is the established understanding, which is spread at both a European and global level, of the need in coastal areas of:

- management: the coastal areas need to be managed, systemizing endogenous resources according to a longterm plan and in relation to a program of sustainable development. Coastal areas are, in fact, very complex systems, with regards to both their natural systems, as a meeting point of the two ecosystems of land and sea, as well as from the perspective of human activities, as coastal areas are the preferred area for many economic, production, living, transport and tourism activities. All these resources and complexities can foster important opportunities to support both economic and social development. This also means that significant competition exists with regards to access (as well as exclusive use) of coastal resources (Siirila, 2012), due to the high number of users of such territories (Vallega, 2001);

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- integration: the different strengths of a territory can, and should, be integrated to develop synergies; the different social and economic users of the coastal areas must enjoy the same opportunities to access such resources, without diminishing the possibility for other actors to use the same resources in an effective way (Siirila, 2012). The coastal areas are the object of a high number of legal and planning tools, which often act in an uncoordinated way, and sometimes contrast one another. In this sense, integration becomes a need concerning not only the "functions" of a territory, but also the actors which operate on that territory. The participation of local actors within planning development is paramount, as underlined by the European Union through their promotion of Community-Led Local Development within the mainstreaming of the LEADE R approach during the planning period 2014-2020; "Ad hoc planning tools": a number of legal and planning tools concerning the coastal areas have been created, which, however, sometimes overlapped and acted in contradictory ways. Therefore, it is necessary to harmonize such tools in order to obtain effective results for the use of the coastal environments and the upgrading of resources, thus safeguarding its identity and guaranteeing its availability for future generations. Despite the fact that there is not yet a specific legal tool for the implementation of ICZM in Europe, the experience of the FLAG and the aims of Axis IV of the 2007-2013 EFF can all be ascribed to the conceptual framework of the ICZM.

Stemming from this consideration, the operational objectives set out by the SHADES project are twofold:

- sharing know-how and good practices between the project partners through carrying out study visits in their respective territories;
- collecting and analysing critically the experiences of the European FLAGs, focusing specifically on those initiatives which have been considered as innovative and which implemented the principles behind the ICZM found in European papers such as the COM(2000) 547 def. and the Madrid Protocol on Integrated Coastal Zone Management (21st of January 2008).

2 METHODOLOGICAL ASSUMPTIONS

We will highlight the methodological assumptions we based our research on, in order to better understand the specific choices and the progress made so far in the SHADES project. The methodological assumptions, which have been widely discussed and shared during the meetings held with all the project partners, take inspiration from, and are based upon, the eight principles defined in the COM(2000) 547 final Communication by the Commission. There

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are three main keywords that summarise the methodological assumptions on which we based this report: Management, Integration and Planning. These three elements are connected to some methodological assumptions, which must be taken into consideration when speaking of integrated coastal zone management.

Fig. 1 Methodological assumptions

2.1 ACTIONS

On the basis of the described methodological assumptions, we tried to highlight those elements that allow us to obtain, from the preliminary investigation, a reference framework with the ability to direct the research in relation to the general topic. The first step entailed the identification of the case studies within the FLAG partner territories. Secondly, significant case studies were also identified outside the territories of the partner FLAGs. This was achieved through the contribution of experts who were involved in the project. This allowed us to rely on a reference framework of specialized knowledge in order to be able to analyze the matter without wasting temporal resources. The results obtained have allowed a comparison amongst the partners in order to identify the good practices regarding the management of coastal areas. To this end, we have asked the partners to identify those case studies, related to the subject of ICZM, which they considered in line to the methodological assumptions and which had effects, or at least similar methodological assumptions, to those of the SHADES project. The collection of information also represents an important opportunity for discussion for the project partners. This allows us to obtain a more effective and better selection, objectified by external experiences, and not self-referential.

2.2 TOOLS

The questionnaire used to analyze the good practices (which can be found in Annex 2) has been drafted by the technical group of FLAG dello Stretto. Its detailed structure allowed the experts of the different partners involved to easily see what information was required in order

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to illustrate projects and/or initiatives which dealt with integrated coastal zone management, structured according to the scientific assumptions of SHADES. This template has been useful to analyze the information collected in depth, and to obtain a detailed summary which highlighted the positive aspects and critical points of the case studies selected. The information that was requested in the questionnaire is described below.

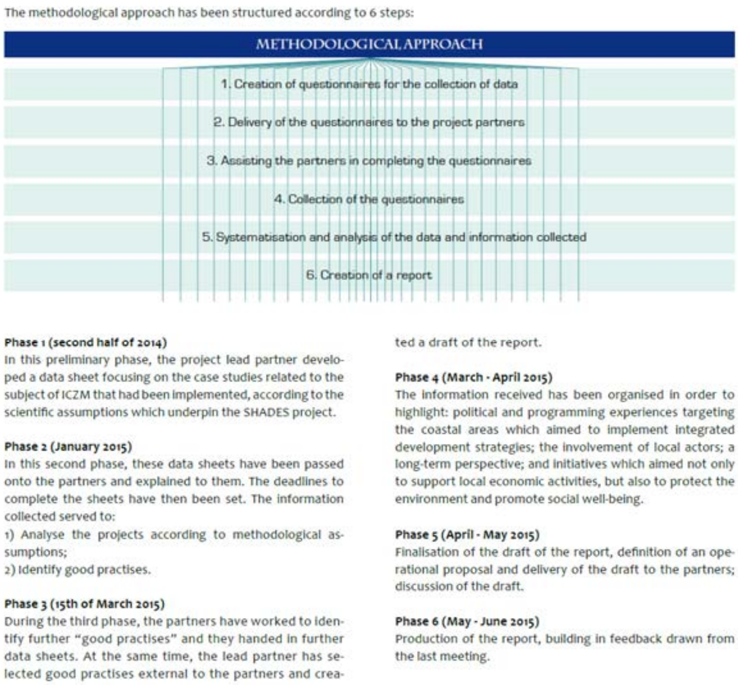

Fig. 2 The methodological approach

2.3 SUMMARISATION TABLE

This section highlights the work carried out by the technical group of FLAG dello Stretto, based on the questionnaires which were sent by the partners. All the information has been normalized, systematized, analyzed and implemented in a
synthesis table that highlights the different elements considered, in order to make it easier to see the specific characters
of the cases presented. Thanks to the partners, 27 case studies have been analyzed in total, 21 of which belonged to the territories of the partner FLAGs and 6 of which have been identified in territories which do not belong to the partner FLAGs. In regards to the information received, it should be pointed out how in several cases it was incomplete, and often submitted in a way which was not compliant with the instructions given: where information was absent

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or inadequate. In such cases the replies have been labelled with the letters "n.a." (not available). This leads to some difficulties in understanding the effective value of the case studies selected. Another problem was that some of the case studies analyzed are still on-going, have been only completed recently, or the results obtained have not yet been evaluated. This said, the case studies which were recommended by the partners have several elements of interest, consistent with the objectives set by the SHADES project. On a positive note, it should be said that some of these case studies show innovative features, using methods and contents which have the potential to be exchanged between territories and offering elements for a more effective future management of coastal areas. The experiences identified have been structured according to a table, and for each of them a synthetic data sheet has been created. Each data sheet contains some information related to the initiatives and to the territories of the FLAGs (partners or non-partners) which have promoted and implemented them, while the table allows us to clearly outline the aspects that have been analyzed in more detail, specifically:

Methodological approach:

- the triple focus of Management, Integration and Planning;
- holistic approach;
- man - nature relationship;
- participatory processes.

Indicators of good practices within the ICM conceptual framework, according to com (2000) 547 final:

- broad and "holistic" (thematic and geographic) perspective;
- long-term perspective;
- adaptive management that uses gradual processes;
- expression of local specificity;
- activities that respect natural processes;
- participation in planning;
- support and involvement of all relevant administrative bodies;
- using a combination of different instruments.

Objectives shared with the Madrid Protocol (2008):

- facilitate, through the rational planning of activities, the sustainable development of coastal zones by ensuring that the environment and landscapes are taken into account in harmony with economic, social and cultural development;
- preserve coastal zones for the benefit of current and future generations;
- ensure the sustainable use of natural resources, particularly with regard to water use;

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- ensure preservation of the integrity of coastal ecosystems, landscapes and geomorphology;
- prevent and/or reduce the effects of natural hazards and in particular of climate change, which can be induced by natural or human activities;
- achieve coherence between public and private initiatives and between all decisions by the public authorities, at the national, regional and local levels, which affect the use of the coastal zone.

Repeatability

2.4 SUCCESS ELEMENTS OF THE CASE STUDIES ANALYSED AND OPERATIONAL PROPOSAL

This proposal was born from a synthesis of the main elements highlighted and valued as positive among the initiatives carried out in the FLAG and non-FLAG territories, targeting the SHADES objective, i.e. an integrated coastal zone management, being sustainable from a financial, environmental and social point of view. None of the case studies analyzed offers complete information, since they often only provide a synthetic data sheet or short report. Often the context is explained in depth, but the methodologies used and the evaluations carried out were not. The consolidated approach at a European level, which requires an evaluation of the actions at all the stages of their progress, up to the determination of the real, indirect or direct, outcomes, has not been implemented with regards to the themes that the SHADES project deals with. Further to this, the holistic approach, one of the pillars of integrated coastal zone management, has not been used sufficiently. All this leads to inability to understand the incidence, the value and the effectiveness of the case studies analyzed. This applies to both the experiences quoted in the main projects of cooperation and particularly to those that were submitted by the territories. This is due to the fact that these initiatives are recent: all but a few were started less than ten years ago and some of them are still in progress. For these latter, it is obviously impossible to obtain a conclusive assessment; nevertheless, we can already gather that also those initiatives have addressed only marginally the evaluation of the starting conditions. It should be underlined that, while in the partner territories the implementing bodies were strongly connected to the local context, in the external projects visibility and involvement have also involved the higher level of territorial governance. This is the case for 6 of the projects that have been examined. All of this considered, the operational proposal presented is a synthesis of the elements analyzed and deemed as effective to achieve integrated management. These include from the holistic approach to the involvement of the public and private stakeholders, from an attention to

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sustainability indicators, to the use of the coastal areas for tourism. The tool presented here shows some elements of innovation (specifically, knowledge building) and some consolidated elements (specifically, the participation in the creation of indicators). This tool has been named SIGAC, Integrated territorial knowledge System for the management of coastal areas in the FLAG territories.

2.5 SIGAC: AN INTEGRATED TERRITORIAL KNOWLEDGE SYSTEM FOR THE MANAGEMENT OF COASTAL AREAS IN THE FLAG TERRITORIES

The analyses of the case studies carried out so far showed a lack of knowledge regarding the on-going dynamics and the real potential of the territories. Further to this, a difficulty in achieving a holistic approach within the subject of integrated coastal management has been identified. The tool we suggest is the result of the analysis carried out so far, and of those case studies that have had a successful and lasting outcome on the territories. We found that a tool was needed to mediate the diachronic process. Today, the rhythms of technology contribute to accelerate this diachronic condition even more, which introduces into the world mechanisms and tools that are further ahead than the scientific descriptions of the world available in the various fields of knowledge. Discoveries made during the first years of the last century only today are successfully applied, since the rhythms of assimilation and adoption of these mechanisms are slow. They need long processes and experimentation, for which sufficient time must be allocated. This process of differentiation between the rhythms of man, defined as "historical" by Enzo Tiezzi, and the rhythms of technology, is apparently similar in a number of aspects, to that previously described different between "historical" and "biological rhythms". Thus, humans do not manage to keep up with their own creations and lose control of them, not understanding their potential at the time of creation. From these assumptions a new problem arises, regarding the transformation and management of the territory, and concerning the institutions that decide on its use and control the dissemination and implementation of new communication and information technologies able to support the process of territorial planning and management. This growing problem can be tackled using two tools: electronic governance, better known as e-governance, a new form of "participatory" governance relying on the new information technologies, and Computer Systems, that support de tools, in recent years, have undergone deep modifications and adapt well to the complexity of today's reality. This reality is not simply a source of data, but rather an active counterpart, forcing us to recognize that action and knowledge are inseparable.

SIGAC: aims and objectives

The operational proposal was created to identify an appropriate tool for the management of the complex reality found in the coastal areas, combinations of different ecosystems, and to

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plan and build an integrated territorial knowledge system. The SIGAC aims to qualify and rationalize the decision-making processes through an understanding of relationships, and wants to be a tool in support of actions and decisions within the multi-scale processes of integrated coastal zone management. The implementation of a structured Integrated Knowledge System aims to connect citizens, experts from different sectors, administration executives and representatives of the institutions, through the possibility to access and acquire in reduce the time needed to reply to the same requests through traditional ways, eliminating logistic and bureaucratic links, guaranteeing not only a saving in terms of time for operators and users and, but especially, a greater knowledge of the territory and the participation to the policy choices that will be put forward.

The specific objectives of the Integrated Knowledge System targets are:

- guaranteeing that information is systematic, homogeneous, comparable, general and updated;
- ensuring that relevant information and its analysis is readily available in the course of decision-making processes;
- widening the dissemination of information and promoting its decentralized access;
- allowing the consideration of all the relevant elements jointly and simultaneously while creating strategies for territorial development and management;
- supporting management based upon the triple focus planning, management and integration.

Fig. 3 The operational proposal

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AUTHOR'S PROFILE

Francesco Vita is a territorial planner and PhD in Park and garden architecture and territorial organisation, specialised in local development. His research focuses on the subject of complexity as a key to understand local systems. He is specialised in applied ICTs for management and improvement of the processes of transformation of the territory, focusing on participation. He has carried out extensive work both in Italy (Provincial Territorial Plan planning office in the district of Reggio Calabria, with the title of wide area planning specialist, 2008-2012) and abroad (University of Newcastle Upon Tyne - UK - School of Architecture, Planning and Landscape - Global Urban Research Unit, 2008). He has been a Local Development Officer within Department 3 – Community Planning of the Calabria region since 2011. He has been working as a technical advisor for LAG BaTiR and FLAG dello Stretto since 2012.

Fortunato Cozzupoli, specialised in local development policies and territorial cohesion, is currently the Director of LAG BaTiR and FLAG dello Stretto. He is a specialised consultant for public and private organisations in different fields: from territorial, strategic and marketing planning to local planning, evaluation of development policies and territorial enhancement. He has worked extensively in tackling the problems of the economic, cultural, production and social contexts, starting up long-term local development processes.

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NEW LOCAL PROJECTS FOR DISADVANTAGED INNER AREAS

FROM TRADITIONAL MODEL TO BIO-REGIONAL PLANNING

***ANNA MARIA COLAVITTI, ALESSIO FLORIS FRANCESCO PES**

Department of Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: amcolavt@unica.it

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ABSTRACT

The reflections on the so-called "internal areas" are developed, in Italy, following the definitions of specific policies for the South, focused on the promotion of generally exogenous industrial models that are detached from the context. At the same time, having to respond to the challenges posed by the intensification of territorial inequalities and the urgent need to concretely implement the ecological transition, the territorial communities have developed several "bottom-up" projects linked to the practice of multifunctional agriculture, recovery of civic uses, circular economy and recovery of traditional supply chains for the purpose of a re-reading of the context through a bio-regionalist perspective, according to the principles and procedures defined by Alberto Magnaghi. The paper investigates the systemization of these bottom-up initiatives within the planning system. Through the case study of the historic region of Ogliastra, the work provides some insights to foster new synergies between the communities that support these initiatives and the institutions responsible for plans and programs at various decision-making levels.

KEYWORDS
Bioregion; Inner Areas; Local Development; Sardinia; Ogliastra Region

* The other authors are: Sergio Serra, Alessia Usai.

1 INNER AREAS AND LOCAL PROJECT: FROM THE TRADITIONAL PARADIGM TO THE BIO-REGIONALIST MODEL

The reflections on the so-called "inner areas" in our country develop following the definition of specific policies for the South, focused on the promotion of generally exogenous industrial models (Barbera, 2015; Parascandolo, 2016). The process of globalization has profoundly changed the linear relationship between places of production and the well-being of the territories, but it is not sufficient in itself to explain the phenomena of rising unemployment, creating pockets of poverty and the state of suffering of many peripheral territories: these dynamics have a complex and multi-scale genesis (Veltz, 2008).

The French economist Laurent Davezies underlines the ineffectiveness of the traditional economic models used on the national scale for the analysis of local territorial realities: in these contexts, the basic incomes are increasingly disconnected from the productive capacity and from the exports of goods and services following the financial crisis of 2008-2009 and the debt crisis of 2010-2011. Even in the presence of a general resilience of France as a whole, the different territories have registered very different behaviors (Davezies, 2001; Davezies & Lejoux, 2003; Davezies, 2012). Similar dynamics of acute intra-national territorial imbalances occurred in numerous western contexts.

The territorial communities living in the internal areas, with a view to responding to the challenges posed by the intensification of territorial inequalities and the urgent need to concretely implement the ecological transition, have generated a whole series of projects with a bottom-up approach, linked to the practice of multifunctional agriculture, the recovery of civic uses, the circular economy and the recovery of traditional supply chains. This "back-to-the-land" approach, however, requires a shared vision capable of generating coordinated support actions (Marchetti et al., 2017; Parascandolo, 2017; Viesti, 2017).

In such a scenario, the bioregional paradigm can constitute an important element in the process of conscious re-appropriation of territorial resources by local communities (Colavitti, 2013, 2017).

Traditional planning tools available at local and regional scale, based on a rationalist approach, have proved to be generally outdated and unable to provide adequate responses to territorial challenges. The question is in particular about the capacity of local territorial plans to contribute qualitatively to contemporary development processes and to the re-generation of "common goods" (Palermo, 2009) through functionalist-based planning mechanisms, which are still expressed by the urban standard per inhabitant and by the determination of specific urban functional units for every part of the municipal territory.

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Alberto Magnaghi defines the concept of "urban bioregion" as a set of strongly anthropized local territorial systems, interrelated by environmental relations characterizing a bioregion (a valley system, an orographic node, a hilly system, a coastal system and its hinterland, etc.) and characterized internally by the presence of a plurality of urban and rural centers (Magnaghi, 2014).

Among the aims of such a bioregional system, Magnaghi identifies the enhancement of local territorial identities, the production of "territorial added value" (Magnaghi, 2014) and the "redesign of urbanity" to cope with the dynamics of de-territorialization of the contemporary metropolis (Magnaghi, 2000).

Therefore, seven construction elements to govern the bioregional project are defined (Magnaghi, 2014):

- the culture and the knowledge of the territory and the landscape;
- the environmental structures;
- the urban centralities and the polycentric system of settlements;
- the local productive systems;
- the local energetic resources;
- the multifunctional agroforestry structures;
- the structures of self-government for participatory federalism.

Finally, it is useful to show the way in which Magnaghi structures the socio-cultural relationships between the settled populations and their own living place from the perspective of the bioregion through a dialogue between the "energies of contradiction" and the "energies of innovation" (Magnaghi, 2001). The Italian architect and urban planner defines "contradictory energies", "the behaviors, the social and cultural movements and the conflicts that emanate from the new poverties produced by the processes of de-territorialization" (Magnaghi, 2001) in order therefore to be configured as new forms of spatial and relational connections, in opposition to the ongoing dominant processes. The "energies of ambivalence and innovation" are, instead, those "technological potentials – communicative, telematics, biological, energy, etc. – that can foster, if correctly directed and managed, the development of a new territoriality" (ibid.). Among these, we can highlight, for example, telematics technologies and those for the production of clean energy.

2 RECENT TERRITORIAL DYNAMICS AND REGIONAL LANDSCAPE PLAN: THE CASE-STUDY OF OGLIASTRA

In Sardinia, the policies related to tourism and economic development have generated important territorial imbalances, which have been highlighted through a process of

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concentration of the population in coastal areas and a consequent abandonment of internal areas. In general, the process has resulted in a reduction of the role of representation and the presence of intermediate bodies in places of the community (Decandia & Lutzoni, 2016; Magnaghi, 2000; Rosboch, 2017).

Even though, from a certain point of view, the depopulation dynamics represent an endemic element of the Sardinian territorial reality (Brundu, 2017), the decisive contribution of contemporary development strategies linked to the "Rebirth Plan" after World War II cannot be underestimated (Colavitti, 2013; Lecis, 2017; Scroccu, 2011). According to data from the 2015 IFEL report, in Sardinia, 84.4% of the Municipalities, which account for the 52.3% of the total regional population, belong to the so-called internal areas as defined in the National Strategy for Internal Areas (SNAI).

Among the territories considered as extreme periphery, there are large areas of the historic regions of Gallura, Ogliastra and Barbagie, affected by an important depopulation phenomenon that led to a loss of population of 13.9% from 1971 to 2011. Among the national and international policies pursued for local development, starting from the year 2000, the Local Action Groups (LAGs) foreseen by the Leader program, show the interest towards the territory as a "community of life" among their strong points.

The historic region of Ogliastra represents an excellent case-study for the construction of a bioregional scenario supporting inland areas. According to the last census, the population of the Municipalities belonging to the suppressed province of Ogliastra[1] amounts to 57,185 inhabitants; the two main urban centers of the area, Tortolì and Lanusei, do not exceed 15,000 inhabitants. In the year 2017, according to the ISPRA Report on Land Consumption, the Province of Ogliastra appears to be among the Italian provinces with the lowest percentage of consumed land, equal to 2.61% of the whole municipal surface area, although in the presence of strong imbalances between several municipalities: the highest values are recorded in the coastal municipalities of Bari Sardo (6.5%), Girasole (7.11%), Lotzorai (8.3%) and Tortolì (13.71%), mainly due to settlement pressure linked to tourist flows, especially inside the 300 meter strip from the coastline.

The territory is structured according to a "cavea" conformation constituted by the ridge of the reliefs of the Gennargentu massif, closed in an arc on the coastal plain.

The Ogliastra settlement system reflects this conformation and the main inhabited centers are arranged along three main lines (Sanna & Cuboni, 2009):

[1] The former province of Ogliastra included the Municipalities of Arzana, Bari Sardo, Baunei, Cardedu, Elini, Gairo, Girasole, Jerzu, Ilbono, Lanusei, Loceri, Lotzorai, Osini, Perdasdefogu, Seui, Talana, Tertenia, Tortolì, Triei, Ulassai, Ussassai, Urzulei and Villagrande Strisaili.

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- the municipalities of the Rio Pardu valley (Gairo, Osini, Ulassai, Jerzu);
- the settlement belt halfway up the hill, along the eastern slope of the massif of Gennargentu (Lanusei, Ilbono, Elini, Arzana, Villagrande Strisaili, Talana, Urzulei, Triei e Baunei);
- the coastal settlement and the wetland area (Tertenia, Cardedu, Bari Sardo, Tortolì, Lotzorai and Baunei).

Presence of "civic uses" is another interesting fact – consisting of the right to collective use of the land for grazing, agriculture and forestry activities: these areas cover a 60% of the Ogliastra area and about 482 km^2 fall into protected areas of the Natura 2000 network (Programming Service of the Province of Ogliastra, 2013).

The active population is mainly employed in the secondary and tertiary sector, in particular in the tourist and hospitality sector. Instead, the weight of craft or agricultural professions continues to decline. Ogliastra also presents a population with an Aging Index of 165.3%, which is increasing and is already above the national average[2]; this data justifies the inclusion of Ogliastra in the Blue zones with the highest longevity in the world (Pes & Poulain, 2014; Buettner, 2015).

The historical region is included in one of the 27 landscape units of the Regional Landscape Plan, which defines some strategic project guidelines. Among the most significant identified measures, it is possible to highlight the redevelopment of the slope centers through the strengthening of services for hospitality and receptivity, the enhancement of the environmental system of municipalities in the Rio Pardu valley, the redevelopment of the coastal settlement along the SS125 line by strengthening and integrating local services and connections between the coastal municipalities and those of the hinterland, the conservation of the ecological potential of the coastal ecosystem, of the wetlands of Tortolì and of the hydro-geographic basin that feeds them.

3 REPLICABILITY OF THE BIO-REGIONAL MODEL FOR THE INTERNAL AREAS: WHICH "ENERGIES" HAVE TO BE USED FOR OGLIASTRA?

From a bio-regionalist point of view, Ogliastra presents a settlement structure composed of medium-small centers hierarchically oriented towards the coastal settlements in which the main services are concentrated, despite the absence of real dominant polarities.

The data taken from the 2011 ISTAT census describe an activity rate of around 48% of the population, a figure just below the regional average, which stands at 49.9%. The territory's

[2] ISTAT data- 8mila Census "Profilo del territorio della provincia di Ogliastra".

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workforce is represented by a total of almost 24,000 active individuals (of whom 19,637 are employed) out of a total of 50,035. A significant portion, around 23% of the employed population, works in the commerce and hospitality sector, while over 20% is engaged in the industrial sector.

In the agriculture, forestry, and fishing sector, however, only 12% of the population is occupied, confirming the dynamics found at the regional level. Finally, the 2010 Agricultural Census shows the presence of 3,336 farms on the territory of the former province of Ogliastra – more than 50% are small businesses that use an agricultural area of less than 2 hectares, while about 27% of companies exceeds 5 hectares of utilized agricultural area. The territorial connections with the other historical regions are guaranteed by the SS125 "Orientale Sarda", the main arterial road that runs through the region from North to South; railway connections are limited to the presence of the historic route of the *Trenino Verde*, currently used for seasonally tourist purposes. Ogliastra responds to the territorial type of bioregional contexts characterized by a coastal system and the complex multi-scale relations with its own hinterland, generated by the polarization of the dynamics between mountain and coast. According to Patrick Geddes, the Ogliastra context could be an excellent example of a "valley section" (Geddes, 1925).

For a retelling of the context in a bio-regionalist point of view, however, it is necessary to integrate and systemize also those bottom-up initiatives created with the aim of opposing the dominant economic paradigm. These local initiatives are capable of producing conditions of self-sustainability and "Territorial added value" through a new alliance between citizens and local producers. Among the bottom-up initiatives, it has been pointed out, by way of example, the "Terra Libera.

Biodiversity in Ogliastra" project, consisting of mini-courses of self-production and various "know-how workshops". Coping with the issue of the productive relationships linked to the food resource, the Solidarity Purchase Groups (SPGs), the experiences of direct sales between consumer and producer and the farmers' markets, are among the most common forms through which the citizens are freed from the channels of the traditional food chain. The SPGs, despite their strategic importance, have been recognized by an administrative act drawn up by the Union of Municipalities of Ogliastra[3], which unfortunately has never been put in place. Only one social farm is present within the "Regional register of multi-functionality of agricultural and fish farms" for the former province of Ogliastra, in contrast with 10 educational farms.

[3] Del. n. 26/2014 by the Administrative Board of the Municipalities Union of Ogliastra. Online: https://www.regione.sardegna.it/documenti/1_17_20140908182541.pdf [last accessed: 11/03/2019].

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In both cases, almost all of these activities are located in coastal Municipalities, which probably shows that even the existence of these realities follows in some way the same dynamics that have characterized the tourism sector.

4 FINAL CONSIDERATIONS

At the end of the reflections carried out so far, it is possible to trace some considerations.
The present research shows the many possibilities and perspectives that would be generated by the adoption of a bio-regional development model for a context such as that of Ogliastra. Public planning initiatives at different institutional levels, aiming at promoting and enhancing the territorial heritage, cultures and knowledge deposited in the local *milieu*, constitute a good starting point, as a result of an increased awareness by administrators and local stakeholders. However, it is clear the need to significantly schedule the knowledge of local resources, as well as to enhance the bottom-up initiatives deriving from the will of citizens and associations, which constitute the "contradictory energies" of bioregional contexts and that are often not taken into account by the provisions of institutional plans and programs.
The Regional Landscape Plan of Sardinia was draft in 2006 with the purpose to resolve some urgent problems about the model of development. It represented an important innovation in terms of maintenance of the widespread cultural heritage, restoration of historical centres and protection of coastal and agricultural landscapes.
Nevertheless, the planning objectives are implemented through traditional prescriptive rules, in which the bounding conservation elements prevail over project strategies. In comparison, regional Landscape Plans of Tuscany and Apulia based on a "territorialist" approach appear to be more dynamic and participation-based. Furthermore, existing local municipal plans are not able to fully grasp the whole territorial relationships and doesn't take into account the richness of grass-root initiatives and informal "energies" expressed by local communities.
To systematize these energies into an overall framework and integrate the dimension of bottom-up initiatives in programming and planning tools, a highly original element could be found in the establishment of forms of agreements between communities and policy makers, able to highlight the territorial values represented by the main environmental invariants of the context. In this sense, bio-districts, multifunctional agricultural parks, River Contracts and Lagoon Contracts - the last two governed by a recent regional regulatory provision by the Basin Authority[4] - represent the most advanced tools.

[4]Del. n. 2/2018 by the Institutional Committee of the Regional Basin Authority. Online: https://www.regione.sardegna.it/documenti/1_617_20190109155046.pdf [last accessed: 11/03/2019].

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The agricultural sector is a central element in Ogliastra economy; local product promotion strategies should be based on encouraging organic production, creating quality certification systems, creating multi-sectoral networks integrated with tourism, catering and trade supply chains. In this sense, the establishment of a "bio-district" of Ogliastra region along the lines of recent national and regional initiatives[5] could constitute a winning prospect.

This is also due to the specificity of Ogliastra context, in which there is a great wealth of land for civic use in a state of non-use that could be enhanced through the strengthening of agroforestry production chains. The bio-district could also accommodate and integrate in a unitary project all those ephemeral experiences related to Alternative Food Networks and multi-functionality initiatives of agricultural practice. The analysis carried out in this paper has shown that the total number of experiences resulting from the establishment of educational farms and social farms is quite small, so it is difficult at present to imagine a significant impact outside an integrated and multi-scale project.

The most urbanized contexts of the Ogliastra, thanks to the bio-district, could somehow restructure the relationship between city and country, with a view to contrasting the soil consumption. In the end, the structuring of a Lagoon Contract for the wetlands of the Tortolì Pond and the hydrographic basin that feeds it and of a River contract for the Rio Pardu basin, would make it possible to integrate the bio-district production strategies with the need for protection and valorization of environmental resources, operating an overall reconnection between the mountain-hill and coastal centers.

Also in this case the virtuous examples are not lacking, both at national and regional level: in Sardinia there are already the River Contract of the Coghinas valley, the River Contract of the Temo valley and the Calich Lagoon Contract. Still from a bioregion perspective, it is finally possible to outline some of the future perspectives on the basis of the seven constructive elements elaborated by Alberto Magnaghi, in terms of development of territorial information systems about the paths, agricultural and gastronomic productions, civic uses and archaeological preexistences, reconnection of the polycentric settlement network through cycle and pedestrian and equestrian excursion routes, restoration interventions of the historical centers and of the architectural elements characteristic of the rural landscape, marketing of typical products, landscape and tourist-accommodation in multi-functional farms, use of forest biomass in the energy field and the local closure of the waste cycle through its unified and integrated management, enhancement of educational and multi-purpose farms,

[5] The "Bio-district of Parks in Sardinia" is an initiative created by the Managing Entity of Porto Conte Park, that elaborated a framework agreement between the Municipality of Alghero, the Natural Regional Park of Porto Conte, COPAGRI Sardegna (Confederation of Agricultural Producers), ASAB Sardegna (Sardinian Association for biological agriculture), Legambiente and Biocertifica – ICEA Sardegna.

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self-produced laboratory initiatives, strengthen of the participatory dimension of the communities in local decision-making processes.

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AUTHOR'S PROFILE

Anna Maria Colavitti is an Associate Professor in Urban Planning at the Department of Civil, Environmental Engineering and Architecture (DICAAR) – University of Cagliari (IT) and PhD in Urban Planning. She teaches Fundamentals of Urban Planning, Urban and Regional Planning. She is member of the Scientific Board of the PhD Programme in Territorial planning and Urban Development. Her research focuses on recent developments in cultural heritage, environmental and urban planning with particular attention to local development approaches, integrated area-based programs and territorial governance processes.

Alessio Floris is an Architect, graduated in Architecture at the University of Cagliari with full marks and honors, with a final thesis in the field of urban planning, focusing on policies aimed to control urban sprawl and to contrast land take. He is currently PhD student in Civil Engineering and Architecture and his research investigates the topic of the enhancement of public real estate assets as a resource to support urban regeneration processes. The aim is to identify new paradigms through which to sustain its strategic value, integrating the socio-economic aspects with those linked to the territory and the urban habitat, in a perspective of social innovation and territorial development. He also collaborates with the Department of Civil and Environmental Engineering and Architecture in the drafting of municipal urban plans and detailed plans for the recovery of historical centers.

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Francesco Pes is an Architect and Ph.D. in Civil Engineering and Architecture. He researches at DICAAR - Department of Civil and Environmental Engineering and Architecture, University of Cagliari (IT). His research is based on urban and territorial planning tools and methods for auto-sustainability through innovative bioregional assessment approaches and ecosystem services evaluation at the local neighbourhood scale. He enhanced his educational background carrying out international academic projects at the Harbin Institute of Technology (China), Centre for Urban Ecologies - University of Californa San Diego (USA), Institute d'Aménagement de Tourisme et Urbanisme – Universitè Boredaux-Montaigne (France), Centre for Public Interest Design - Portland State University (USA). He is author of about 10 scientific publications about his research topics.

Sergio Serra is an Architect, Ph.D. in Civil Engineering and Architecture and Research Fellow in Urban and Regional Planning at the Department of Civil and Environmental Engineering and Architecture, University of Cagliari (IT). His research interests focus on the application of innovative approaches and market oriented tools, in the field of urban planning, aimed to the control of land-take phenomenon, the recovery of historical centers, the protection and enhancement of cultural and landscape heritage, the urban and territorial redevelopment. He also collaborates in the drafting of urban municipal plans and detailed plans for the historical center, in compliance with the Regional Landscape Plan. He is author of several publications of international and national relevance, included the recent peer-reviewed book "Diritti edificatori e consumo di suolo. Governare il territorio in trasformazione".

Alessia Usai is a Civil Engineer and Ph.D. in Technology for the Preservation of Architectural and Environmental Heritage. She researches at the Department of Civil, Environmental Engineering and Architecture (DICAAR) – University of Cagliari (IT). Her research focuses on the relationship between cultural heritage and urban planning according to the creative city principles and the landscape approach outlined by the European Landscape Convention to identify best practices for the development of innovative cultural policies and new urban regeneration tools.

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INCLUSION OF MIGRANTS FOR RURAL REGENERATION THROUGH CULTURAL AND NATURAL HERITAGE VALORIZATION

***ELISA CONTICELLI[a]**
CLAUDIA DE LUCA[a], AITZIBER EGUSQUIZA[b]

[a] Department of Architecture, Alma Mater Studiorum, University of Bologna, Italy
e-mail: elisa.conticelli@unibo.it
claudia.deluca5@unibo.it

[b] Sustainable Construction Division
Tecnalia Research & Innovation, Spain
e-mail: aitziber.egusquiza@tecnalia.com

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ABSTRACT
Rural areas all over Europe are facing similar chronic economic, social and environmental problems such as depopulation, reduced service provision, ageing, decline of agriculture income, inhibited accessibility. At the same time, rural landscapes are continuously threatened by loss of biodiversity, climate change impacts and short-term management decisions and perspectives that further aggravate the economic and social conditions of rural communities. Despite these critical socio-economic conditions, rural areas are cradles of civilization, repositories of old traditions, dialects and languages, of uses, handcrafts skills and social practices which must be preserved and exploited. The majority of the European heritage is found in rural areas, therefore Cultural and Natural Heritage can represent a driver for migrants' integration, by fostering a heritage based sustainable regeneration of rural territories that is able to support a new model of integration. The overall aim of the paper is to investigate the challenges and possibilities offered by migration trends in rural areas to create rural regeneration models for inclusion of migrants and refugees, based on cultural and natural heritage introducing them to the job market. Section 2 explains the methodology of the study and gives an insight of the research topic within the overall RURITAGE project methodology. Two case studies of rural regeneration through the inclusion of migrants into the valorisation processes of cultural and natural heritage are presented in Section 3, while the preliminary results and main findings are discussed in Section 4. In Section 5, conclusions and future research steps are presented.

KEYWORDS
Cultural Heritage; Natural Heritage; Rural Regeneration; Migration

* The other authors are: Angela Santangelo, Simona Tondelli.

1 INTRODUCTION

Rural areas all over Europe are facing similar chronic economic, social and environmental problems: depopulation, reduced service provision, ageing, decline of agriculture income, inhibited accessibility are the most critical challenges that hardly find effective and long-lasting solutions. Moreover, rural landscapes are continuously threatened by loss of biodiversity, climate change impacts and short-term management decisions and perspectives that further aggravate the economic and social conditions of rural communities.

Despite these critical socio-economic conditions, rural areas are cradles of civilization, repositories of old traditions, dialects and languages, uses, handcrafts skills and social practices which must be preserved and exploited. Moreover, the majority of the European heritage is found in rural areas, therefore recognizing rural areas as poles of excellence, where the role of Cultural and Natural Heritage is relevant in heritage capitalization, which could be a different perspective to establish new rural regeneration paradigms.

In many places, rural environments have been nurtured and managed effectively so to attract and retain young people, develop new business, and increase biodiversity (ICOMOS, 2016) benefiting from CNH in myriad ways: from the restoration of historical buildings, to the holistic usage of rural landscapes and biodiversity assets, including the revitalization of ancient traditions, arts, and crafts. In this framework, a positive contribution could be found in foreign people arriving in a given place for different reasons.

Strong migration flows to rural areas are part of a more global phenomenon in the European context that worth investigating (Jentsch, 2007). Beyond the challenges, the arrival of migrants can create new opportunities for growth – particularly for areas suffering from population decline, demographic ageing and closing services that have been afflicting European rural areas for decades, thus contributing to maintain rural communities alive. The ageing of the rural and farm population and the need to accommodate or reduce the flow of young people out of the countryside has been a serious challenge to the generational renewal and the sustainability of the European rural regions (Kasimis, 2010). The importance of hosting newcomers have been recognized by policy makers and issues of their integration are relatively high on the political agenda.

Cultural and Natural Heritage (CNH), rich in rural areas, can represent a driver for migrants' integration, fostering sustainable regeneration of rural territories, involving newcomers as well as the host society. Moreover, highlighting the positive contribution of migrants to the development of rural areas can be fundamental for the creation of an inclusive society (Lourens, 2007).

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In this context, the overall aim of this paper is to investigate the challenges and possibilities offered by migration trends in rural areas and to introduce rural regeneration models for inclusion of migrants and refugees, based on cultural and natural heritage, introducing them to the job market. The proposed approach has been developed within the H2020 project RURITAGE[1] – Rural regeneration through systemic heritage-led strategies, that considers migration as one of the key areas of innovation to be adopted in rural territories where a regenerative potential could be identified. Section 2 explains the methodology of the study and gives an insight of the research topic within the overall RURITAGE project methodology. Two case studies of rural regeneration, through the inclusion of migrants into the valorisation processes of cultural and natural heritage, are presented in Section 3, while the preliminary results and main findings are discussed in Section 4. In Section 5, conclusions and future research steps are presented.

2 METODOLOGY

The research aims at better understanding the positive contributions that cultural heritage can provide for migrant integration in rural areas, by using an empirical case study analysis approach, a well-established research method (David, 2006; Gerring, 2007; Yin, 2009) that examines a contemporary phenomenon and help to inform practice by illustrating what has worked well, what has been achieved and which have been the main issues or challenges.
The investigation has been implemented within the H2020 RURITAGE project, where cultural and natural heritage is considered as a key driver and enabler for sustainable development in all its dimensions, and crucial for the recognition as valuable roots for economic and environmental growth and regeneration, as well as major contributor to social cohesion and civic engagement. RURITAGE has identified six Systemic Innovation Areas (i.e. pilgrimage, sustainable local food production, art and festivals, resilience, integrated landscape management and migration) whose intersections constitute a European model of heritage-led rural development.
In this paper, the contemporary phenomenon studied is migration, considered as a driver for rural regeneration though the valorisation of cultural and natural heritage. Indeed, despite

[1] RURITAGE is a four-year EU-funded research project, initiated in June 2018, which strives to enable rural regeneration through cultural and natural heritage. Throughout the RURITAGE project, 13 rural areas have been selected as Role Models. Role Models can be considered as successful cases where rural areas have been regenerated thanks to cultural and natural heritage. Role Models practices are analyzed to be transferred to 6 selected Replicators, one per SIA. Replicators represent local communities within rural territories that are in the process of building their own heritage-led regeneration strategies, but need to improve their skills, knowledge and capacity building. For further information: www.ruritage.eu

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the posed challenges, rural areas can take advantage of the opportunities provided by an influx of migrants as a source of new vitality to restore declining villages. In areas suffering from population decline and closing services, the arrival of migrants can create new opportunities for growth; migrant contributions can be financial, but also in the form of social remittances, exchange of expertise and cultural change. There are clear potential win-wins for migrants and declining local areas in Europe. Nevertheless, well-coordinated and sensitively managed integration policies are needed in order to benefit both migrants and hosting communities.

Beyond the challenges presented by the migration crisis, especially in the countries most affected by the migrants' arrivals (e.g. Greece and Italy), and by the received application of asylum (e.g. Germany), the arrival of incomers can also create opportunities for repopulation, growth and potential for rural regeneration. In this context, cultural and natural heritage, in terms of local tradition, languages, art and crafts, etc. can play an important role in boosting and accelerating the process of integration and regeneration.

3 CASE STUDIES ANALYSIS

In the RURITAGE framework, specific model territories and communities have been identified for each Systemic Innovation Area (SIA), aiming to analyse their regeneration process and then to extract good practices that could be successfully transferred to other territories to help them in building their own regeneration strategy. In the migration SIA, two different case studies have been identified and analysed: the PIAM Onlus and the Lesvos Global Geopark. These are different integration models representing two steps in the hosting process migrants are subjected: Lesvos Global Geopark has developed a model for managing the emergency, when migrants arrive in Europe, mainly through illegal and unofficial channels; while PIAM is working for establishing a more structured integration of migrants in local communities.

3.1 MODEL OF MIGRANTS HOSPITALITY AND INTEGRATION IN ASTI PROVINCE

The activities of migrants' hospitality in the Asti Province have been led since 2014 by PIAM Onlus, an NGO working in the field of migrants' integration and inclusion. Asti Province, located in the heart of Piedmont Region, has an outstanding heritage, featured by the Monferrato and Langhe wine landscapes that in 2014 have been awarded the prestigious Unesco world heritage recognition. Besides, the area suffers a population decrease (-3% since 2010) with an unemployment rate of 9.5%. The presence of foreign people is around 12% of the total according to the Italian statistic bureau data.

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The economic sector is characterized by local enterprises mainly concentrated in agriculture and manufacturing sector. The good reputation of the province of Asti as a holiday destination has increased: it is one of the Italian provinces with the highest concentration of quality restaurants and wines and offers an environment often still intact and a series of traditional and folkloristic events[2].

Within this territory, a model of hospitality based on cultural heritage recovery and rediscovery has been implemented with relevant results. PIAM started its work in the framework of the SPRAR programme, whit the aim of providing concrete solutions to contrast human trafficking of women and migrants. The NGO hosts foreign people in some historical buildings in the countryside of Asti, where it started to involve them in practical activities, such as the recovery of Villa Quaglina, an ancient villa of the last century located in the Asti countryside and owned by the religious order of the Oblates of St. Joseph, and abandoned for some years. The renovation of the villa and its rural system ensured to host about 45 migrants, creating guest rooms and wide spaces for various events (conferences, parties, cinema, etc.). The same way of intervention was used for the recovery of the old railway station of Chiusano, which has been completely restored and is now a housing facility for a hospitality and integration program dedicated to refugees. These activities enabled migrants to fully fit into the local community. The old villa renovation allowed to start other different heritage-based activities directly involving migrants: ancient grains cultivation and distribution to the territory, where some people involved in the cultivation process have been taken part in the product selling in local markets for organic farming products, establishing relationships with farmers in the province; recovery of the old vineyard and its cultivation foreseeing the collaboration of oenologists who trained 2-3 migrants each. This supported the creation of a migrant-ethnic cuisine catering that is now active in the whole province*.* A stronger collaboration with local winegrowing companies is foreseen in order to deal with different processing techniques; job traineeships for refugees in the urban maintenance sector, employing several youngsters as menders in the public works sector of the Municipalities of Asti and Settime, in order to form professional people and to finalize the activities of refugees in works for the public interest, to serve the local community. Ad-hoc training courses conceived for refugees in the catering and in the artistic craftsmanship sectors have been organized as well, leading to the development of a brand "Terre di Monale" that produces hand-made ceramics for professional kitchen and home.

[2] For further information: www.provincia.asti.it

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3.2 BOOSTING MIGRANT INTEGRATION WITH NATURE IN LESVOS ISLAND

Lesvos is the third largest island in Greece, located in the northeaster Aegean Sea. It faces the Turkish coast from the north and east; at the narrowest point, the strait is about 5.5 km wide.

The entire territory of Lesvos is awarded as "Lesvos UNESCO Global Geopark", a UNESCO status given to territories with an outstanding geological heritage. Lesvos contains one of the finest and rarest geo-monuments in the world (Zouros, 2015) and it has been declared a Protected Natural Monument. Fossilised plants have been found in many localities on the western part of the island.

Socio-economic trends in the island register a population decrease (-6%), and an unemployment rate of 15.8%. Lesvos's inhabitants are mainly local, only 6% are foreigners. However, this percentage does not consider the big trend of migrants' arrivals that have been affecting the island during the last years. Lesvos Geopark received in 2015 and 2016 more than half a million migrants making it the most important entrance gate for migration in Europe. The entire community of Lesvos has done its utmost to support and handle this extreme situation and tried to make the life of the migrants as good as possible. The Geopark has supported these activities and has developed several integration and information programmes aiming to help migrants in becoming familiar with the new environment since the very beginning of their arrival, by organizing educational programmes. The programmes include the collaboration with authorities for the integration and information on the Lesvos Island UNESCO Global Geopark, the geological history of Greece and the importance for the preservation and conservation of the Natural and Cultural heritage.

Groups are accompained by bus from the refugees' camps to the Natural History Museum of the Lesvos Petrified Forest and pass a day away from their everyday programme in the camp. This programme runs in collaboration with NGOs working specially with children and young refugees. The activities run from special informative presentations on Lesvos Island UNESCO Global Geopark and the Petrified Forest to guided tours for families, young teenagers and children who have migrated to Lesvos. The objective is the acquaintance of migrants with the cultural and natural heritage of the island and to train them in case of Natural disasters, especially earthquakes, by using the museum's earthquake simulator. The programme also includes the simulation of the conservation procedures that are implemented in the fossils and the migrants are allowed to conserve specially selected fossils in order to appreciate and value the importance of the petrified wood. Moreover, refugees get to know the local products and the gastronomy of Lesvos, discovering flavours and similarities between their country and the host country.

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4 PRELIMINARY RESULTS

RURITAGE activities are currently focused on the analysis and systematization of the models's practices, in order to extract sort of "regeneration recipes" to be transferred to other territories. Notably, the analysis of the case studies in the migration sphere has been targeted to collect relevant information for decipher the processes and changes that have led on the one side to rural regeneration through the inclusion of migrants and on the other side to boost migrants integration through cultural and natural heritage. First of all, the two case studies have been analysed independently in their context. Secondly, the practices developed and implemented in each case study have been mapped and classified according to several aspects: challenges; proposed strategy objectives, drivers and barriers; initial and obtained capitals (Tab. 1).

	ASTI PROVINCE	LESVOS ISLAND
Challenges	Ageing of the population, especially in rural areas; high concentration of international immigrants	Ageing of the population, especially due to the departure of young people; international immigrants, especially due to the proximity with the Turkish coast; depopulation, due to the economic crisis in Greece; unemployment
Proposed strategy objectives	Providing trainings to migrants; reviving and preserving local agri-food and handcraft production heritage; promoting safety and maintenance of the natural environment	Boosting migrants integration through the development of Lesvos as a geotourism destination
Proposed strategy drivers	Innovation in culture and heritage; cultural and natural heritage preservation	Natural heritage preservation; tourism; innovation in culture and heritage
Proposed strategy barriers	Market related issues with new products developed	Living conditions of migrants and different social, economic and cultural background
Initial capitals	High cultural and natural heritage; educational activities, especially in food sector	High cultural and natural heritage educational activities and humanitarian actions
Obtained capitals	New skills related to the local culture; social cohesion; reuse of historic buildings	Improved recognition of natural heritage; migrants inclusion in the local natural and social environment

Tab. 1 Case study analysis through challenges, proposed strategies and capitals

The analysis showed that rural regeneration through migration can be considered as challenge-driven, and that the initial capitals that have been mobilised are more related with human and social resources. In both cases the initial capitals present in the territory, mainly based on natural and cultural heritage, have been enriched by new or improved capitals related with human and social aspects.

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Indeed, the regeneration process led in Asti province started from several challenges, such as migrant hospitality emergency, a necessity of actions contrasting human trafficking, but also lacks of resources for reducing abandonment and degradation of rural assets. These challenges became the drivers for a overall regeneration strategy routed on training to migrants, preservation of local agri-food and handcraft production heritage, safety and maintenance of the natural environment. A relevant role in this process was played by PIAM Onlus, local public services and communities, which have supported the process of inclusion and consequently the rural regeneration and reappropriation of Villa Quaglina and its surroundings.

Lesvos Geopark started its experience in 2016, facing the challenge of addressing the need to relief the pressure migrants suffer by living in large camps, with people having different social, economic and cultural backgrounds, without any contact with the local environment. This challenge has been tackled through a strategy that has been involving migrants in the discovery of the local cultural and natural heritage, proposing geotourism related activities managed by the Geopark. This approach have been producing social and mental benefits for migrants, while preserving local identity and economic activities. This model experience has been possible thanks to a deep involvement of relevant stakeholders, such as the Natural History Museum, NGOs active in educational activities for migrants, and the local community. Lesvos Geopark ensures to train around 200 migrants every year upon the 6.000 people yearly arriving. Finally, the case study analysis has allowed the identification of specific good practices, summarized as follows: (i) to integrate migrants within the local agro-food chain and the creative industries, (ii) to restore old and unused buildings to give hospitality to the migrants, (iii) to offer training to migrants and residents related with organic farming, arts, built heritage restoration, traditional crafts and trades, etc. (iv) to facilitate the connection with residents with defined food and art-related activities, (v) to offer internships for migrants in local businesses, farms, tourism related activities, (vi) to to develop integration and information programmes for migrants and citizens, (vii) to offer educational programmes and guided tours, specifically tailored for migrants to introduce them in the CNH of the territory. These practices represent the basis for boosting and accelerating the process of integration and regeneration since the very beginning of the migrants coming.

5 CONCLUSIONS AND FUTURE RESEARCH

The two model territories analysed have shown how relevant is the role of cultural and natural heritage not only for migrants integration within the local society, but also for rural regeneration by repopulating the area, reusing historical assets, strengthening local traditions and raising awareness of local natural and cultural resources. Indeed, the involvement of

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migrants in local activities has been activating an integration process which involves cognitive, cultural, behavioural and attitudinal change for both newcomers and the host society.
Basing on these actions that have been identified as relevant for boosting the rural regeneration of the interested territories, the further steps of the investigation aim at extracting significant “lessons” to be transferred in other rural territories which suffer similar challenges and want to build innovative heritage-led regeneration strategies for integrating migrants in a significant rural renaissance. Cultural and natural heritage will thus emerge as a universally shared human trait with transnational similarities that are able to facilitate contact and exchange in a safe environment and it will highlight the positive contribution of migrants to the development of rural areas and for the creation of an inclusive society.

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WEBSITES

www.provincia.asti.it; www.ruritage.eu; www.istat.it

AUTHOR'S PROFILE

Elisa Conticelli is a Ph.D. in spaces and times of city and the territory, she is junior assistant professor at the University of Bologna, Department of Architecture. Her research is mainly focused on sustainable rural and urban regeneration processes, landscape valorization, sustainable mobility in rural and urban contexts, which are investigated at planning and design levels. She is currently involved in several European projects on the aforementioned topics as research group member. She is author of over 45 publications.

Claudia De Luca is a Ph.D. candidate at the department of Architecture, University of Bologna. Environmental scientist (MSc), now focusing on sustainable urban planning and urban regeneration processes related with the use of nature into the cities (Nature Based Solutions). Involved in the Planning and Regeneration research groups, leaded by Prof. Simona Tondelli, she is actively involved in several H2020 and INTERREG funded project (RURITAGE, ClimateKIC NBS and MATCH-UP).

Aitziber Egusquiza is a Senior Researcher at Tecnalia. Ph.D. on decision making processes for improving sustainability and liveability of historic districts using multiscale information management. She has graduated as architect with a post degree in Restoration and Rehabilitation of the Historic Architecture and a master degree in Urban Management and Valuation. Scientific coordinator of RenoZEB project. Member of several coordinating teams of European and National research projects developing decision making methodologies, multiscale information models and decision support systems for the improvement of the sustainability of buildings and districts. Member of the scientific committee of EECHB.

Angela Santangelo is a Building engineer and Ph.D. in Architecture, she is research fellow at the Interdepartmental Centre for Applied Research - Buildings and Construction at the University of Bologna. Her research has mainly focused on urban planning and particularly on policies and tools dealing with energy efficiency and occupant behaviour in the public housing sector. She is member of the planning and regeneration research group coordinating the H2020 RURITAGE project and collaborating on several other European projects. She is MC Substitute of the EU COST Action European Energy Poverty.

Simona Tondelli is an Environmental engineer and PhD in Building & Spatial Engineering and she is associate professor of Urban Planning. She has 20 years of research experience in sustainable urban planning and regeneration. She is the scientific responsible of the Refurbishment and Restoration division of the UNIBO Interdepartmental Centre for Applied Research on Buildings and Construction (CIRI-EC). Coordinator of RURITAGE H2020 project, of MATCH-UP INTERREG EUROPE project, ECOTALE INTERREG IVC project, and currently partner in one ERA-NET JPI Urban Europe project (SPN), SHELTER H2020 project, SEERRI H2020 project and many Erasmus + projects, and scientific responsible of many regional/local Research Projects. Vice-Director of the Emilia-Romagna section of the National Urban Planning Institute - INU. Member of the scientific board of the UNIBO PhD Programme in Architecture and Design Cultures. Author of over 100 publications.

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ENVIRONMENTAL AND SOCIAL SUSTAINABILITY OF THE BIOENERGY SUPPLY CHAIN

SEBASTIANO CURRELI

Department of Civil, Environmental Engineering
and Architectural, University of Cagliari, Italy
e-mail: sebastiano.curreli@unica.it

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ABSTRACT

The presence of high amounts of nitrates in the first and second layer of groundwater is a common problem faced by all countries where traditional farming and animal husbandry are practiced intensively. In addition the other cause is the growth of synthetic chemical industry which led to the spread of the use of nitrogen fertilizers and fertilizers. Groundwater in the areas subjected to spreading livestock effluents are increasingly likely to infiltration phenomena from the surface and storage in the soil thickness that are not saturated and possess very high quantities of nitrogen, which are progressively washed in water. The problem of contamination of nitrate waters is also an important issue in Sardinia, a region of Italy. In implementation of Directive 91/676 / EEC concerning the protection of water from pollution caused by nitrates from agricultural sources, the opening of the infringement procedure n. 2249/2018. Among the tasks undertaken in Italy that directly involve the Sardinia Region there are competent Program of Action for the nitrate vulnerable zone of Arborea. In addition, the failure to designate new vulnerable nitrate areas, where the monitoring activities of the surface and underground waters have detected exceeding limits of concentrations of nitrates and water bodies in a hypertrophic and eutrophic state, which involve different areas of the regional territory. The present work aims to provide strategy and territorial planning tools for compliance with the legislation, with benefits for the environment, safeguarding the competitiveness of farms present in the agricultural areas of Arborea, where the Shares Cooperative Society is located. There are in total around 230 member companies on the regional territory, with 230 million liters of processed cow's milk and about 38,000 heads for an annual turnover of 182 million Euros in the last financial year.

KEYWORDS
Sustainability; Rural Development; Bioenergy

1 INTRODUCTION

Today the agro-zootechnical activities play a multifunctional role. They no longer focus exclusively on tout court production, but also focus their attention towards protecting the environment and the rural landscape. The provisions of the Nitrates Directive 91/676 / EEC, in accordance with the provisions of the Water Framework Directive 2000/60 / EC as regulated by the Legislative Decree 152/2006 and of the Ministerial Decree of 7 April 2006, have been implemented in the Sardinian regional territory with the DGR n.1 / 12 of 18.01.2005, employing which the vulnerable nitrate zone of Arborea was designated and the DGR n.4 / 13 of 31.01.2006 and DGR n.14 / 17 of 04.04.2006 with which the Region has adopted the relative Program of action. Subsequently with DGR n. 21/34 of 05.06.2013 the Region has adopted the "Regional Discipline that regulates for the entire regional territory the activities of agronomic utilization of livestock manure and waste water for the phases of production, collection, storage, fermentation and maturation, transport and spreading (Regional Effluent Discipline)". The recourse to the productive specialization that characterizes the livestock sector, both in dairy cattle breeding farms and from fattening, has led companies to concentrate on a reduced number of activities that are strictly related to stable activities (in particular internal stable logistics and animal welfare). The activities often appear disconnected with each other thus resulting in an inevitable separation between the breeding (stable) and cultivation (field) activity. With regard to this criticality, regional regulatory interventions have multiplied in recent years, drawing attention to the management of effluents by promoting an integrated approach to spreading activities. It should be clarified that livestock manure (EA) can have positive effects on the soil only if they are introduced with appropriate technologies and after appropriate treatment aimed at their denitrification. On the other hand, where organic fertilization has been reduced for some time, a depletion of the organic substance content in soils has been noted with a consequent acceleration of erosive processes and loss of fertility (Bassanino et al., 2011). The Nitrates Directive 91/676 / EEC directs practices towards a better use of EA because their incorrect use can results in pollution of the soil, water and air (Morvant et al., 2015). The practice of fertilizing agricultural soils, carried out through the use of effluents from livestock farms, is the subject of a specific regulation aimed at safeguarding groundwater and surface water from pollution caused, at first, by the nitrogen present in the by-products. In order to better protect the environment, the directive and consequently national and regional regulations have lead to a strong reduction in the possibility of using effluents, especially in vulnerable areas. This criticality is reflected in the Monitoring and Control Plan (PMC) for the Nitrate-Vulnerable Zone of Agricultural Origin (ZVNOA) of Arborea, in the report dating back to October 2017 (2016

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activity and 2013-2016 results), underlines a growth trend in the quantities of nitrates in surface water table. Moreover, the values indicate how the registered nitrogen loads are close to the quantities present in the years in which the ZVNOA action program was not yet in action.

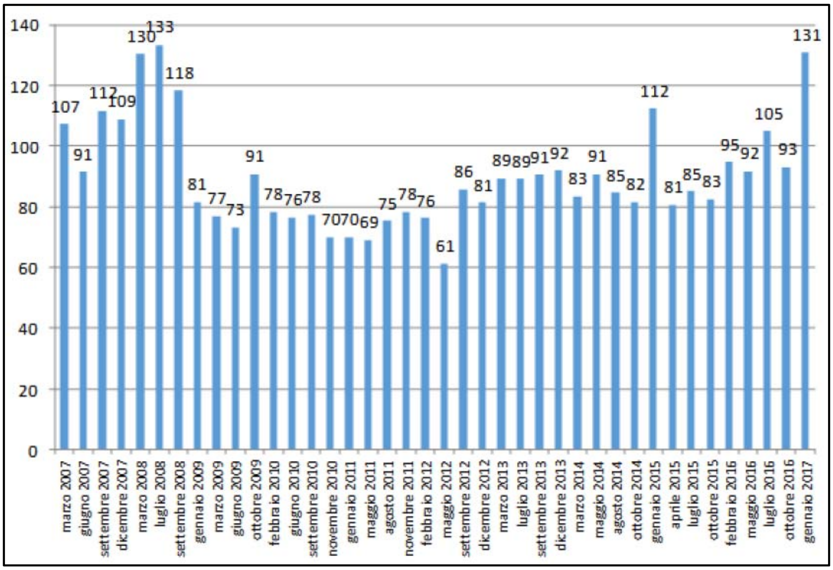

Fig. 1 Average quarterly nitrate content in surface water table (mg / l). Source ZVNOA of Arborea - PMC - 2016 Activities and 2013-2016 results

Taking into account the significant repercussions that could occur on the territory from the outcomes of the aforementioned infringement procedure, in particular on the agricultural and livestock sector, recently the Directorate General for the Regional Agency of the Hydrographic District of Sardinia together with the Directorate General for Agriculture and Reform agro-pastoral, have established a joint technical table with ARPAS, Regional Agency for Development in Agriculture (LAORE) and the Provinces in order to agree on the strategies to be adopted on the heavy criticalities highlighted by the PMC.

2 SCOPE OF WORK

The objective of this study is to provide strategy and territorial planning tools for compliance with the regulations, with benefits for the environment, safeguarding the competitiveness of the companies in the Arborea agro-livestock sector. The adaptation to the legislation is certainly linked to a clear and shared indications requires a gaze capable of bringing attention

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to the individual company, which in any case maintains its responsibilities, to the territory understood as an aggregator element. In fact, the objective of environmental improvement implied by these regulations cannot be achieved without uniform intervention in a territory that must extend at least to a supra-municipal level. In this sense, the initiatives that aim to address the management of livestock effluents at the consortium level must not only be favored, but also be guided properly. Reducing the impact of livestock activities on the environment is a primary objective in all rural planning and development tools; which can also result in a greater qualification of the products in the performance of the multi-functionality characterizing the agro-livestock sector. An innovative management of production processes enhances and guarantees sustainability while promoting the marketing of the primary product. The research has been, therefore, aimed to identify design approaches able to address and resolve the critical environmental issues of the sector, which are shared by the government and acceptable by public opinion.

The main expected results of the project activities are summarized in the paper:

- contribution on the state of production of nitrogen of zootechnical origin in the Compartment containing the assessment of critical issues at municipal level in relation to nitrogen loads and the possibility of compensating for excess nitrogen quantities between the different areas;
- contribution to EA management techniques aimed at containing nitrogen in the field with particular reference to possible treatments and their applicability on farms or in consortia;
- definition of a consortium energy management model according to a collective approach, which is based on the implementation of technological solutions for distributed energy generation.

3 METHODOLOGICAL APPROACH

The evaluation of the limitations to the use of EA derives essentially from the combination of two information: the quantity of nutrients produced by the animals and the receptivity of the soils, both understood not only as limitations introduced by the application of the nitrates directive, but also as an agronomic request deriving from the cultivations practiced. In fact, from a sustainability point of view, the supply of higher amounts of nutrients than what is necessary for crops results in an excess of nutrients, which can increase the risks of release to the environment. Therefore it is important to identify the critical areas of the territory in question, to gather information on the agricultural use of the soil in terms of the both surfaces and the kind of use, with a particular relation to the crops grown and their relative yields. In

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this regard, the available data in the Agronomic Utilization Plans (PUAs) of the companies surveyed were used, from which it was possible to identify the crops that are utilized in the area and their geo-referenced location. The PUA is the main technical instrument of the Program of action for areas vulnerable to nitrates from agricultural sources, which has been designed to achieve a substantial balance between the intended nitrogen supply to the land through the use of AEs and the foreseeable need of the crops. The reading of the PUAs also provided data on the consistency of the farms and the type of housing of the animals. The different types of housing in fact influence the production of effluent equal number of animals raised. Based on these data and using the production and effluent characterization parameters required by the regulations in force, the coverage of crop needs with livestock effluents was defined. To the analysis of the corporate data, it is then necessary to introduce the further constraints connected to the application of the nitrates directive and from the provisions of the Ministerial Decree of 7 April 2006, implemented by the Sardinia Region with the DGR n. 21/34 of 05.06.2013.

3.1 ENVIRONMENTAL COMPATIBILITY OF ZOOTECHNICAL LOADS

The environmental compatibility of the agronomic use of livestock effluents requires the consideration of some elements of an agronomic nature and of normative aspects. The field terms, on which the regulatory limitations are based, is used to define the nitrogen contained in the EA in the moment when it is taken from the storage structures to be transported to the field. This value does not take into account the nitrogen losses that occur primarily in the operations of handling inside the barn (effluent transport in the first collection tanks and pumping to the storage tanks) and subsequently by volatilization, at the time of distribution, and for runoff and leaching once incorporated into the ground. Thus, in order to determine the quantity of nitrogen that can actually be available for the crops, it is necessary to introduce an assessment of the efficiency of the nitrogen in the field. In reality the term efficiency in this context assumes the meaning of quantity of nitrogen that is absorbed by the crops in relation to that brought to the field. Efficiency can be influenced by multiple factors. Among which the main ones can be traced back to the time and to the distribution techniques in relation to the cultivation practiced and to the characteristics of the land on which the effluents are applied. In a consortium-based assessment, the precise determination of nitrogen efficiency becomes problematic. In connection to the objective of the analysis, the use of average nitrogen efficiency coefficients was deemed adequate. This choice is supported by the indications given in Annex A to the DGR n. 21/34 of 05.06.2013 that allows achievement of a minimum efficiency value of livestock effluent, reporting efficiency values differentiated by type of effluent, in relation to the type of production and the texture of the land on which

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it is distributed. The difference between the quantities of nitrogen produced and the maximum available in the Utilized Agricultural Area (SAU) provides a synthetic assessment of the condition for each company, allowing mapping of the situation of consortium nitrogen surpluses. The results in terms of both absolute nitrogen values and the company's SAU, provide an up-to-date reading of the amount of efficient nitrogen for crops and make it possible to highlight in terms of geographical distribution the quantities of surpluses produced and their territorial location.

3.2 INTERVENTION SCENARIOS FOR THE REBALANCING OF LUBRICATED LOADS

The intervention strategies identified in the project pursue the aim of improving the management of the effluents through solutions ranging from redistribution of the same adoption of treatment techniques of nitrogen containment to make them more manageable byproducts. Many techniques examined are well tested but applied only individually, without treating the issue in an integrated and territorial way. These strategies must be adopted and applied taking into account the specific business contexts to maximize their effectiveness and thus allow their effective use. This involves an in-depth analysis of the structure of the livestock farms and of the characteristics of the land so as to be able to evaluate the effect of the interventions and their economic impact on the production system, and to assess their sustainability. This activity, linked to the environmental assessment was treated with multi-criteria analysis; thus making it possible to provide a contribution to the problems in an organic and shared way, with a territorial rather than an individual approach. To achieve this result, an examination of the agro-zootechnical companies was started, focusing on the structural and managerial characteristics, with a particular attention to the production of effluents and their agronomic use. The obtained management model is based on a series of input data of the sample companies were selected among the 155 belonging to the territorial area of Arborea, Terralba and Marrubiu. The definition of the sample companies was carried out starting from the retrieval of the company data reported in the PUAs. The sample consists of 60 companies. The analysis of the PUAs was followed by the technical inspections aimed at defining the variables that mostly affect qualitatively and quantitatively the production of EA, for the sample. In fact, the variability in the quality of the EAs is very high depending on factors deriving both from the nature of the activities carried out in the companies and from the internal management of the stable. The set of indicators of variability in AE productions was defined by referring to three areas of a technical-managerial nature of the Company. They can be summarized as:

- livestock consistency of the Company;

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- type of housing;
- water and process water control.

While the first two areas are complex to manage, not lending themselves to easily implementable changes, the area relating to the management of process and meteoric waters often shows ample room for improvement. The mismanagement of this variable causes a dangerous impoverishment of the methanigen potential of manure and bedding. The areas in which the water volumes are the most generated are the waiting area and the washing of the technological systems. In addition to the information collected by the PUAs, the analysis in the field has allowed to build a Database managed by the Territorial Informative System.
At the same time, treatment strategies that can be applied to zootechnical wastewater have been examined to reduce the amount of nutrients and moisture present and to improve the management of wastewater. The logical path was then defined to combine the elements available in order to obtain the simulation management model. The methodology used for the simulations is based on the comparison between the nitrogen load of animal origin existing on the territory and the maximum quantities allowed by the legislation. The definition of the management model is based on the calculations that consider the availability of the land for the distribution of the effluents, built with multi-criteria methodology, and the treatment strategies applied to the effluents, thus defining the different work scenarios. The management model provides the amount of effluent to be distributed in relation to the availability of the land and calculates the costs related to the built scenarios. The management model provides for the return of detailed company-level and summary information for all companies in the sample in order to compare the different situations. In this way, it is possible to make assessments for all the possible techno-economical sustainability of the hypothesized solutions. The results of the activity carried out have allowed us to analyze the situation regarding the environmental impact of the livestock farms in the Arborea Section and to identify the technical solutions that can be adopted by companies with nitrogen excesses.
The methodology developed and tested over the course of the work has also made it possible to evaluate the possible management solutions that can be implemented in specific areas, taking into account the zootechnical load of the individual companies and the availability of land for the distribution of effluents also for non zootechnical companies.
The developed tool represents a prototype that can be easily applied to other situations as long as an adequate knowledge base is available. In fact, the territorial analysis carried out in the study areas is based on a data structure (DB) numerical and cartographic that is not always available and, if necessary, must be specifically created. In particular, while the availability of a cartographic base at the cadastral level is nearly always available, the location of company centers is often not easy to obtain. Furthermore, the arrangement of cartographic

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intersections and the relational structure of numerical and cartographic DBs are indispensable for the characterization of the territory through indicators.

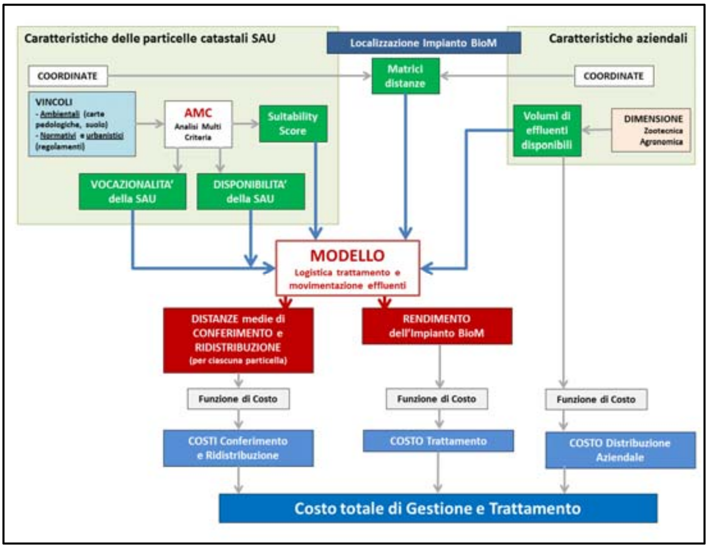

Fig. 2 Outline of the model created for the evaluation of management solutions. (Source: author's elaboration)

The preparation of these elaborations has been extensively tested from the operational point of view and, therefore, reproducible also for other realities, but requires the precise knowledge of the observed reality. The quality of the results that are obtained obviously depends on the quality of the DBs used, including those related to treatment costs that are not reported in this work. The methodological scheme used envisages the possibility of modifying the options and hypotheses carried out for the assessment, so as to modulate them in an appropriate manner in relation to the type of territory investigated. The management alternatives that can be examined are many just as the hypotheses that can be made for the availability of extra farmland. It is clear that the results obtained are derived from the feasibility of the choices that are set in the examined management models. In this regard, in the application to the areas of study carried out, three levels of intervention were chosen, from management alone to the intervention based on treatments. This allowed identifying, for the various areas, the general indications that can provide companies with an orientation on individual or collective strategies to be adopted. The purpose of the methodology is not, in fact, to carry out a rough design of interventions, but to highlight the viable solutions in different situations. Subsequently, leaving it to business decisions as how to translate operatively these directions, by evaluating the feasibility which is often not only nature technical-economic, but also

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involves aspects related to the interaction between the agricultural entrepreneurs of the territory and the relationship with the governing bodies of the cooperatives. The model tested on the Arborea case study can be adapted to other fields of study that can have different characteristics from the territorial point of view, such as pedology, availability of land, naturalistic and environmental character, amount of produced nitrogen. These differences may significantly affect effluent management, highlighting the applicability and effectiveness of the simulation model. The analysis of the corporate and spatial structural features combined with the effluent management models make it possible to highlight the amount of nitrogen output produced in the study areas and to reveal critical situations. The analysis of the problems related to the management and reduction of nitrogen of zootechnical origin highlights how the solutions that can be followed even if carried out in individual companies must be approached in an organic and shared way, with a territorial rather than an individual approach. In order to make the adaptation of livestock farms to regulatory constraints sustainable, it is necessary to modulate the interventions in relation to local conditions by providing technological alternatives suited to individual needs. In this context, corporate solutions should be supported by consortium solutions and by the use of those operating on behalf of third parties, especially for activities related to the movement of biomass or products in the supply chain. Furthermore, the role of support and coordination carried out by technical assistance and public administration should be emphasized.

4 PROSPECTS OF RESEARCH AND CONCLUSIONS

The consortium management of the effluents represents one of the fundamental aspects towards the development of the agro-livestock supply chain. Certainly another strategic asset of the project lies in the integrated management of the variable energy. The spread of local energy systems from a smart energy governance perspective would lay the foundations for an alternative scenario by "using numerous small power plants, located near the point of consumption of the energy itself. This could currently be done by combining plants still based on fossil fuels and others that rely instead on renewable sources" (Moroni, 2015). Referring specifically to the rural context under consideration, off-grid solutions would be desirable, able to enhance the important concentration of agro-zootechnical companies in the Arborea sector. The added value lies in fact in the historically structured presence of a reality that already operates according to a cooperative logic. Certainly the availability of matured technologies and dedicated infrastructures (systems of production, accumulation, distribution of energy) does not in itself guarantee the solidity of a renewed local energy system; the hypothesis of their diffusion must be combined with the governance of the subjects capable of dealing with it. The new opportunities for collective organizations for the production and management of

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energy services are manifold; it is not limited to the simple integration of business units, but rather new forms of cooperation between farmers, breeders or mixed public-private partnerships. In order to be effective in the community context the cooperative project forms must be real and present formal or informal but tangible characters of a consolidated relationship between inhabitants, environment, culture and territory. Another fundamental element is the relationship with the Public Administration (PA) which can support, even in direct forms, the cooperative enterprise action arising in a territory. The factors traced briefly describe the case of the so-called "community cooperatives". There are basically two conditions that lead to the formation of a "community cooperative". The presence of a territory in vulnerable conditions and / or for a specific need, capable of also generating an entrepreneurial opportunity, expressed by a real community. In this condition an economic activity is developed aimed at pursuing community development and maximizing collective well-being (not only of the members) and not that of maximizing profit (Invitalia, 2016). In the present case the "community cooperatives" find their specific connotation in the structuring of the Energy Community (EC); the EC concept refers to a set of energy users who decide to make common choices from the point of view of satisfying their energy needs, in order to maximize the benefits deriving from this collective approach, thanks to the implementation of technological solutions for the distributed energy generation and intelligent management of energy flows. In summary, analyzing the EC model as a whole, it emerges that the most significant novelty lies in the transition from an individual approach to a collaborative one. However, if on the one hand, the new approach allows obtaining benefits concerning the synergies directly connected to the union of more energy users, on the other hand it suffers from a series of critical issues, which must be carefully evaluated and overcome in order to enable a wide dissemination of ECs. The most critical issues differ in their sphere of influence. The first, the most widespread, concerns the lack of awareness of the advantages deriving from the collaborative approach to energy management. The second critical aspect is of a financial nature, which concerns the finding of the resources necessary for the structuring of the EC. A particularly interesting model refers to the so-called microgrid as a service (MAAS), which requires that a third party, external to the energy community, is responsible for the implementation of the EC - including finding the necessary financial resources - and the subsequent management of the same, selling the energy to the energy users within the same aggregation (Fig. 3). This scheme, reversing the financial burden on the third party, eliminates the problem of finding financial resources by relieving the final energy users of an unbearable weight. A similar energy governance model could be justified in the case study of the agro-livestock sector of Arborea. The subjects and energy and matter flows are represented synthetically in Fig. 4. As can be seen, the management of the effluents is one of the aspects

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that contribute, together with the associated management of energy, to define the Smart Grid of the supply chain.

Fig. 3 Microgrid governance model as a service (Source: Energy and Strategy Group, 2014)

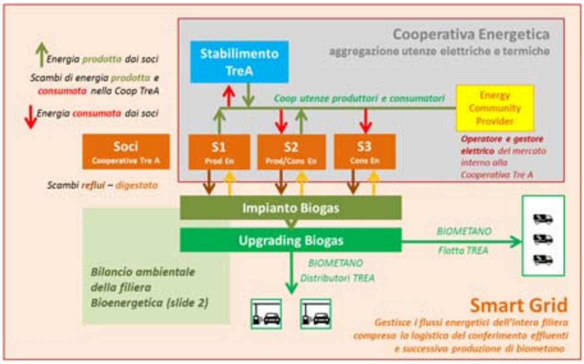

Fig. 4 Governance model of the bio-energy supply chain (Source: author's elaboration)

The attention recalled today by the environmental questions and by the risks deriving from an improper agronomic management of the sector derives substantially from the recognition of the importance of re-establishing the same paradigms linked to the use of the land for agricultural and zootechnical purposes. It is in compliance with this assumption that the Tre A Supply Chain Model pursues the objective of managing green energy at zero kilometers. The production and consumption of energy, coming entirely from renewable sources, take place in the same territory in which the EC operates. The advantages of the model have environmental, economic and social implications. The ability to control energy supply costs, the costs associated with network services and the timely forecast of the energy needs of the users monitored in real time constantly guarantees a competitive price of energy. The use of profits is established by the partners and can be used for interventions aimed at favoring the redevelopment of common services to companies such as the reconstruction of consortium road surfaces. The technologies at the service of smart cities does not therefore remain a proposal that relates to mutual funds for the construction of intelligent and sustainable spaces

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tout court, but the occasion for a re-reading of rural contexts as generative places of community, as indeed these same areas have worked in their original vision (history of the reclamation of Arborea). Smart energy governance in fact bases its foundations on the convergence of two factors: the first is the energy-environmental one, through an action on rural centers that introduces energy efficiency and functionality, an intelligent infrastructure system together with the protection of the environment and landscape; the second concerns both the participation of companies in the processes of defining SGs, and their direct involvement in terms of potential economic development connected to the cooperative management of energy. In summary, if we think of the rural areas, characterized by intensive agricultural and zootechnical activities, as meeting places of dynamics - potentially conflicting - represented by safeguarding the environment and resources and implementing innovation technologies, the proposal for a management energy cooperative, can become the cultural reference plan for a renewed sustainable and intelligent agro-livestock activity.

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PROPOSALS ON THE AGRICULTURAL LAND USE IN ACCORDING TO THE FEATURES OF THE LANDSCAPE: THE CASE STUDY OF SARDINIA (ITALY)

PASQUALE MISTRETTA, GIULIA DESOGUS
CHIARA GARAU

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari , Italy
e-mail: p.mistretta@unica.it
giulia.desogus@gmail.com; cgarau@unica.it

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ABSTRACT

The purpose of this paper is to contribute to the landscapes planning, considering those of Sardinia in Italy, that are rich in natural, morphological and structural factors. In addition, the visualization of agricultural and pastoral lands are an important component to understand the social and economic dimension that characterizes the different sites. To this end, the authors propose an evaluation grid to offer to planning regulations alternatives for the rural areas that are an integral part in the composition of the Sardinian landscape. Therefore, the authors propose to adopt a treatment of cultures, keeping in mind the most favorable options, in order to guarantee a balance in the landscape and, at the same time, considering the cultural factors and the anthropized components. The topic is current because it wants to integrate the guidelines of the Regional Landscape Plan - RLP (2006) of Sardinia in relation to its Inner Areas as the RLP shows great attention only to the coastal areas. The latter in fact represent the most important natural heritage also for tourism purposes. The different types of rural territory are in Sardinia to be evaluated taking into account the changes in the landscape, due to changes in the cultures and seasonality. More specifically, attention is given to rural habitats and conservation prospects, despite the demographic contraction of the entire region and the irreversible aging of many inhabited centers. This aspect should not be underestimated because the rural landscape strongly participates in the cultural identity of the places and therefore is sensitive to the direct degradation in cultures and the environment and to uncontrolled building and to disfiguring impact.

KEYWORDS

Landscapes; Agricultural and Natural Landscape; Agricultural Land Use; Sardinia

1 INTRODUCTION

This contribution aims to activate for the region of Sardinia (Italy) a methodology for the treatment of agricultural soils in relation to landscapes bound by important urban tools such as the Regional Landscape Plan (known in Italian as "Piano Paesaggistico Regionale - PPR") approved in 2006 by the Autonomous Region of Sardinia. In fact, the RLP, respecting the forecasts of the European and national regulations, places a very strong attention on the coastal zones, recognizing the various nuances and defining the requirements, measures and directives for their protection and their enhancement. Only in 2012, in implementation of the provisions of the Code of Cultural Heritage and Landscape, the Regional Council of Sardinia approves the new Guidelines for landscape planning, in which, in addition to the reaffirmation of the importance of safeguarding and of coastal landscapes enhancing, for the first time, the focus is placed on the landscapes of the internal areas and on the rural landscapes, as elements that strongly characterize the identity of the Sardinian people, because they have been closely linked for millennia to the agro-pastoral activities. There have been projects, analyzes and recognition of the Sardinian rural landscapes and the relationships between the coastal areas and the internal areas, but never matured into an effective regulation of the same internal areas. However, this paper aims to discuss the determining factors related to the rural landscape in an urban key, without entering in the skills of the complex agro-zootechnical system. “The rural landscape is becoming a strategic part of the territory not only because it represents the connective of the wider landscape scenario, but also because its state of wellbeing has many effects on the rest of the territory. In this sense, the rediscovery of the rural landscape is not linked to a nostalgic desire to restore bucolic settings and ornamental economies, but to the multiplicity of functions that can benefit the entire territorial system […]. The management of the rural landscape is intertwined with different issues: i) the root of cultural identity in the places; ii) the widespread need to regenerate the conditions of a growing land degradation; iii) the construction of local development projects, and iv) the need to safeguard the environmental dimension of space” (Balestrieri, 2018). In addition, the rural landscape is a mosaic of natural and human managed land uses that vary in size, shape and arrangement (Zaizhi, 2000; Biasi et al., 2016).

In Sardinia, three types of rural landscape can be considered: 1) the pastures in rocky terrain with the presence of the Mediterranean woodland, 2) cultivated land, and 3) arboreal land (from rows of trees along the road to the woods). Each of these types participates in the composition of the landscape in a decisive way, but often its effects are underestimated. In other words, the rural landscape is characterized by an integration between the fixed factors and mobile factors of the territory: the first ones have no variations except in very rigid

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seasonal periods, when they can cover themselves with snow, while the second ones vary not only with the seasons but also with the types of plants that, especially in spring, participate in the chromatism of the environment with the various florescences.

For this reason, the authors believe it is important to study a methodology that can lead to a grid of evaluation of the treatment hypotheses of the rural territory and, in particular of what can affect the nature of the landscape and the visual, cultural, geographical, environmental and identity composition of the landscape itself. For example, the region of Marmilla in Sardinia is not only valuable for the nuraghes or retabli of the Master of Castelsardo (active between the end of the fifteenth and the beginning of the sixteenth century), but also because the Marmilla region identifies itself as an anthropized rural landscape with a symbiosis between environment and history, where the landscape represents the fusion of eras and memory (Garau, 2015). Natural, cultural, and environmental attractions enhanced by the morphology of the hills, the historical value of the local urban centers, and local traditions. Therefore, a landscape set of open fields (Meeus, 1995) cannot be linked to conservation reasons because it is the result of a spontaneous agricultural activity that integrates perfectly with the morphological component, so as to characterize the most beautiful areas (without the sea) of Sardinia. This status could change if the cereal cultures, which contribute to the chromatism of the whole, were replaced by tall trees that could affect the "soft" reading of the landscape, creating discontinuity and even chromatic contrasts. Based on these premises, the article is divided into three parts: the first one describes the structural characters of Sardinian agro on the margins and within the landscapes classified according to literature; in the second one, an evaluation of the agro-landscape determinants is made with a proposal for integration and compatibility of the same. Finally, the paper presents the conclusions, hoping for political proposals and application techniques.

2 THE RURAL LANDSCAPE OF SARDINIA

The dominant rural landscape in Sardinia is therefore characterized by the extensiveness, which can be summarized in the three types described in the previous paragraph. The Mediterranean woodland and permanent natural pastures cover almost half of the island, while the woods and agricultural crops occupy specific areas (Fig. 1): mainly in the hills and mountains the first ones, often managed in agro-forestry systems; in the plains, in the areas equipped with a network of consortium irrigation and in the crown of rural villages and urban centers, the second ones (Camarda et al., 2014).

These considerations on the composition of rural landscapes, in which nature and anthropology play their specific role, must be added to another interpretive line of the natural environment and the landscape that refers to the distant pastoral world of Sardinia, when for

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the shepherd the horizon of affections and interests was defined by the territory that they could control (the country, the fields and the pastures) moving on foot or on horseback. The distance between the country, social focus, and the most distant pastures marked the limit of identity space with its rules of coexistence (Mistretta, 2012). The attention to the historical process is fundamental to understand the substantial modifications of the way of life and the relationships of the inhabitants with the new dimension of the space of relationship.

Today it is possible to regulate the type of intervention in rural and agricultural contexts, obviously without creating penalties of any kind, not even implied by productivity, especially by the profitability of investments made in agriculture, with already existing markets and with those that can be activated. It is evident that the attention on the landscapes of Sardinia and on the modalities of interpretation, representation, and safeguard are strictly connected to the geographic-structural identifying aspects, so much to characterize Sardinia on a world scale, for its identity values. However, it is necessary to understand in what way today's rural landscape is the result of a transformation of cultures due to the modernization of work tools in the fields or is a result of an overload of tourist flows that is sometimes incompatible with to the most authentic expressions of the same habitats. In other words, the control of changes in the Sardinian territory took place with attention to coastal areas with beaches and the reconversion of illegal "bathing" buildings, without any reference to the very strong relationships between the countryside and the destinations of use for tourism purposes. In fact, the pastures, agricultural, wooded features and in particular the monumental morphology of the geography of the places have been neglected. However, it should not be underestimated that on the perception and "capture" of the environment and of the landscape today, more than yesterday, some factors of frenetic modernity intervene: the little time available for a reflexive or commentary stop, the speed of the vehicle (car or bus) that produces an extemporaneousness without soul of the sequence of views; the increasingly sophisticated photographic and filming tools that memorize images without history. All this makes the rural *continuum* as a monotype field, without factors of interest, despite being diversified by cultures and plantings. Therefore, cultural education is important for understanding the environment, landscapes and for developing a harmonious synthesis. In this context, the contextualities of the landscape and the foreseeable and regulable margins of change should be evaluated, without neglecting the productive modifications of the rural system that, as already mentioned, participate in the perceptual synthesis composition. Thus, culture becomes absolutely central to understand over time the place-based dynamism and the mediation between nature, places and people of countries and fields.

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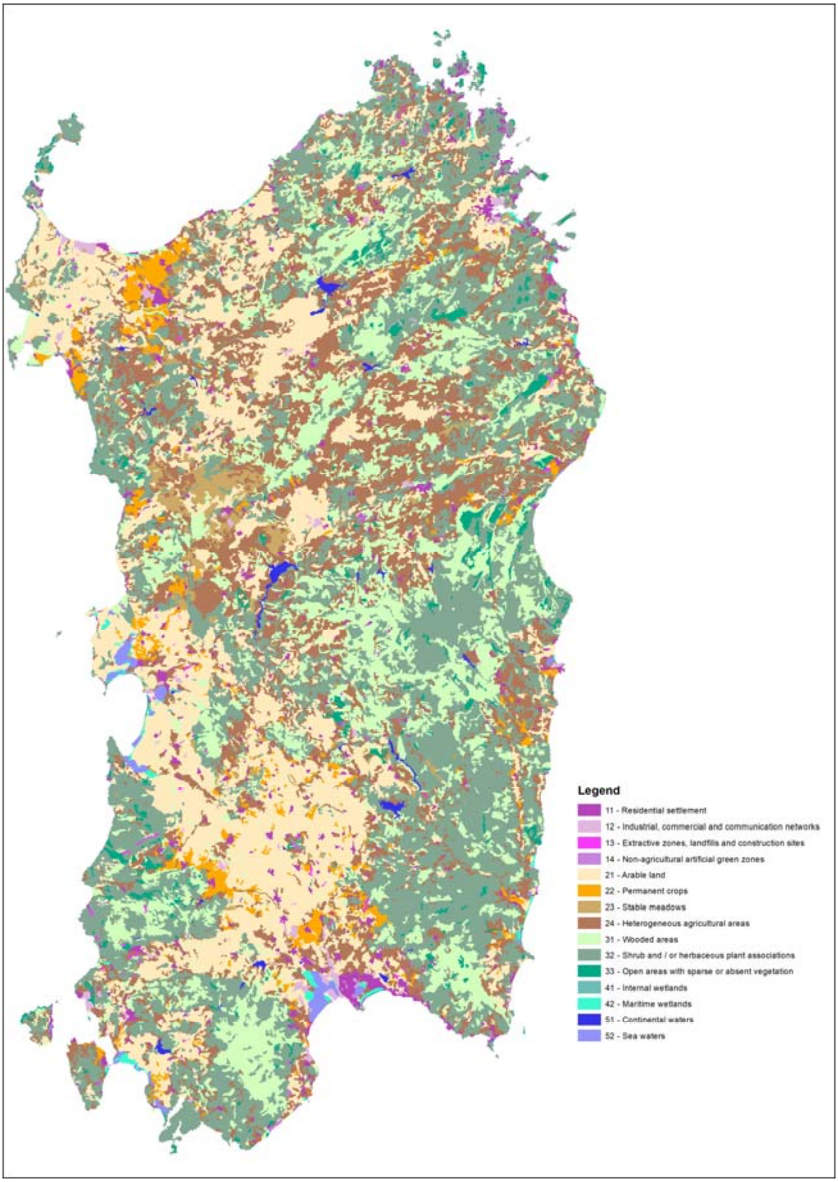

Fig. 1 Corine Land cover (Source: Corine 2018)

In order to do this, the Region, as a superordinate public body with respect to the municipal autonomy, has to formulate the methodology of analysis and proposal, with the indicators of intervention and of organization, also for the management aspects. In fact, it is necessary to understand if tables can be produced that describe the different forms of soil treatment, in order to distinguish and suggest certain cultures (for example vegetable gardens) compared

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to others (for example vineyards) more suited to ensure the balance of landscapes. Or it may be necessary to suggest arboreal cultures, the fruit ones or wood or cork ones, as long as there are no secular trees that constitute the focal point of the landscape to which they belong. This reasoning, in its expository simplicity, wants to give importance to the physical component of the rural product, because in addition to the plant type, the "body" connotations of the essences must not be ignored: heights, depths of roots, ramifications, foliage, growth times and of life, knowing that the green component of the territory is the essential habitat for insects and for birdlife. Moreover, the production results of the agro are influenced by the pedology and geology of the places, which enter into the finalized evaluation of the contexts of which the regional and urban planning must pay attention to formulate the choices of plan. It is, therefore, necessary not only a cultural sensitivity that links man to nature (Turri, 2008), in its most varied expressions, but also a corresponding legislative activity that assists, without prejudice, the economic activities already in place and those most suitable for development. It is also essential to define the current conflicts of vocation of the areas (right or false) through flexible use destinations, supported by a smart infrastructural network. This project is obviously multidisciplinary with the indispensable presence of agronomists and experts in rural law. In fact, the bibliographic reference documentation and the taxonomic description of cultivated soils, especially for promiscuous crops, should facilitate the investigation of the territory and the visualization of the perspectives of use[1]. Obviously, the rules that regulate the use of rural territories cannot be the same throughout Sardinia (cubic meters per hectare), but, having to interpret the environmental and identity context, they will not be neutral because they affect the value of soils and their susceptibility.

In many cases the recent suppression of typological differences led to the impoverishment and undifferentiation of rural landscapes (Franceschetti, 2009), underestimating the effects because the landscape is not monotypic but is the result of the different cultural and disciplinary matrix that contribute to differentiate places and recognize them. Unfortunately, in Sardinia, the depopulation of internal areas certainly affects the future on structural balance and also on the landscape. So that is an irreversible factor, it will be necessary immediately to make concrete proposals sustainable even with guided interventions for objectives aimed

[1] "The landscape of Mediterranean promiscuous crops is the result of the practice of polyculture: intercrossed cereal crops, legumes, vines and fruit trees (a little less densely, and only in the most recent age, forage plants). On the same field are associated three types of crops: the herbaceous ones (cereals, fodder plants and renewal plants), a shrub, that is the vine, and the guardian tree. Sometimes the vine is only associated with trees (peaches, almonds, figs, walnuts and olives), even when they do not serve as support; in most cases it is, or was, "married" to the tree. The "married" vine to the tree in the middle of the wheat constitutes the classical landscape of the promiscuous culture" (Balestrieri, 2018).

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(for identity and tourism purposes). In this case, it is necessary to activate relationships of collaboration with public and associative subjects that have activities of direction and of management in the production system (among which Confagricoltura, Coldiretti, Regional Councilor, Companies, etc.). Therefore, it is urgent to reconsider the different types of cultures and their impact on the landscape, contextually activating specific forms of monitoring to evaluate the guided and spontaneous transformations, taking into account the effects not only of the sector but also on the socioeconomic system of the areas under study. In the analysis of the contexts it is important to take into account, on one hand, the design formed by the dry walls that become goods classified by UNESCO, and on the other, the natural hydrogeological system and the existing engineering works, to avoid the devastating effects of natural disasters[2]. It should be noted that a series of decisive indicators to which reference is not yet available, in order to achieve a classification of cultural scenarios and their effects on the perception of the landscape (Cherrill, 2014).

3 METHODOLOGY

The goal of this paper is to propose guidelines that, through an evaluation grid, can arrive at a targeted treatment of cultures, keeping in mind the most favorable options to guarantee a balance in the landscape. To do this, the cultural factors of the settlement and rural habitats and the anthropized components that diversify case by case must be kept in mind, even if they are not directly involved. In this regard, Mara Balestrieri identifies "34 types of landscape grouped into nine categories ("arctic", "boreal", "Atlantic", "alpine", "Mediterranean", "continental", "Anatolian", "steppic"), starting from climatic, topographic, lithological and land cover data. The landscape typology is obtained from a hierarchical nomenclature organized on four levels. This nomenclature includes: 8 classes for the climate, 5 classes for the altitude, 3 classes of lithology, 10 classes for covering the ground" (Balestrieri, 2018). However, to understand how environmental factors interact with the interventions to be adopted, it must

[2] "Many efforts have made at European level in an attempt to classify the Community landscape, especially after the ratification of the European Landscape Convention in 2000. The identification and evaluation of European landscapes are explicitly mentioned as a specific measure in Article 6 of the Convention (Council of Europe, 2000). Already, in 1996 at the Sofia Conference (Council of Europe 1996), it was recognized the need to define a European Landscape Map (Pan-European Landscape Map) with the aim of distinguishing different types of landscape and to represent its geographical location. However, the difficulties in making such a map appeared immediately evident. So that there are extremely diverse natural and cultural conditions on the European territory, it is difficult to classify the landscapes according to an elementary hierarchy to be applied to the entire continent. Very few papers were therefore actually produced. The European Landscapes Map developed by Meeus is one of the few valid examples, although it should be considered more like a sketch based on expert knowledge since there is no spatial accuracy and a rigorous background analysis" (Balestrieri, 2018; p. 63).

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be considered the manipulation of the field operator, in order to evaluate how much has changed over time and on which hypotheses it is possible to think.
A significant example is the terracings organized by cultures, like vineyard in steep slopes, in fact it can happen that the advent of unpredictable climatic factors, can change the state of the places and in this case, regardless of the loss of production, would change also the reference coordinates with the need to review the landscape design. At the same, in Sardinia frequent fires in the summer months heavily weigh on the landscape; in these cases, the classified landscape loses its motivational requirements, above all due to its substantial and chromatic impact and must be redefined. Among the many indicators extrapolated from the classification of Mücher et al. (2010) the following groupings can be used for the geography of Sardinia: parent materials (rocks, sediments and waste materials); altitude (plains, hills and mountains); land cover (arable land, permanent crops and pastures, Mediterranean woodland, open fields). Some of these are distinguished by the presence of scattered settlements typical of Gallura and Sulcis in Sardinia. With the necessary in-depth analysis and considering the literature on the topic (RAS, 2013; RAS, 2017), one or more grids can be activated for a functional and cultural coordination, aimed at making the "voices" that characterize the landscape integrable with the "voices" that characterize the agricultural land. The authors propose a grid (Tab. 1) that wants to have a methodological meaning without the precision that only the specialists of the agricultural land and cultures can classify in a close dialectic relationship with town planners and landscape designers, taking into account the types already described in the RLP.

4 CONCLUSIONS

The purpose of the contribution is to compare the productive component of the soils and the economic component to which the tourist fruition contributes together with the identity, landscape component. Because it is a matter of different disciplinary subjects, even if they are "bordering" and integrable, a cross-reading of the determinants of the agricultural land and the landscape is proposed by constructing a grid of address with the representation of the options aimed at contributing to the harmonious composition of the landscapes. It is specified that it is only a research proposal because every context, of which Sardinia is rich, assumes its own landscape identity, functional not only for tourist use, but also for a "presence" of inhabitants and operators of the agricultural land. A conclusion of the analysis and impact assessments, planners should prepare to address consistent standards and implementation rules.

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lands	coastal landscapes with degrading rocks and coves	coastal landscapes with beaches	coastal landscapes bordering the countryside	inner landscapes characterized by "monumental" rocks	hilly inner landscapes	flat inner landscapes (valley floor and plateaus)	mountain landscapes[3]
Uncultivated land with rocky boulders	x			x			
Pasture (hills and mountains)	x		x	x	x	x	x
Forage plants				x	x	x	x
1 Arable land (vegetables and similar)					x	x	
2 Arable land (cereals and similar)					x	x	
Terraced vineyards					x		
Fruit trees (Citrus, peach, etc.)					x	x	
Mediterranean woodland, junipers and prickly pears	x	x		x		x	
Dried fruit trees						x	
Wood trees			x	x		x	
Forest (oaks, cork oaks, conifers)		x		x		x	x
Others							

Tab. 1 Addresses for the treatment of agricultural territory to participate in the composition of the landscape

Naturally, the objective of this proposal is to affect the quality of life by keeping the settlements alive and the relationship with the rural territory, within the framework of a healthy economy and a dynamic territorial function. Moreover, this hypothesis of research proposal can be a first step to consider again the great problem of depopulation of the countryside and the decay of small villages, without which it would make no sense to insist with temporary instruments, and with financial incentives in the concrete little incisive.

The future research proposal of this paper is a cross-reading of the different types represented in Tab. 1, in order to obtain an overall value of the "landscape-agriculture" determining factors on which to set the Regional programming lines and the suitable implementation tools.

3 To be evaluated case by case, taking into account the structural component of the rocks and the chromatic effect, as well as the height excursions that contribute to "move" the perceptive framework

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AUTHOR CONTRIBUTIONS

This paper is the result of the joint work of the authors. 'Methodology' was written jointly by the authors. Pasquale Mistretta wrote the 'Conclusions". Giulia Desogus wrote the 'Introduction'. Chiara Garau wrote the 'The rural landscape of Sardinia'.

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AUTHOR'S PROFILE

Pasquale Mistretta is Engineer and Emeritus Professor of Urban and Regional Planning at University of Cagliari, Italy. He was Rector of the same University from 1991 to 2009. He is author of the following books: Autonomia, il sogno e la ragione (2011); Pasquale Mistretta: storia e attualità di un percorso critico (a cura di L. Gulli 2011); Città e sfide: conflitti e utopie (2013); Beni comuni dello spazio urbano (2014); Gli slum e l'urbanistica negata (2017); Nella città che cambia (2017).

Giulia Desogus is architect and PhD student at the DICAAR (Department of Civil and Environmental Engineering and Architecture) of the University of Cagliari. She is author of the books: Il Metabolismo Giapponese (2015); I centri minori della Sardegna e la Città Metropolitana di Cagliari (2016); Nella città che cambia (2017).

Chiara Garau is Assistant Professor of Urban and Regional Planning at the DICAAR (Department of Civil and Environmental Engineering and Architecture) of the University of Cagliari, Italy. In June 2015, she received the Best Paper award at ICCSA 2015 with a paper entitled Benchmarking Smart Urban Mobility: A Study on Italian Cities. In 2015, She won a national research competition (the SIR call proposal—Scientific independence of young researchers, Domain SH—of the Italian Ministry of Education, University and Research) with the GHOST project ("Governing the smart city: a governance-centred approach to smart urbanism"). She is author of over 70 scientific publications, including monographs, conference proceedings, and articles in books and national and international journals.

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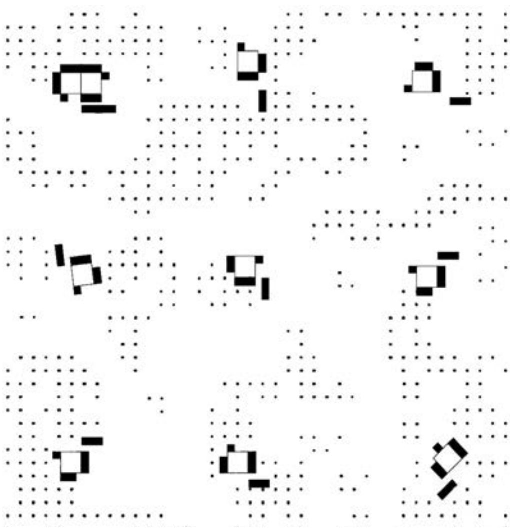

COMMON LAND(SCAPE)

MORPHOLOGIES OF A MULTIFUNCTIONAL RURAL LANDSCAPE IN THE ISALLE VALLEY, SARDINIA

ROBERTO SANNA

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: robertosanna@unica.it
curatorias.wordpress.com

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ABSTRACT

This paper aims to explore the relation between landscape design and multifunctional rural development. Within the frame of the transformation of rural landscapes in the so-called low-density areas, we will focus on the landscape dynamics and settlement morphologies of the common land of Isalle. This 3000 hectares territory is located in the countryside of Dorgali, Sardinia. This rural landscape is a rare example of an integrated network where topics such as polyculture, multifunctionality and the management of rural space have already reached an interesting level of development compared to Sardinian rural space. Two cooperatives of shepherds and winemakers operate in this area. Since the 60s of the'900, their work has radically changed the historical structure based on transhumance, grafting a stable network of folds, barns and crops schemes consistent with the morphology of the site. The paper outlines the settlement history of this landscape, the management policies carried out and the relationship between production dynamics and the environment. Finally, we define how a landscape design strategy could link the network of rural devices and the existing road network to a significant number of archaeological and naturalistic sites in the area. A network such as this could represent a deep change of scale in the meaning of rural multifunctionality.

KEYWORDS
Rural Landscape; Rural Architecture; Multifunctionality; Sardinia

1 INTRODUCTION: ARCHITECTURE AS A MULTIFUNCTIONAL DEVICE FOR THE RURAL LANDSCAPE

The EUCALAND report of 2017 about multifunctional practice in agriculture highlights the importance of landscape management in a multi-scale approach. Many agrarian and landscape scholars[1] see in the strengthening of the proximity networks a possible future for low-density territories. The paper describes a landscape analysis made over a case study territory in Sardinia that, having established an active network of farms in a diversified rural pattern consistent with morphology and the environment, could represents an interesting pilot case of multifunctional rural development. The recent rural studies[2] about the transformations of the Sardinian landscapes consider the urgency to adapt the system of specialized and monoculture breeding farms towards a multifunctional model, able to balance production, environment and the ecosystem services.

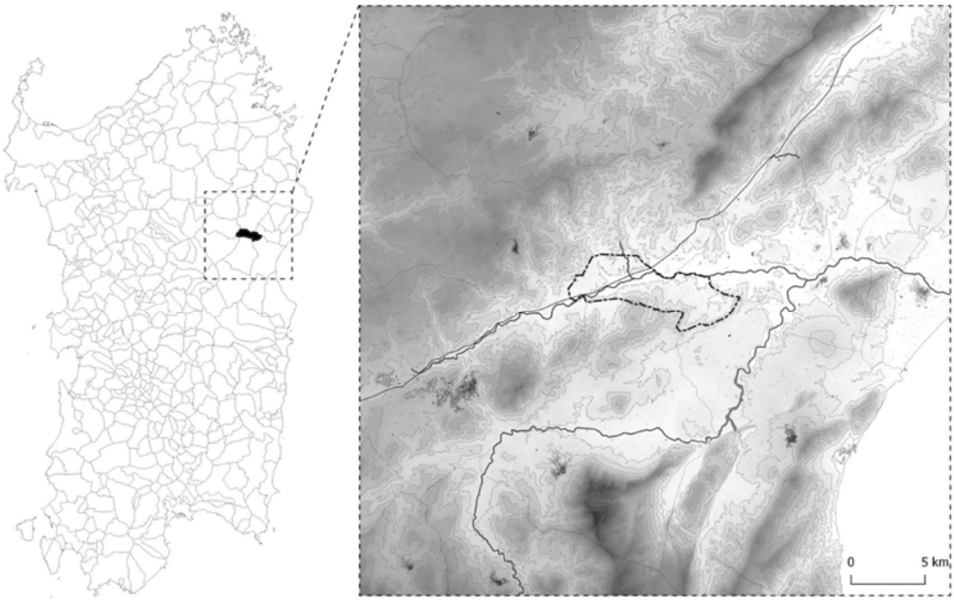

Fig. 1 the Isalle-Orrule Common Land

[1] See Ilaria Agostini (2015). Il diritto alla campagna: rinascita rurale e rifondazione urbana. Ediesse.

[2] See Benedetto Meloni (2006) Lo sviluppo rurale, dall’analisi al progetto.

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This issue is even more important by considering the depopulation phenomena of the internal areas of the island that weakens the settlement structure of the rural landscapes of the island, made by a rarefied network of farms, folds and rural holding whose building is generally recent and tied to the recolonization of the rural space after the Agrarian Reform.

2 THE INTEGRATED POLYCOLTURE OF ISALLE VALLEY: STRUCTURES AND DEVICES

The Isalle valley and the adjoining site of Orrule constitute a 3000 hectares common land within the municipality of Dorgali, Sardinia (Italy). The Isalle River ecosystem, one of the main tributaries of the Cedrino River, marks a wide valley that consists of a large irrigated plain surrounded by granite heights. A co-operative colonization scheme has managed the land since the '60s according to a management structure quite rare on the island.

2.1 THE HISTORICAL DEVELOPMENT OF THE VALLEY

The still visible traces of human presence in the area date back to pre-Nuragic times, as evidenced by the presence of some prehistoric collective burials excavated in the granitic rock called *Domus de Janas*. The Nuragic era is represented by the survival of at least four megalithic towers called *nuraghes* and as many collective megalithic gallery graves, called *tombe dei giganti*. Currently, there are more than thirty archaeological sites of prehistoric, Nuragic, Roman and medieval age within the common land boundaries, surveyed by the local archaeologist Fabrizio Delussu for the archeological survey of the municipal planning of 2010. Of these, the most important one is the *Tomba dei giganti* of *S'Ena 'e Thomes*, which is one of the most important examples of this kind. Most of the sites lie in a precarious condition due to a lack of information devices and walkways. Each archaeological site in the area differs by origin, typology, and position: we should remember for example the *nuraghes* placed on the southern heights of the area, from which it is possible to frame a general view of the common land. In many of these sites, archaeologists found several remains dated back to the Roman and Middle Ages, a sign of a continuous human presence structured in small hamlets placed in the most favorable places. This low density but high capillary settlement model was common on the island before the deep changes during the late middle age, which led to the still current situation of a model based on a few large villages able to control portions of land which dimension changes according to the local resources (Artizzu, I. 1966). In fact, in the area, is recorded the presence of a settlement, *Isalle* or *Izarle*, which survived until the seventeenth century. The survivors and the rights to use the land resources passed to the village of Dorgali, far more than 15 km, and today only some traces of the church of the

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depopulated village remain. In those circumstances, the effective ownership of the territory belongs to the local feudal lord, who directly administered the land through rents, concessions and guaranteeing the rights of use to local communities. The modern history of the Isalle territory, whose size is comparable to that of many municipal areas of the island, in fact, follows the historical dynamics of the Sardinian rural area. It became the preferred transhumance location from the nearby mountain villages and occasionally was used for agricultural purposes. The traces of these activities remain from toponyms and the presence of numerous pastoral enclosures and shelters, made by the tenants of the feudal lord and the free occupants of this space. The definitive transition to the municipal administration of Dorgali took place after a complex dispute between the State, the Municipality and some private individuals for the ownership of this land whose reconstruction goes beyond this study. After that, at the end of the XIX century, Isalle became a common land of the Municipality of Dorgali. During the ‘50s it was involved in the agrarian strikes occurred in the Italian countryside due to the high demand for arable land for the unemployed peasants. Starting from the 1960s and '70s, the municipality established some cooperative societies of peasants for the management of the land, starting a process of rural transformation that continues today. A cooperative of local winemakers established a hundred hectares vineyard in the river plain in the 60s, after several reclamations works. Starting from the 1960s and '70s, the municipality established some cooperative societies of peasants for the management of the land, starting a process of rural transformation that continues today. A cooperative of local winemakers established a hundred hectares vineyard in the river plain in the 60s, after several reclamations works. The entire winemaking process took place in the local social winery of Dorgali, one of the most important of the island. The cultivation of this vineyard represented a radical landscape transformation that constitutes one of the main visual polarities along the highway that cross the common land connecting the cities of Olbia and Nuoro. The shepherds 'Isalle-Orrule' cooperative4 gathers about a hundred breeders who are required to comply with a precise regulation for the management and use of pastures. The integration of pastures and forage crops makes the flocks of sheep and goats and the herds of cattle free from external food supplies, except for the winter periods when the shepherds keep the flocks in the stables, also to encourage the regeneration of the pastures.

A dairy farm located in Dorgali deals exclusively with the processing and marketing of products collected by the whole 38 rural centers and by other shepherds members of the society. This management system seems to respond positively to the now age-old criticalities of the lasting ovine monoculture scheme of the island. Furthermore, the shepherds act as farmers as well: they established a 7 hectares vineyard to diversify their activities and grow their vegetables in kitchen gardens near their rural centers.

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Fig. 2 the Isalle valley (image courtesy of archaeologist F. Delussu, 2018) and the relationship between rural devices (red circles), the river and vineyard system and the landscape figures of the valley

2.2 THE RURAL DEVICES AS A MINIMAL UNIT OF COLONISATION

In the Isalle valley, the rural centers colonize the space according to a parallel line between the river and the woodland relief, establishing a kind of 'valley section' balance between them. Instead, the rural devices of the Eastern part of the common land, called Orrule, establish a punctual colonization scheme due to the homogenous pastureland. The current building stock in the common land is classifiable in two kinds of buildings, referring to the two different cooperatives that operate in the area and to the historical presence of a station house now used as a rehab facility. The buildings linked to the winemakers' cooperative, which manages

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most of the vineyards, are small warehouse placed in the vineyard and a larger building used during the harvest. The buildings belonging to the shepherds' cooperative, on the other hand, represent a precise rural colonization scheme designed and built since the 1990s. 38 so-called 'rural centers' have been created. They are autonomous devices assigned to each member who intends to start there his/her activity there. There are two types of devices: the single type, managed by one member and the double type, managed by two members at the same time. Groups of four or five rural centers cover each of the eight sub-areas that subdivide the total common land, based on the micro-geological and morphological characteristics. A ninth sub-area placed along the river plain covers the common production of the crop for the animals. Each rural center, therefore, establishes a direct relationship of transformation of its rural micro-landscape and, together with the others present in the sub-area, constitutes the minimal unit of colonization of that landscape. If we consider the land tenure and the subdivision into nine sub-areas, in which eight of them have got five centers each, in about 2618 hectares, we could note that each business center has a virtual control of about 60 hectares, which exceeds three times the average 20 hectares of land of farm in Sardinia (ISTAT, 2010). This abundance of space allows better management of land resources and avoids phenomena of overgrazing and soil depletion and erosion. As we can see by the photo areas of the years 1968, 1977 and 2013, the progressive erosion of the woodland shows a strong transformation of the rural space but seems to reach a substantial balance starting from the early 2000s, having reached a condition that agrarian scholar defines it as an agro-sylvan-pastoral system. This system, which in Sardinia we could relate to the so-called *meriagros*, very similar to the better-known Portuguese *Montado* system, seems to be a condition of substantial balance between anthropic uses and environmental dynamics. A right balance as such, between the farming activities in the countryside and the conservation and enhancement of the environment, is also an important tool for the valorization and management of all those kinds of rural landscapes characterized by low human density. Hence, the punctual presence of productive buildings in this particular space, and their direct relationship with the transformative dynamics shows how their dispositio appears even more important. The operational logic of these micro-settlements also acts on a double scale: they represent the minimum control unit of the agro on the one hand and, they constitute largely autonomous productive tools on the other. Each rural center consists of a courtyard around which the different volumes are disposed: the sheepfold, the barn, the storage area are in a direct and univocal relationship with the court; the support space of the shepherd instead lies in a tangent way, acting as the threshold of the complex. The milking room instead stands generally outside the yard and is always associated, in every rural center by a trough. Every center has water through artesian well systems. In the case of twin centers, this arrangement

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is made by juxtaposing the logic of the court and buildings along the same slope. There is not a specific project for each of the 38 centers but every complex of building represents the adaptation of the building types described above to the most different morphological conditions of each site. The great variety and the analogy within the differences shows a very topical lesson of architectural morpho-typology. When rigid building schemes grant a possibility of modification, they continue to be consistent with the fundamental principles of settlement transformations that the Italian school of Caniggia and Muratori theorized. Basic principles such as the enclosure and the cell and modification laws such as juxtaposition, doubling in length, in-depth or in elevation still find perfect compositional correspondence in rural architecture. As Giorgio Grassi stated, rural architecture continues to surprise the architectural scholar because they seem to be "*buildings in which geometry is only a means to build figures and not figuration itself; where composition has a literal meaning, since the accent is placed on relationships, on the relationships between elements that are widely defined* "(Grassi, 1970)

3 ISSUES FOR AN ADAPTIVE RURAL MODEL FOR THE LOW-DENSITY TERRITORIES

As we can see, the courtyard building type is an ordering element of space and a settlement model at the territorial scale. Such an adaptable configuration spreads interesting issues for the landscape design in the rural context. The sheepfolds are currently responding only to internal production logics, while they could further strengthen their territorial role by welcoming new uses linked to multifunctional agro management. As a matter of fact, the principle of the enclosure and the cell already owns a proper interpretative grid of new needs and new uses able to integrate with those of production. Micro colonization nearby the buildings through small systems of vegetable gardens and morphological modifications between buildings and pasture is already evident. At the same time, the presence of numerous historical pastoral enclosures, today largely abandoned, represents a further design issue, as they could constitute intermediate spots within a network able to connect the various rural centers, the archaeological sites and the naturalistic hotspots. The opening of tens of km of rural roads built in the last 30 years partially replaces the paths identified by the reading of the historical land cadasters. The ancient road network responded to different needs, both productive and technological. Still, this road network could regain its importance because it continues to relate the ancient sites of this territory, such as fords, abandoned settlements, devices historical productions and transhumance paths. The presence of a double order of roads, of which the last (the ancient one) is partly compromised or canceled, is a severe

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critical issue to be resolved through a landscape project capable of integrating these two infrastructures to achieve a new network configuration. Only a design strategy could be able to set up the different devices of colonization of this rural space. Also, the presence in the area of a religious procession road is still not integrated into a structured network system.
This 30 km rural path crosses Isalle at the halfway point. A huge company of pilgrims leaving the nearby town of Nuoro goes on foot twice a year to the sanctuary of San Francesco, in the territory of the nearby village of Lula. Here the people gathered from the nearby towns celebrate a religious and community feast lasting several days. The 30 km road that crosses Isalle represents an extraordinary opportunity to rethink the rural road network to strengthening soft mobility, cycling networks and eco-tourism. Such a network would constitute the ideal framework to set up models of development deeply integrated between local production needs and enhancement of the historical, cultural and environmental issues of the site. Such a network could represent a deep change in the scale of the meaning of rural multifunctionality.

4 CONCLUSIONS: TOWARD A MULTIFUNCTIONAL NETWORK OF RURAL DEVICES

As a matter of fact, the so-called common landscape of Isalle represents an interesting approach toward the rural development issues that emerged from the EUCALAND report of 2017. The co-operative logic seems to overcome the excessive fragmentation of the rural productive base of the island, as evidenced in the 6° General Inventory of Agriculture in Sardinia[3], which strongly reflected the weakness of its socio-economic structures. The Isalle scheme proposes an adaptable method that overtakes the single farm-oriented vision of rural multifunctionality towards an integrated and multifunctional network of rural devices. Nowadays Isalle is an embryo of a rural district, able to expand and deepen its effectiveness. The management of this network and the sharing of common rules constitutes the structure through which even punctual improvements are possible. Despite this, we saw that this is not enough for a truly organic rural development model. The noteworthy presence of archaeological and cultural spots in and around this territory suffers for substantial invisibility. Their presence and potential is not yet a network, conceptual even before physical. Integrating and relocating this constellation of elements to the existing production network requires a planning scenario capable of put together these different complexities toward an organic system through design strategies. The essential tool for this step forward must be a

[3] Inventory produced in 2013 by the Autonomous Region of Sardinia.

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multi-level project, able to operate through micro-interventions coordinated according to landscape dynamics. Putting together the network of production devices, the network of roads connecting them and the constellation of archaeological and naturalistic spots, could improve a mixed-farming logic toward a true poly-cultural landscape. The classic motto that sees a beautiful landscape linked to fine food urgently needs a third way, which, further from considering a territory a mere scenario, should reinterpret the "thickness of time"[4] of these places (Gomes Da Silva, J. 2013). Therefore, relating what history has left in its stratigraphic progress to the current production and ecological needs should represent a common key for the development of many similar contexts. A network acting as an open system of relationships between objects may reinforce the apparent uncertainty and fragmentation of rurality. As Landscape Architect João Nunes[5] said, "*in the contemporary world what is increasingly important are not the objects themselves, but the relationships that bind them, whether they are latent or not yet evident"* (J. Nunes, 2018). Through a morphological study of the built heritage and the landscape's dynamics of the Isalle Valley, the paper evidenced Nunes advice through a rethinking of the 'invisible' objects of a particular rural space, binding and linking them together in order to build a new operative and multi-scale network, made by an integrated system of object, activities and adaptable relations.

Fig. 3 masterplan of the multifunctional rural network: the rural centres (red square), the archaeological sites (black triangles), the local network (red lines), the main roads (black lines), the vineyard (grey), the river (dark grey)

[4] As Landscape Architect Joao Gomes Da Silva defined his conference in Lisbon "Thickness of time" on 25/02/2013.

[5] See João Nunes preface in Dessì A. Le città della campagna.

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AUTHOR’S PROFILE

Roberto Sanna is an Architect. Ph.D. student in Civil Engineering and Architecture at DICAAR, University of Cagliari. His research deals with the design issues related to the transformations of rural landscapes and architectures in the low-density areas. Author of the project ‘CURATORIAS - mapping landscapes of Sardinia', by which investigates the current state of the landscapes of Sardinia and their historical dynamics. Didactic assistant in the design courses and thesis laboratories of the school of architecture at the University of Cagliari where he develops his academic research joining local research groups and international conferences and workshops.

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SHEEPTOSHIP LIFE: INTEGRATION OF ENVIRONMENTAL STRATEGIES WITH RURAL DEVELOPMENT POLICIES

LOOKING FOR AN ECO-SUSTAINABLE SHEEP SUPPLY CHAIN

***ENRICO VAGNONI[a], ALBERTO S. ATZORI[b]**
GIOVANNI MOLLE[c]

[a] CNR-IBIMET, Institute of Biometeorology
Sassari, Italy

[b] Dipartimento di Agraria
University of Sassari, Italy

[c] AGRIS Sardegna, Loc. Bonassai, Italy

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ABSTRACT

Mediterranean dairy sheep farming can represent an interesting case study of the trade-off theme in sustainable agriculture (agricultural intensification and benefits of multiple services of livestock systems). Sardinia (Italy) is one of the main European regions for sheep milk production, where several types of dairy sheep farming systems coexist; hence, it can represent a special context for testing strategies of climate change mitigation for the small ruminant sector. The SheepToShip LIFE (Looking for an eco-sustainable sheep supply chain) is a EU project launched in 2016 to develop and implement a model of carbon footprint mitigation for the sheep-dairy supply chain of Sardinia, able to reduce GHG emissions by 20% over the next 10 years through improved efficiency of production systems. The ultimate purpose of the project is to deliver an Environmental Action Plan defining a roadmap for fully integrating mitigation measures for the sheep sector into Sardinian development strategies. Transferring the SheepToShip LIFE model and fostering replication from local/regional to European level, is another vital goal for which specific rural development measures (based on effective eco-innovation criteria) are needed.

KEYWORDS

Eco-Innovation; GHG Mitigation; Dairy Sheep Sector

* The other authors are: Alberto Manca, Giovanni B. Concu, Gianluca Cocco, Antonello Franca, Elena Campus, Pierpaolo Duce.

1 INTRODUCTION

Despite the growing public scrutiny of livestock sector as one of the main anthropogenic source of greenhouse gases (GHG) contributing to climate change, the Mediterranean sheep supply chain can contribute to boost animal agriculture in the transition toward a more sustainable bioeconomy-based society. GHG mitigation is highly correlated with increasing production system efficiency and profitability (Jones et al., 2014), therefore improving the environmental performance of sheep farming could not only help combat climate change by reducing GHG and maximising ecosystem services, but also enhance socio-economic sustainability of local supply chains. This is a key point since in a context of structural economic crisis of the EU sheep sector, the risk that an effort to improve environmental performance would be perceived by farmers as a threat to their livelihood should be avoided by all means. Understanding the drivers of GHG emissions within a farming system following a Life Cycle Thinking approach, could be useful for defining sustainability strategies in an economically feasible way. In particular, Mediterranean dairy sheep farming could represent an interesting case study of the trade-off between agricultural intensification and benefits of multiple services of livestock systems, a crucial issue on the greening agenda. As Sardinia is the leading sheep milk producer in Europe (Rural Development Programme of Sardinia – RDP, 2014–2020), a proactive benchmark of climate change mitigation strategies for the dairy sheep sector in Sardinia could contribute to this debate. SheepToShip LIFE (www.sheeptoship.eu), a 4-year (from July 2016 to June 2020) project financed by the EU LIFE Programme Climate Action 2014-2020 for improving the environmental sustainability of the dairy supply chain in Sardinia, clearly points in this direction. The overall objective of the project is to reduce by 20% in 10 years GHG emissions from the Sardinian dairy sheep sector. Its actions promote the inclusion of environmental strategies for the sheep sector into rural development programmes, focusing on i) efficiency of production systems and ii) valorisation of the ecosystem services provided by pasture-based farms. The immediate goals of the project are to identify innovative solutions for the reduction of GHG through a Life Cycle Assessment (LCA) approach and to demonstrate the environmental and socio-economic benefits deriving from eco-innovation in the dairy sheep farming and dairy industry sector. The end goal of the project is to transfer the knowledge generated into an Environmental Action Plan for the sheep sector of Sardinia, which harmonizes the project's intervention strategy with regional policies to mitigate climate change. Furthermore, one of the project objectives is to increase the level of knowledge and awareness of stakeholders and the general public regarding the environmental quality of products made from sheep's milk and their contribution to the mitigation of climate change. The inclusion of policy makers involved in environmental, climate

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and rural development sectors at regional, national, and European levels is essential to guarantee the project's sustainability and replicability. To achieve its ambitious goals the project cannot ignore the importance of involving policy makers and key stakeholders to ensure that climate change mitigation and adaptation is fully accepted as an integral part of regional development strategies for the sheep sector. In line with the project strategy, the SheepToShip LIFE partnership involves local authorities responsible for the definition and implementation of policies on environment and livestock production systems (Sardinia Region, Department for the Environment), technical assistance services (Laore Sardegna), researchers of the regional agency focused on the animal husbandry sector (Agris Sardegna), as well as scientists of the local University (two departments of the University of Sassari) and national research bodies (two institutes of the National Research Council of Italy).

2 METHODOLOGY AND RESULTS

The evaluation, with an LCA approach, of the environmental implications of the main Sardinian dairy sheep farming systems and dairy plants using a case study methodology, represents the basis of the SheepToShip LIFE logical framework (Fig. 1). SheepToShip uses this metric procedure to determine the environmental hotspots of the sheep's milk business in Sardinia, including the environmental impacts of Sardinian Protected Designation of Origin (PDO) sheep cheeses. Eco-innovative solutions will be tested in several case studies (sheep farms and dairy businesses) through the introduction of low-input techniques whilst retaining the same quality standards of products. Therefore, on the basis of the assessment of the environmental and socio-economic effects of the SheepToShip LIFE implementation actions, a Sardinian Environmental Action Plan aimed to reach the general objective of the project (-20% of GHG emissions in 10 years) will be defined. The Action Plan will establish priorities and iterative roadmap of sustainable mitigation measures for the Sardinian dairy sheep sector in a way that it will continuously up-date/grade the existing regional policy tools such as the Rural Development Programme and the Regional Strategy for Climate Change Adaptation (https://portal.sardegnasira.it/piano-regionale-di-adattamento) according to a Deming cycle approach (Fig. 1).

Within the planning phase, a cradle-to-farm gate LCA was conducted in 2017, according to international standards (European Commission Recommendation 2013/179/EU). The LCA study analyzes the impacts of 20 sheep farms located in contrasting pedo-climatic zones of Sardinia and representing the main sheep farming systems in Sardinia as described by Molle et al. (2018).

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Fig. 1 SheepToShip logical framework structured with a Deming cycle approach

This study, identifying the main sources of GHG emissions and technical areas limiting efficiency of milk production, allowed to highlight best practices as well as to define a preliminary mitigation strategy. Moreover, it represents the first step to looking specifically the environmental footprint of the whole Sardinian dairy sheep value chain. Diets with greater GHG-generating potential per kilogram, directly related with enteric methane emission (the main environmental hot spot of milk production, by far), and off-farm produced protein-based feed represents the key areas of sheep farming to target for mitigation efforts. These results are in agreement with several studies on dairy sector and sheep farming (FAO, 2006; Marino et al., 2016; O'Brien et al., 2016). Considering that the emissions baseline of the Sardinian sheep sector (estimated "from cradle to farm gate") resulted equal to 1,407 kt of CO_2-eq (attributable for 80% to milk and 20% to meat) (Atzori et al., 2017) the SheepToShip LIFE target reduction is about 280 kt of CO_2-eq in 10 years. To reach this goal, maintaining undiminished the current Sardinia's sheep milk production (about 315 kt of milk per year), it can be reasonably assumed an improvement of production level of about 35 kg/ewe (from 150 to 185 kg/year per present ewe), combined to an estimated reduction of about 640,000 ewes plus replacement lambs. The outline of the technical approach adopted by the project for reducing environmental and economic costs of sheep farming systems is reported below:

Flock management

- monitoring of reproduction performance to increase fertility;
- monitoring of milk production to improve culling strategy;
- disease control/prevention;
- feed quality improvement (use of forage legumes, feedstuff analysis to better balance sheep diet, feed blocks for improve the digestibility of straw and cereal stubbles).

Land use

- introduction of native self-regenerating legumes-grasses mixtures and Sulla (a biannual forage);

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- low-input agricultural practices (minimum tillage, direct sowing, reduced use of fertilizers, etc.);
- soil and water analysis to better drive pasture fertilization.

Since the adoption of these innovations depends greatly on farmers' and other stakeholders' attitudes (i.e. beliefs and opinions) towards climate change, a survey was carried out on a sample of 238 people in order to map their general perceptions and goals related to their businesses and to climate change. This information is propaedeutic to the design and communication of the Environmental Action Plan. The survey found that on climate change related topics, sampled farmers have homogeneous favourable attitude, but on the general topic of innovation, they are deemed "conservative" and have heterogeneous attitude on environmental conservation. Whilst on "adaptation" and "effects of farming on climate change" farmers display general agreement, their attitude towards causes of climate change and innovation may hinder adoption. Additionally, different attitudes and perceptions among farmers, researcher and extension officers were observed. For instance, regarding the importance of experience on the improvement of farm efficiency (Fig. 2), the survey highlighted that most of the farmers count only on their experience to improve the efficiency of their businesses.

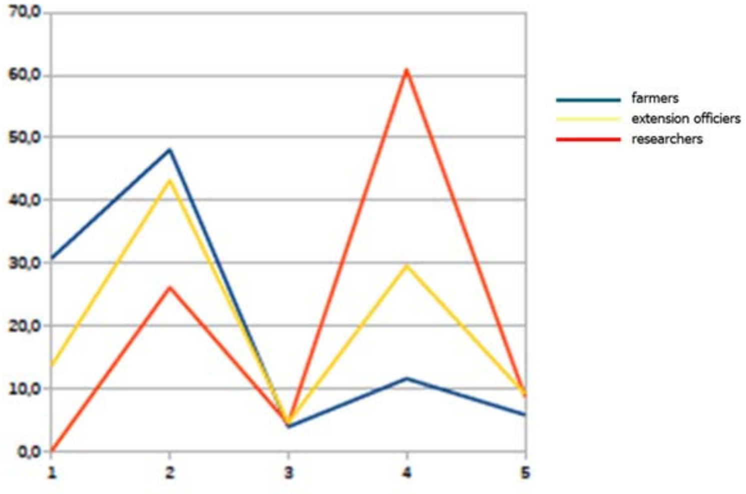

Fig. 2. Neyman-Pearson Lemma test on importance of experience on farm efficiency improvement. The score 1-5 indicates not favourable and extremely favourable, respectively

Given the significance and representativeness of the Sardinian sheep sector at European level, SheepToShip LIFE proposed Sardinia as a European lab for climate change mitigation and, for

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this reason, the strategy of the project put special emphasis on networking, communication and dissemination of its results. Therefore, a key aspect is the engagement with European stakeholders as well as governance actions, since the integration between agricultural and environmental policies represents a pillar of the long-term sustainability and replicability of the project.

The transferability of the SheepToShip LIFE model is essentially based on the following factors: i) the high interest demonstrated by the sector operators, smallholder farmers as well as medium and large dairy companies, towards environmental improvement and valorization of the traditional livestock products, ii) the analysis of the local and international market trends, where green (and genuine) products are gaining ever-growing importance, iii) the actual guidelines of the European policy on agricultural and food sectors, which place particular emphasis on innovation and environmental efficiency of the production systems.

Among the communication and networking activities, an important place had the first meeting with EU institutions and stakeholders, titled *Environmental actions for the EU sheep sector* held on January 23, 2019 at the premises of the Autonomous Region of Sardinia in Brussels. This meeting was meant to offer scientific input and practical support to policy makers and regulators (at local, national and European level) who have to define fundamentals and parameters for agriculture and livestock measures, taking into account evidence-based knowledge and good practices developed by projects' initiatives for improving and innovating livestock systems. The main goal of the meeting was to promote the interplay between environmental and rural development strategies through a collaborative process for defining agro-environmental measures to mitigate GHG emissions from the sheep sector within the next Rural Development Programmes.

About 40 representatives from the following organizations attended the meeting: European Institutions (DG AGRI, DG CLIMA, ENRD, EASME/LIFE Programme, European Shepherds Network, ENVE Commission of the Committee of the Regions); delegates of 5 EU projects focused on sustainability of livestock production systems; the Italian Ministry for Agriculture, Forestry and Tourism; the Autonomous Region of Sardinia (Agriculture and Relationships with EU departments); the Permanent Delegation of Castilla y Leon (Spain) and Occitanie (France) Regions at the EU Commission.

The main outcomes of the meeting are summarized below:

- all participants agreed with the idea that the improvement of the environmental performances of livestock systems represents a clear priority for the new CAP agenda, taking also into account the socio-economic benefits that this will bring;
- the representatives of the invited European projects highlighted that their own experiences point towards definite progress in improving the overall efficiency of

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production systems, and this could provide a basis of knowledge and data to inform the design of the future Rural Development Programmes;

- the dairy and meat sheep supply chains have to be considered as different sectors that need specific policy measures;
- the active participation of DG AGRI and CLIMA, as well as of national and regional institutions, confirmed that policy-makers representatives and regulators are open to listen and carefully consider bottom-up proposals;
- the debate initiated by this meeting contributed to promote and increase the institutional relationships among all the organizations that participated, boosting effective cooperation and networking.

Moving from the results of the meeting, the next steps will be the design of a preliminary roadmap for defining agro-environmental measures within the next Rural Development Plan, aimed at reducing GHG emissions from the sheep milk sector. This point will be evaluated with special attention, since it represents a key element of future SheepToShip LIFE actions and its follow-up.

3 CONCLUDING REMARKS

The reduction of GHG by 20% in 10 years in Sardinia seems technically feasible by increasing farm efficiency at flock and field levels. However, new policies are needed to support GHG abatement within and outwith the next Rural Development Programme. They should be possibly driven by the evaluation of farm environmental performance through an LCA-based metric. Rural development measures should support actions aimed at increasing animal productivity, quality of forages and reduction of input at field level. Moreover, measures should be tailored as much as possible to background systems and co-designed by the stakeholders (farmers *in primis*) using an approach similar to European Innovation Partnership (EIP), and its impact should be evaluated using *smart* indicators (effective and cheap).

The SheepToShip LIFE initiative can thus serve as a model of good practices for other European contexts, and can contribute to improve the environmental performances of production processes and products of the European small ruminant sector.

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https://portal.sardegnasira.it/piano-regionale-di-adattamento

AUTHOR'S PROFILE

Enrico Vagnoni, SheepToShip LIFE project manager. Research scientist with expertise in rural development. From 2001 to 2008 he lived in South America working in different pilot projects for the sustainable development of local communities (International Cooperation for Development). Since 2009, research scientist at the CNR IBIMET, in Sassari, Italy. His research experience and interest mainly concerns the application of Life Cycle Thinking tools to agricultural systems and rural environments.

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Alberto Stanislao Atzori is an Assistant Professor in Animal Nutrition at University of Sassari. He holds a PhD in Animal Science from the University of Sassari (Italy). He spent 6 months as visiting scholar at Texas A&M University (USA) studying system dynamics modelling applied to greenhouses gas emissions mitigation in dairy cattle sector. His research focused the relationship among ruminant nutrition and environmental impact of farms to enhance production efficiency and profitability of farming systems.

Giovanni Molle, senior researcher at Agris Sardegna, the agriculture research agency of Sardinia. Currently team leader of animal nutrition research unit based at Bonassai farm (Olmedo). His study area is ruminant nutrition with a focus on dairy sheep feeding and grazing management. Current interests include technologies to monitor feeding behaviour of grazing ruminants, focus feeding of ewes at mating to improve sheep reproduction efficiency and nutrition and grazing management to reduce GHG emission by dairy ewes.

Alberto Manca, agronomist at Agenzia Laore Sardegna, team leader of the unit 'Support to the sustainable management of livestock and fish farms', located at Arborea (OR) headquarters. In recent years, he focused his work in the agronomic management of manure in Arborea, the only vulnerable area to nitrates in Sardinia, as well as in the whole territory of the island.

Giovanni B. Concu is a researcher in the field of agricultural and natural resources management. He specializes in the assessment of consumer's preferences and the monetary evaluation of environmental assets. He holds a doctorate in Agriculture and Natural Resource Economics from the University of Western Australia (Australia).

Gianluca Cocco, Public Manager, currently Director of the Environmental Sustainability and Information Systems Department at the Directorate General for Environmental Protection of the Autonomous Region of Sardinia. From 2011 to 2015 he was also Director of the Environmental Assessment Department (EIA and SEA). He works for years on environmental issues (climate change, sustainability, GPP), energy (efficiency, public lighting and mobility) and new technologies (information systems and monitoring networks). He is author of several publications.

Antonello Franca, Researcher at the Institute for Animal Production System in Mediterranean Environment (ISPAAM), PhD in Crop Productivity, University of Sassari, Italy. Its main scientific activity concerns Ecophysiology of pastures, Germplasm collection and evaluation, Silvopastoral ecosystems, Seed bank dynamics.

Elena Campus is head of Communications at the Institute of Biometeorology of the National Research Council in Sassari and Communications Manager of the SheepToShip LIFE project. She holds a BA in Public Relations and Corporate Communication from the IULM University in Milan and an MA in International Journalism from the University of Westminster, London. Over the past decade, working on a number of EU-funded projects related to sustainable development and environmental conservation, she has developed extensive expertise in communication and dissemination of scientific research results and technology transfer.

Pierpaolo Duce, Senior Scientist at CNR IBIMET, in Sassari, Italy, where he has been scientific responsible for the local Research Unit since 2005. He is also scientific coordinator of the SheepToShip LIFE project. Responsible for several national and European research projects mainly devoted to the evaluation of agricultural and forest carbon sinks, the assessment of climate risk in agricultural and forest ecosystems, and the analysis of the environmental performances of agricultural production and food products.

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THE TERRITORIAL PLANNING OF EUROPEAN FUNDS AS A TOOL FOR THE ENHANCEMENT AND SUSTAINABLE DEVELOPMENT OF NATURAL AREAS

TOWARD 2030: THE SARDINIAN EXPERIENCE OF THE STRATEGIC RELEVANCE AREAS OF THE ERDF OP 2014-2020

STEFANIA ARU, SANDRO SANNA

Centro Regionale di Programmazione, Regione Autonoma della Sardegna, Italy
e-mail: staru@regione.sardegna.it
ssanna@regione.sardegnait
URL: www.sardegnaprogrammazione.it/

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ABSTRACT

With the publication of the new multiannual financial framework and the proposed post-2020 regulations, the European Commission has kick-started directing the dimensions of the budget and the regulatory framework for future European programming 2021-2027. Leaving from the experience of the Sardinia region in the current 2014-2020 concerning territorial development with reference to the Strategical Relevance Areas (identified in the ERDF Operational Program), the present work is focused on territorial development in UE post-2020 planning. The European Commission has already expressed interest on this topic introducing, for the first time, within the Common Provisions Regulation, a specific objective, "A Europe closer to the citizens by fostering the sustainable and integrated development of urban, rural and coastal areas and local initiatives". In particular, a reflection will be conducted on the contribution that the territorial approach strategies supported by the European cohesion policy will provide for the pursuit of the sustainable development objectives of the UN 2030 Agenda.

KEYWORDS
Territorial Planning; Sustainable Development; Agenda 2030; SDGs; ERDF

1 INTRODUCTION

One of the most relevant innovations of the European programming period 2014-2020, implementing the new principle of territorial cohesion (Lisbon Treaty, 2009), consists of the so-called "place-based" approach, that pays attention to the "specificity of places" (RAS, 2014).

The Regulation (EU) 1303/2013 fixes the common provisions of the European Structural and Investment Funds (ESI Funds) for the 2014-2020 programming period (EU, 2013).

It establishes that the five ESI funds, each according to their own operating rules, must provide financial support to the specific investment objectives and priorities set out in the Europe 2020 Strategy (EC, 2010), taking into account the development needs and territorial challenges in an integrated way.

To this end, it is necessary to consider the geographical or demographic characteristics and take measures to address the specific territorial challenges for each region in order to unlock their development potential, thereby also helping them to achieve smart, sustainable and inclusive growth.

The Regional Operational Programme ERDF of the Sardinia Region 2014-2020 (POR) adopts the indications contained in the Position Paper of the Services of the European Commission (EC, 2012) and in the Partnership Agreement (AdP) (DPCoe, 2014).

The programming model proposed is based on a "co-planning process", that actualizes integrated territorial development projects built together with the territories.

The framework of the Regional Unitary Program[1] ensures the effectiveness of these initiatives (Aru et al., 2019).

At the beginning of the new programming cycle 2021-2027, the experience conducted by Sardinia Region represents a good practice that should be continue in accordance with the new regulatory framework and re-proposed in other territorial contexts, in order to pursue the Sustainable Development Goals (SDGs) of 2030 UN Agenda[2] (UN, 2015).

2 THE INTEGRATED APPROACH TO LOCAL DEVELOPMENT

The place-based strategy foresees the development of local policies based on the enhancement of the (territorial) specificities and natural and institutional resources. The POR

[1] DGR n. 9/16 of 10.3.2015 "Indirizzi per la realizzazione del modello di Governance per la Programmazione Unitaria 2014/2020".

[2] www.sustainabledevelopment.un.org

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defines a specific intervention model for rural areas: the Regional Strategy for Inner Areas (*Programmazione Territoriale, PT*), inspired by the National Strategy for Inner Areas (SNAI) (Barca, 2009). The *PT* is based on the valorisation of territorial resources (material and immaterial) jointly with the creation and/or strengthening of local firms and social services. In fact, fighting against depopulation of internal areas means either job opportunities and citizen services[3]. Furthermore, the *PT* in Sardinia is characterised by the integrated use of the various EU funds. Innovation keys of the approach to local development are: 1) the precise identification of the areas of intervention[4], 2) the promotion of development through projects financed by European Funds as well as 3) the certainty of timing and resources, and 4) the constant monitoring of the results. The Unions of Municipalities and the Mountain Communities, based on the changes introduced by the regional law in 2016[5], are identified as responsible for the planning and implementation of the projects[6]. The beginning of the territorial planning process coincides with the construction and the synthetic definition of the development strategies within an Expression of Interest. After verification of the admissibility of the proposer, the phase of co-planning or negotiation phase begins. The working methodology adopted is a participatory (*Metaplan*®[7] or GOPP[8]), in the framework of *Project Cycle Management* (PCM), as it bases the planning activity on the participation of the development actors (*stakeholders*). All the key actors of a specific territory define a project strategy through a clear identification of the objectives in a *Logical Framework* (Bussi, 2001). This methodology was disseminated by the EU Commission as quality standards in the planning, management and evaluation phases of complex projects (EC, 2004). The importance of the real commitment of stakeholders (*engagement*) and the need for their alignment with the objectives to be achieved through the project are documented in the academic literature (Freeman, Rusconi & Dorigatti, 2007; UNEP, 2015). The methodology of *PT* was also tested in some specific areas of the Sardinia Region, characterized by the

[3] DGR 9/22 of 10.03.2015

[4] The minimum areas/administrative units subject to intervention are represented by the Unions of Municipalities and by the Mountain Communities, both single and in associated form, plan their development based on the real needs of the territory

[5] Regional Law 4 february 2016, n. 2

[6] Intermediate bodies are required to have a minimum level of organization, essential to ensure the correct and effective implementation of the projects they will have to manage directly, on the model of what the LAGs are already implementing for the implementation of Local Development Plans financed with EAFRD resources.

[7] www.metaplan.com

[8] Goal Oriented Project Planning.

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presence both of environmental and cultural attractions of great value, not yet fully exploited and promoted for tourism purposes.
The "Aree di Rilevanza Strategica" (Strategic Relevance Areas, SRAs), have been identified directly by the POR and selected through a multilayer analysis. The objective is to diversify the regional tourist offer, reducing the temporal and territorial concentration of demand (tourist seasonality). In this way is possible to trigger virtuous processes of containment of environmental impacts related to tourism and integrate the tourism sector with the other productive sectors, improving the quality of services and the attractiveness of tourists, in particular foreigners ("qualified" visitor flows).
The operational items for the experimentation was defined already in 2016 within a Deliberation of the Regional Government Board[9]. There are ten SRAs identified with the multilayer analysis; the set of indicators led to the identification of two experimental areas on which the POR intervenes in priority[10], with the PT methodology[11]:

- the territory of the Municipalities falling within the Parco Regionale di Tepilora (Tepilora Park)12 boundaries and/or within the Natura 2000 Network site Supramonte di Oliena, Orgosolo e Urzulei – Su Sercone13 (respectively Union of Municipalities of Montalbo and the Mountain Community Nuorese Gennargentu Supramonte Barbagia) (Fig. 1a);

the territory of the Municipalities of Area Marina Protetta Penisola del Sinis-Isola del Mal di Ventre (Marine Protected Area "Sinis-Mal di Ventre"[14] - Union of Municipalities of Costa del Sinis - Terra dei Giganti) (Fig. 1b).
Sardinia Region completed the process of co-planning with all the experimental territories and in all cases the development strategy was defined starting from the enhancement of cultural and environmental attractors. The Union of Municipalities of Montalbo (Tepilora Park) decided to allocate all the resources assigned to the enhancement of the environmental attractor, with particular importance to the issue of accessibility of the territory even to the disabled people. The importance of this topic is the result of a very simple consideration: official data analysis shows that in Europe there are about 60 million disabled tourists, including the elderly with specific age-related needs, who, every year, are looking for an "accessible" destination, capable of hosting tourists with "special needs". It follows that a territory able to organize its

[9] DGR 41/23 of 12.07.2016

[10] POR, Section 1 Strategy

[11] Both DGR 9/22 of 10.03.2015 and DGR 41/23 of 12.07.2016

[12] Established by Regional Law 24 October 2014, nr. 21

[13] Site *ITB ITB022212* established under the "Habitat Directive"

[14] Established by DM 12/12/1997, modify by DM 06/09/1999 and DM 20/07/2011

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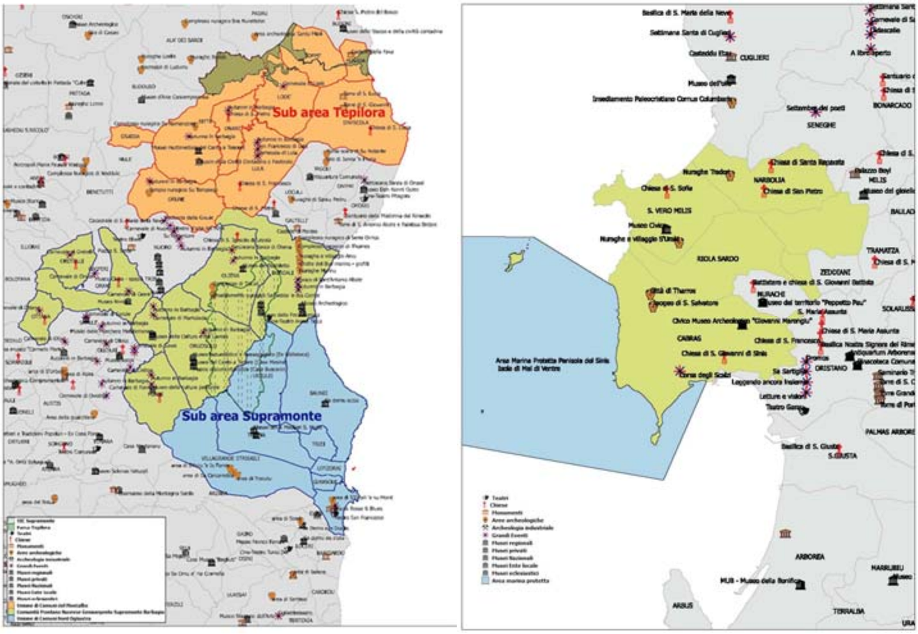
tourism offer according to the needs of a particular segment of tourist demand, could have an important competitive advantage. In addition, recently, the Tepilora Park received the important acknowledgment as a "MaB UNESCO Biosphere Reserve". The Mountain Community Nuorese, Gennargentu, Supramonte e Barbagia (Su Sercone) decided to address all the resources assigned to the enhancement of the paths that allow to reach the environmental attractor by foot, by mountain bike or horseback; this element is strategically connected to the strengthening of local entrepreneurship linked to the tourism services.



(a) (b)

Fig. 1a & 1b. Selected Strategic Relevance Areas in Sardinia for the 2014-2020 programming period

The differentiation of the territorial tourist offer is the leitmotif of the development project also for the Union of Municipalities of the Costa del Sinis-Terra dei Giganti, where the presence of high-value cultural assets becomes one of the elements of development. The giants of Mont'e Prama thus become the element on which to set up policies for tourist development.

The experience in SRAs shows that institutional and administrative capacity is one of the determining factors for a good territorial planning: territories that work in a cohesively way and program resources in an integrated manner are those where the institutional capacity of public administrators and administrative structures is higher.

The experimentation carried out on the *SRAs* is also part of a good co-planning practice, a model that will have to be strengthened in the new 21-27 programming.

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2.1 TERRITORIAL APPROACH TO LOCAL SUSTAINABLE DEVELOPMENT IN THE EUROPEAN COHESION POLICY 2021-2027

On 2 May 2018 the European Commission presented its proposal for the next Multiannual Financial Framework (MFF) of the EU for the period 2021-2027 (EC, 2018a).

Integral parts of the package of measures that completes the proposal for the next MFF 2021-2027 are the proposals of the future legislative framework of UE cohesion policy, published on 29 May 2018[15]. The EU cohesion policy is one of the most transversal and crosscutting policies, which contributes to most, if not all 17 SDGs of 2030 Agenda (EC, 2019a).

Specifically, the Communication of the European Commission COM (2018) 375 final (EC, 2018b), containing a proposal for a regulation on common provisions (CPR) applicable to EU cohesion policy funds, establishes the common set of fundamental rules for the (next) seven funds to shared management: Cohesion Fund (CF), European Maritime and Fisheries Fund (EMFF), European Regional Development Fund (ERDF), European Social Fund Plus (ESF+), Asylum and Migration Fund (AMIF), Instrument for border management and visas (BMVI) and the Internal Security Fund (ISF)[16]. Regarding the strategic approach, the 11 thematic objectives of 2014-2020 period have been simplified and reduced to 5 clear policy objectives: smarter Europe (PO1), greener and low-carbon Europe (PO2), more connected Europe (PO3), more social Europe (PO4) and, with particular reference to this document, Europe closer to citizens (PO5), aimed at the sustainable and integrated development of urban, rural and coastal areas through local initiatives. As already reported (Sanna et al., 2018), this structure allows the immediate identification of the declination that the concept of sustainable development will certainly assume in future operational programs. Nevertheless, in a context of general reduction of the European budget, the ERDF regulation maintains thematic concentration requirements. Resources will be dedicated for the most part to the POs 1 and 2. The proposed ERDF regulation (EC, 2018c) also provides for a greater concentration of resources on sustainable urban development and establishes that 6% will have to be allocated to this. The regulation introduces also a simplified approach to participatory local development. Integrated local and territorial development strategies should ensure the coherence (internal and external) of the interventions. On CPR have already formally expressed their opinion: the European Economic and Social Committee, the European Court of Auditors and the Committee of the Regions, and, on several occasions, the EU Council,

[15] Legal texts and factsheets are available at the following link: https://ec.europa.eu/commission/publications/regional-development-and-cohesion_en

[16] In the EC proposal, the European Agricultural Fund for Rural Development (EAFRD) is missing from c cohesion policies.

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while the parliamentary debate is still open17. At domestic level, within the 3rd Commission "European and international affairs" (AEI) of "Conferenza delle Regioni", the amendments and the positions of the regions and the autonomous Italian provinces either on the EC proposals and on the future of cohesion policy are being discussed and carried out (CR, 2019). Again, the recent Commission Staff Working Document "Country Report Italy 2019" contains the EC Investment Guidance on Cohesion Policy Funding 2021-2027 for Italy (EC, 2019b).
The reading of these documents highlights some key aspects about territorial approach:

- cities and regions have a crucial role to play in the achievement of the SDGs. Most underlying policies and investments are a shared responsibility across levels of government;
- it is necessary to increase administrative capacity of beneficiaries, in particular at local level, to prepare and implement projects;
- territorial strategies must to be implemented in synergy with the other policy objectives with the primary aim of fostering economic and social development in areas most affected by poverty;
- investment needs are identified at territorial level, in terms of functional areas: medium urban areas need to develop innovative ways of cooperation in order to enhance their economic, social and environmental potential, taking vulnerable groups into account;
- investments needs are also identified to promote cultural heritage and support enterprises in the culture and creative sectors.

3 CONCLUSIONS

The territorial approach adopted by the Sardinia Region in current period 2014-2020 represents a model that can be well applied also in the future programming of EU cohesion funds for the period 2021-2027. Moreover, the Sardinian experience anticipates the new EU approach for local development.
The results of the current territorial development policies and methodologies will allow the Region to have reliable indications for future planning. The experimentation already started therefore represents an added value of great importance that can help to achieve a more effective and sustainable planning of resources and interventions in the coming years.
The experience realized allows us to draw out some first indications, both of contents and method: the investments made, also in terms of growth of territorial capital and institutional

[17] https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2018/0196 (OLP)

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capacity, must be pursued also in the future. The real challenge of the territorial approach does not lie, in fact, in how much money is assigned to each territory, but in the capacity of the local administrations involved to achieve an increase in institutional quality and to create greater professionalism to respond quickly to the territorial development needs.

In this perspective, support to the growth of territorial capital represents the real challenge to pursue at the local level the SDGs in the 2021-2027 period. The method used, both in urban areas and in inner areas, with the involvement of different stakeholders and co-planning, cannot and must not be abdicated due to political changes.

In conclusion, all levels of government (local and regional) must proceed together in a common growth path able to offer opportunities for improvement and pursue an actual "glocal" sustainable development.

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AUTHOR'S PROFILE

Stefania Aru, graduated in Political Science at the University of Cagliari, she also obtained the Master Degree on "European Union and International Organisation Law" at the A.De Gasperi Postgraduate School of Specialization in Rome. Since 2000 she carried out technical assistance with Public Administrations on programs co-financed by the Structural Funds. She coordinated working groups on issues related to the planning and development policies. From 2005 until 2010 she was the coordinator of the Territorial Laboratory of the Province of Ogliastra in the Integrated Planning ROP Sardinia 2000-2006 and 2007-2013. Since 2014 she is Administrative officer for the Autonomous Region of Sardinia (RAS) - Programming Department - Regional Center of Programming and from 2015 is a constituent of the technical staff of Managing Authority of Sardinian Regional Operating Programme ERDF 2014-2020 and Referent for the Local Development strategy (Territorial Programming and Strategic Relevance Areas)

Sandro Sanna, Graduated with honors in Environmental Engineering at the University of Cagliari, he also obtained the MSc Degree in "Economics e Environmental Management "at the Bocconi University of Milan and the Master on "Multilevel Governance: integrated management of public policies" at the Faculty of Law of the University of Cagliari. Since 2009 he is a technical executive of the Regional Programming Center of the Sardinia Region and - after a brief experience at Municipality of Cagliari as Technical Head - since 2015he is a constituent of the technical staff of Managing Authority of Sardinian Regional Operating Programme ERDF 2014-2020, of which he is the contact for sustainable development and public procurement and member of the Secretariate of the Monitoring Committee. Since 2019 he is also supervisor for the start-up of the 2021-2027 programming period.

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THE INTERNATIONAL GEODESIGN COLLABORATION

THE CAGLIARI CASE STUDY

MICHELE CAMPAGNA, CHIARA COCCO
ELISABETTA ANNA DI CESARE

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: campagna@unica.it
URL: http://people.unica.it/urbangis

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ABSTRACT

This paper presents a two-scales geodesign study of the Metropolitan City of Cagliari developed according the International Geodesign Collaboration (IGC) guidelines and standards. As such, the study aims at contributing to the broader IGC research questions concerning how the geodesign approach to spatial planning can help addressing the most urgent complex challenges of sustainable development. After an introduction on the main key-features of the IGC initiative, the case study is presented in terms of the design approach and workflow. The paper concludes with a discussion on what lesson can be learnt from applying the geodesign approach with regard to planning education and practice.

KEYWORDS

Geodesign; International Geodesign Collaboration; Collaborative Decision Process, Systems Thinking

1 INTRODUCTION

Geodesign is a novel approach to spatial planning and design aiming at addressing current challenges of spatial development. Geodesign methods relie on extensive use of spatial information technologies to support collaborative, iterative, and dynamic design and spatial decision-making. Thanks to the use of state-of-the-art GIS technologies and Planning Support Systems, geodesign workflows proved to be successful in framing processes facilitating fast awareness-rising and achievement of consensus among participants in the strategic phases of spatial planning (Steinitz, 2017). In addition, geodesign can support all the design phases from project inception to the detailed design of implementation plans and projects (Moreno Marimbaldo et al., 2018). As a part of an international initiative aimed at fostering geodesign research worldwide, this paper reports on a geodesign study undertaken on the Metropolitan City of Cagliari (MCC) according to the International Geodesign Collaboration (IGC) guidelines. The IGC is an international geodesign research initiative started in 2018 aiming at building and facilitating the sharing of knowledge on the possible ways to address major sustainability challenges of current time. The means envisaged to achieve this ambitious objective are standardization and sharing. Accordingly, almost one hundred partners, mostly from academia, from all over the world joined the IGC, and along 2018 the partners completed 56 studies of local planning and design at various scales. The results were presented at the first IGC meeting held in February 2019 in Redlands, CA, and hosted by ESRI.

The IGC standards for the geodesign studies include:

- modular size for the study areas at various scales (i.e. double multiples of 0.5 km);
- a set of Global Assumptions, which identify major current global dynamics (e.g. global population growth, climate changes, sea-level rise, etc.[1]) to be studied in their local influence in the selected study areas;
- a standard number of 9 Systems to be analyzed, including blue, green, grey, energy and transport infrastructures, low-density and mixed high-density housing, institutional and industry-and-commerce land uses, plus a system to be chosen locally (for the MCC study History and Cultural Heritage was chosen);
- a set of Technology Innovations to be considered for each system: innovations include the latest or forthcoming technologies which can introduce technical improvements in design with regard to each system (e.g. autonomous vehicles or hyper-loops in

[1] for a full list of GA see https://www.envizz1.com/global-systems-research.

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transport, photovoltaic road pavements in energy production, or green building and 3D printing in housing);

- a common format for reporting the results of the study, in order to facilitate comparison among the studies.

There is broad consensus in the geodesign community of researchers and practitioners to refer to the geodesign framework proposed by Steinitz (Steinitz, 2012) as a flexible though robust methodology approach for organizing geodesign studies. The Steinitz framework for geodesign entails the iterative development of six models, the first three of which (i.e. representation, process, and evaluation model) concern the creation of the knowledge base for design and decision-making, while the last three (i.e. change, impact, and decision model) include the creation of design alternatives, the assessment of their impacts, and the creation of a final design based on consensus. While the representation and the process models entail the description of current territorial systems dynamics and their likely evolution without any action, the evaluation model is intended to express an assessment of the current and future conditions in the study area. The product of the evaluation model is a series of maps representing less or more favorable settings for action for the territorial systems taken into account to inform the design, on the base of which change alternatives should be developed (i.e. the change model). The Steinitz framework for geodesign was applied by the authors to develop the study of future scenarios for Metropolitan City of Cagliari according to the IGC guidelines and standards as described in the remainder of this paper.

2 CASE STUDY: FUTURE SCENARIOS FOR THE METROPOLITAN CITY OF CAGLIARI

The recently established (2016) Metropolitan City of Cagliari comprehends seventeen municipalities of South Sardinia (Italy), including Cagliari, the regional capital. The population is approximately 430k inhabitants, in an area of 1,248 km². The area is surrounded by mountains to the East and on the West, by the Gulf of Cagliari to the South, and by the agricultural Campidano plain to the North. In 2018, the MCC started the works for its first planning initiative, the Territorial Strategic Plan, which is going to set the development framework for future physical planning. However, to date, no inter-municipal planning endeavor has ever been carried on in the region. Hence, developing a new strategic plan for the area represents a challenge and an opportunity for innovation, both in technical, political and socio-cultural terms for the local community. This study represents a first attempt to propose a working framework for reasoning on possible future development scenarios, in line with the IGC assumptions and perspectives, on territorial technology innovation.In the last

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decades, the MCC faced overall stable trends in population growth, affected mainly by a limited movement of population from the inner small towns of Sardinia and very limited immigration flows; meanwhile the Municipality of Cagliari lost approximately 30% inhabitants in favor of neighboring municipalities within a 15-20 km radius, due possibly to market dynamics related to real estate prices. As a major challenge for future coherent and balanced development, the MCC needs to balance spatial development patterns in terms of infrastructures and services, as well as ensuring environmental and economic sustainability. In order to explore possible scenarios for the MCC future sustainable development, two workshops (WS) applying the guidelines of the IGC were organized as design studio exercise at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari. The WS were conducted in October 2018 using the Geodesignhub planning support system (Ballal, 2015), after the set of evaluation maps was created in August 2018 as a preparatory phase of the study by the authors, using ESRI ArcGIS. The first WS was held within the Spatial Planning Course of the Civil Engineering MSc program, concerned a study area of 80x80 Km including the whole MCC (Fig. 1), and involved 58 students. The second WS was held within the Geodesign course of the Architecture BSc program, concerned a nested area of 20x20 Km (Fig. 1), and involved 76 students. Running two WS in sequence allowed to experiment the change of scale in the design as the architecture students had to comply with the design earlier developed by the engineering students. A number of underlying local assumptions were considered to inform the study.

Fig. 1. Case Study areas: a) the first study concerned the whole MCC area (80x80 km); the second-high scale study, concerned the South-East area (20x20 km)

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A population growth of 25k and 50k inhabitants was assumed as baseline scenario in order to set quantitative targets for the ten systems, where possible. In addition, a number of objectives were adopted to inform the creation of the evaluation and change models with regard to each system, as described below:

- water Infrastructure (WATER): reduce hydrological risk and limit pollution of resources.
- agriculture (AGRI): protect prime soils, promote bio products and foster innovation in production to address desertification processes, climate change, and possible future shortage of water.
- green infrastructure (GREEN): enhance connectivity and expand protection to natural or semi-natural areas.
- energy: increase green production through technology innovation, promote local production.
- transport infrastructure: improve accessibility to most populated areas and the level of service of current road infrastructure. Improve the light-rail network. Foster active travelling in recreation, leisure and cultural heritage accessibility.
- industry and commerce (INDUSTRY): promote technology innovation in production and balance spatial distribution within the MCC to reduce workers commuting.
- residential lower density (LDH): accommodate demography growth limiting fragmentation and sprawl;
- residential with commerce and services (MIX): accommodate demography growth with densification and enhance accessibility to commerce and services.
- institutional (INST): promote locational accessibility and balanced spatial distribution.
- cultural heritage (CULTH): preserve historic centers and protect archaeological sites while enhancing fruition.

Following the Steinitz framework, ten evaluation maps – one for each system - were created following standard legend and color code (Fig. 2) to facilitate their understanding and usage by the participants. The color code use the "traffic lights" metaphor were red means "stop" (i.e. the system is working well and no action is needed), yellow means "alert" (i.e. it is not advisable to take any action due to constraints or hindering factors), and different shade of green means growing levels of suitability for actions within each system (the darker the green, the more suitable).

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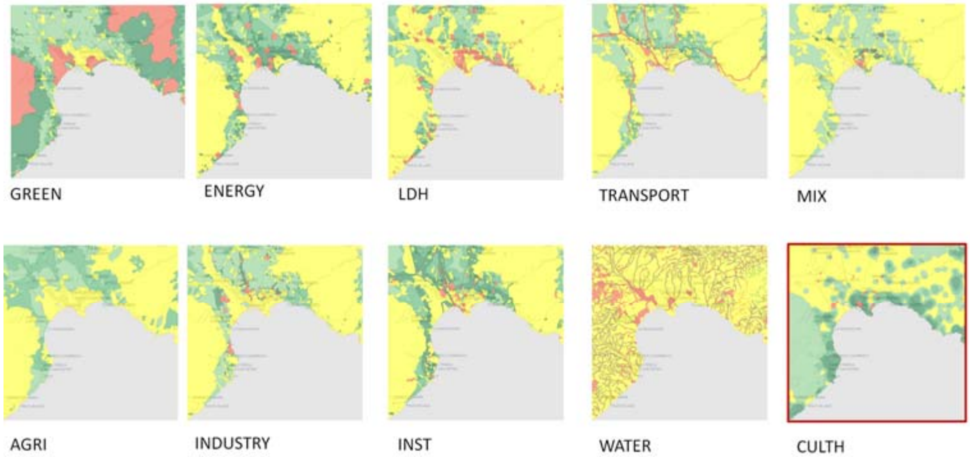

Fig. 2. Set of evaluation maps (i.e. one for each system)

3 GEODESIGN WORKSHOP SETTINGS

Two geodesign workshops were organized, one for each case study area. Each workshop was scheduled in five 3-hour sessions (Fig. 3), according to the following steps: 1) design of project and policies (i.e. diagrams); 2-4) iterative design of integrated syntheses (i.e. scenarios), 5) negotiation. The workshops were supported by the Geodesign hub planning support system (www.geodesignhub.com). Geodesign hub is a web-based collaborative geodesign platform where each participant joins a virtual planning studio workspace offering interactive design and decision-making tools needed to carry-on the workshop workflow.

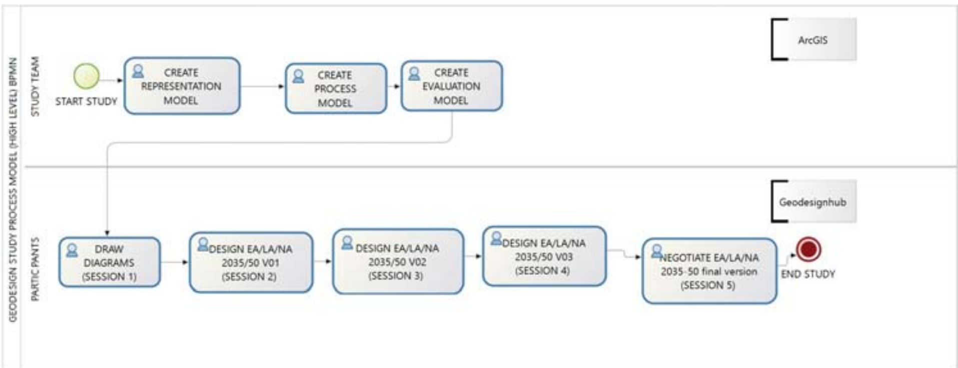

Fig. 3 Geodesign workshop process model

In the first phase (i.e. step 1) participants played the role of experts in one system (e.g. transport planners or engineers, housing experts, etc.) whose duty was to produce three diagrams each: diagrams had to represent projects implementable respectively with

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technologies available at the three time horizons chosen for the study by IGC (i.e. 2020, 2035, and 2050).

The rationale behind this step was to get the participant familiar with possible technologies able to bring innovation to projects in their system. All the diagrams were saved and shared in Geodesignhub in a matrix organized by system (column) and color-coded accordingly (Fig. 4, right). It should be noted that Geodesignhub takes, as input layers for its geographic interface, the evaluation maps developed prior to the WS, which can be used as mash-up overlay to support locational choices during the design of a diagram (Fig. 4, left).

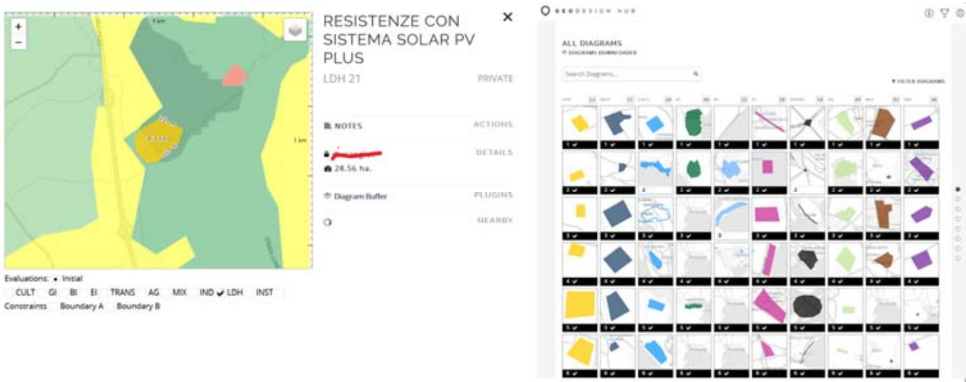

Fig. 4 (Left) Diagram creation in Geodesignhub; (right) the shared diagrams matrix

In the second phase (i.e. steps 2-4) participants developed their integrated design, or syntheses, under different assumptions and requirements which were set-up to explore possible development scenario alternatives depending on time horizons (i.e. 2020, 2035, and 2050), rate of technology innovation, and likely growth dynamics (Tab. 1).

TEAM	DEVELOPMENT SCENARIO	TIME HORIZON	TECHNOLOGY INNOVATION	POPULATION FORECAST
EA35	Early Adopter	2035	Available 2035	+ 25K Inhabitants (as-is)
EA50	Early Adopter	2050	Available 2035-2050	+ 50K Inhabitants + 10-15% (high growth)
LA35	Late Adopter	2035	None	+ 25K Inhabitants + 10-15% (high growth)
LA50	Late Adopter	2050	Available 2035-2050	+ 50K Inhabitants + 10-15% (high growth)
NA35	Non-Adopter	2035	None	+ 25K Inhabitants (as-is)
NA50	Non-Adopter	2050	None	+ 50K Inhabitants (as-is)

Tab. 1 The six scenario-driven change teams

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The teams developed their syntheses, along three dedicated sessions, moving iteratively between the change and the impact model - or in other words between design and impact assessment - thanks to the built-in impact model in Geodesignhub.
At the end of the fourth session, the teams presented their syntheses to each other. In the final session (i.e. step 5), a negotiation was held between the couples of teams having the same technology rate of adoption and different time horizons (i.e. EA35 and EA 50; LA35 and LA50; NA35 and NA50). Three final designs resulted from the negotiation process: EA3550, with the higher level of innovation up-take; LA3550, with an intermediate level of technology innovation; and NA3550 with little or no technology innovation. Fig. 5 and 6 depict the three results of the 80x80km and 20x20km studies respectively. Tab. 2 reports a summary of most used technology innovations[2].

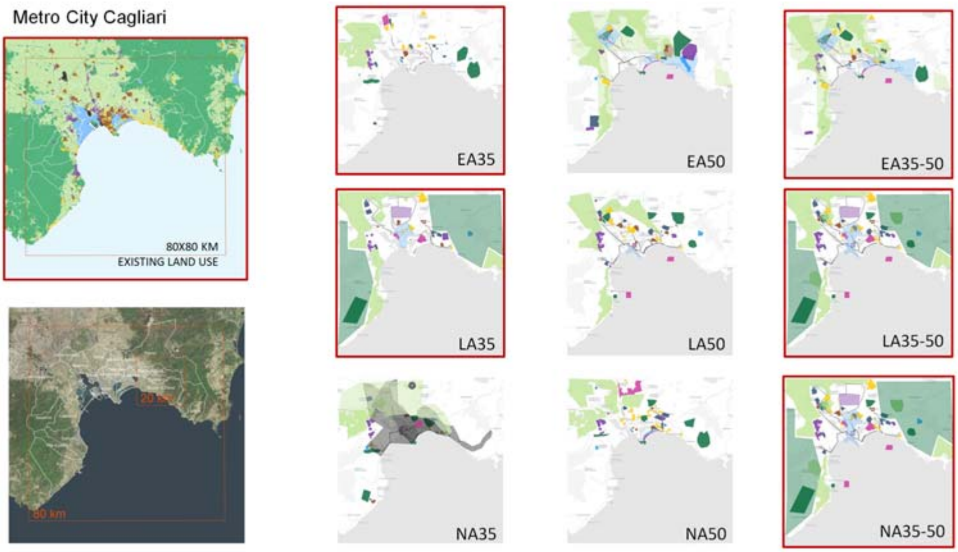

Fig. 5 Geodesign workshop results in the 80x80 km study area

3.1 SCENARIOS IN THE 80X80 KM AREA

The Early Adopter (EA) team started locating green Energy Infrastructures (i.e. eolic and photovoltaic) in the South-North axis to compound existing commercial-industrial land-uses. The transport network was extended with light rail to enhance connectivity between the Eastern settlements to the centre and the South East Coast.

[2] for a full list of IGC technology innovations see https://www.envizz1.com/global-systems-research

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SYSTEM	TECHNOLOGY INNOVATIONS
Water	Wat 2035 5 waterseer, wat 2035/2050 2 water retention
Agri	Agr 2035/2050 1 organic agriculture, agr 2035/2050 5 agroturismo, agr 2035/2050 12 rooftop gardening, agr 2035/2050 15 drones in agriculture
Green	Grn 2035/2050 5 integration of vegetation into building design, grn 2035/2050 6 genetically modified trees and engineered trees, grn 2035 12 green roofs
Energy	Ene 2035 3 olar roads, ene 2050 12 small wind power on power pylons, ene 2035 4 tidal power
Transport	Tra 2035 7 electric autonomous vehicles (eav), tra 2035 13 redefining biking with bikeshares and e-bikes, tra 2035/2050 5 hyperloop transport, tra 2035 16/17 transportation network with sustainable energy infrastructure
Ind/com	Ind/com 2035 8, renewable energy sources, ind/com 2035 2 industrial robotics, ind/com 2035 3d printers and cnc devices
Res	Res 2035 1 building integrated solar pv plus storage, res 2050 6 3d printed buildings and materials
Mix	Mix 2035 11 mart city as smart systems, mix 2035 12 innovation districts
Culth	Hist/cult1 virtual reality, hist2 smart apps location based services

Tab. 2 Technology innovations

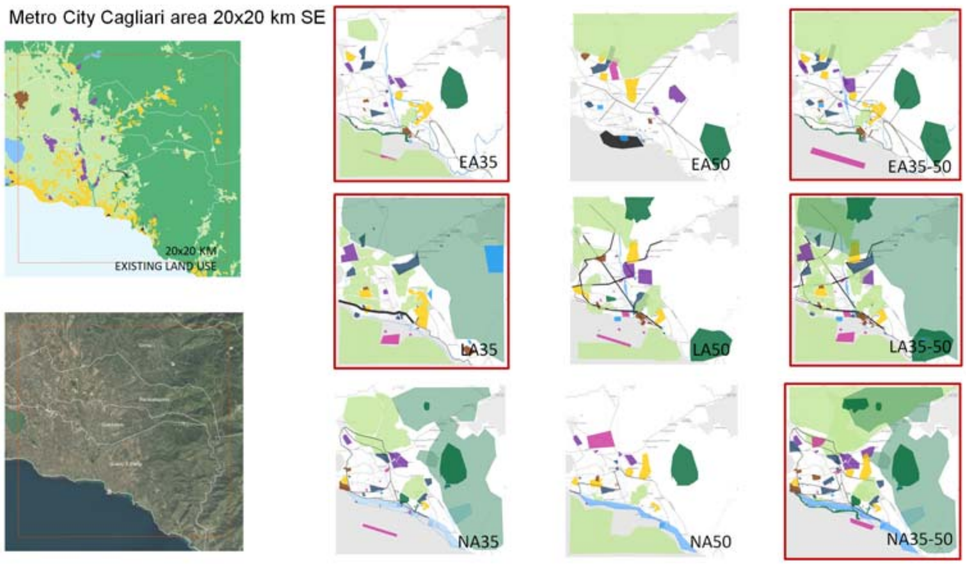

Fig. 6 Geodesign workshop results in the 20x20 km study area

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The Eastern and Western edges were preserved to consolidate existing green infrastructure, while further industrial development was maintained nearby the existing plants. New areas for mixed uses and low-density residential areas were located in the central areas with decreasing intensity of use from the center to the outer edges.
The development for the 2050 was planned to accommodate further demographic growth aiming at reaching the given target for all the systems.
As results the 2050 design included a central more developed area surrounded by a green belt. Innovations were considered used in particular to address water (i.e. WAT 2035 5), energy (e.g. ENE 2035/2050 and ENE 2035 3) and transport (i.e. TRA 2035/2050 5) issues.
The Late Adopter (LA) team started the design considering the Blue Infrastructures and Mixed use together with Transport infrastructures to address current issues in the central area of the Metropolitan City. Accessibility and connectivity were considered important as well as water supply and hydrological risk reduction.
The Eastern and Western areas were preserved mainly as green areas for agriculture and forest uses. The central development was thought as a network of higher density single or multifunctional poles. The development for the 2050 was planned to accommodate further demographic growth aiming at reaching the given target for all the systems. Similarly, to EA2050 the LA2050 design included a central more developed area surrounded by a green belt, though with a different use patterns. Innovations were considered in particular to re-think industry development (i.e. IND/COM 2035 2) transport infrastructure (e.g. TRA 2035 7 and TRA 2035 17) and green energy production (i.e. ENE 2035 3). The Non-Adopter (NA) team started the design considering the improvement of the Transport and the Blue Infrastructures of primary importance as well as preservation and management of the rich Cultural Heritage resources in the area.
Renewable energy and Green Infrastructures were also considered of major importance. Change patterns reinforce connectivity along the coast aiming at supporting tourism development. Residential development was distributed in the North-Eastern and Eastern part of the more developed areas, and more space for green infrastructure and agriculture was preserved in the West/North-Western and South-Eastern areas respectively. Mixed uses were preferred to Lower Density Housing in order to contain urban sprawl and soil consumption. While no substantial technology innovation was considered by the Non-Adopters, technology changes included the promotion of sustainably building and transport (i.e. promotion of car and bike sharing), as well recovery of traditional agricultures relying on currently existing innovation.

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Scenarios in the 20x20 km area

The Early Adopter (EA) team developed the first design focusing mainly on coastal and marine areas, also developing a submarine infrastructure for energy production and a big submarine crop, responding to the need to increase food production despite water scarcity. They also provided for a flora coastline protection green infrastructure and a cycle network along the whole coastline, connecting the archaeological sites of the area, which represent an important asset for tourism. The restoration of the natural waterways project and the rainwater reuse project was located in the inland and north-west territory, where the main residential areas are concentrated, together with industrial plants and services.

In the scenario planned for 2050, agriculture was developed in a large northern area, where the team located an underground crop. In the Eastern part of territory, they planned two green parks. They also increased the areas for institutions, low density housing and services in the western part of the study area and, as a consequence, increased the accessibility through a complex transport system, including vehicle accessible roads, cycle networks and an infrastructure for fast magnetic levitation trains.

The Late Adopter (LA) team mainly focused on: preservation of natural resources, through a green infrastructure policy involving an extended north-east part of the study area, and food production, through the localization of a great number of organic farms and a submarine crop in the sea. They also planned for taking advantage of renewable energy sources, through the creation of a tidal power station.

The low-density residential areas were located in a big central area, while the main services and industries further north. For the transport system, the team defined sustainable mobility infrastructures concentrated mainly along the coast, where fast trains and cycle networks were planned.

In the 2050 scenario they confirmed the initial asset of the study area and planned for further sustainable transport infrastructures, connecting also the coastal zone with the inland ones. Also, an increase in renewable energy production system was foreseen, which will meet the needs of the new residential areas and industries, together with two important blue infrastructures intended to reduce flood risk.

The Non Adopter (NA) team started localizing three macro areas: a very extended buffer running from north-east to south-east which includes green infrastructure policies and projects, a large area dedicated to agriculture land-uses in the north-west, and eventually a central zone with mixed and residential big areas, mostly located in the coastal part, and scattered institutional and industry projects. Lastly, in order to connect the macro-areas, they designed two main routes.

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In the evolved scenario, the three macro areas were confirmed with some minor changes. The agricultural area were extended to the east part, while in the central area an increased number of projects were localized, including: low density housing areas in the inland places, new institutional projects (i.e. the hospital and the university campus), and green energy infrastructures. Moreover, along the coastal areas, an extended blue infrastructure was planned in order to canalize the rainwater, to react efficiently against to climate change-related extreme events (i.e. extreme storms and heavy rainfall) and protect the built-up areas.

4 DISCUSSION AND CONCLUSIONS

The geodesign study presented in this paper is the first example of the application of the IGC guidelines to the Metropolitan City of Cagliari. The main objectives of the study were to earn early insights on how the study area reacts to the pressure of the global dynamics which affect the planet and generate the current challenges to be addressed in planning and design for sustainable development, and on how technology innovation in infrastructure and land-uses may affect future sustainable development scenarios. While the results of the intensive workshops alone may be far to offer final solutions for future planning in the study areas, if considered together to, and in comparison with, the results of all the other studies undertaken under the umbrella of the International Geodesign Collaboration, they may offer a rich knowledge resource for geodesign research. In this sense, all the materials produced in the first year of the IGC project are open-access and can be used by the partners and by other researchers as knowledge base for further systematic and comparative investigations, which will be developed within the future IGC activities.
In addition, the two workshops proved to offer a number of benefits to the participants, including the coordination team and the workshop participants. They represented a visioning exercise with regard to possible future sustainable development scenarios for the study areas. The workshop preparation and implementation supported all the participants in earning a better understanding of the territorial dynamics and to design collaboratively by applying systems thinking. This may be considered as much of a value especially where traditional planning systems are structured by sectors (e.g. regional planning, local land-use planning, transport planning, energy planning). Geodesign approach seems, in fact, to be particularly valuable especially in early stages of strategic planning, when the planning actors face new complex problems and need to build their understanding of inter-related territorial dynamics. From the teaching perspective, the workshops were very well-received by the participants, which were students with little or no previous knowledge of both spatial planning and design, and on using spatial information technologies. The learning curve observed by the instructors during the sequence of the five WS sessions was surprisingly efficient, and the overall results

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were eventually difficult to achieve otherwise in such short time (i.e. 15 hours). The participants, which were students in civil and environmental engineering and architecture, also learned a new approach to design which was based on proactive collaborative team-work. This is peculiar of the geodesign approach, according to which no single planner or designer may be able anymore, due to the current the increased complexity of territorial systems, to design alone.

From this, as well from previous experiences of the authors (Campagna et al., 2016) and from other similar experiences reported in literature (Nyerges et al., 2016; Steinitz, 2017; Rivero et al., 2017; Zschaber de Araújo et al., 2018), in running geodesign studies and workshops it seems reasonable to expect that similar benefits can be achieved in the planning practice. In particular, in such cases as in the Metropolitan City of Cagliari, where planning actors were traditionally used to plan at the municipal level whereas the institution of the new metropolitan city requires a shift in perspective for planning at the wide area scale, the collaborative geodesign workshop with Geodesignhub can represent a novel reliable approach to foster collaboration, systems thinking and awareness rising, consensus building and negotiation.

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AUTHOR'S PROFILE

Michele Campagna is Associate Professor of Spatial Planning at the University of Cagliari where he teaches spatial planning, Geodesign, and GIScience. His actual research interests deal with the scientific method in planning, geodesign, metaplanning, Planning Support Systems (PSS), Social Media Geographic Information in urban and regional planning. He authored over one-hundred publications, and he was editor of the volume GIS for Sustainable Development published by CRC-Press/Taylor and Francis Group in 2006. In 2011 he directed the International Summer School on Information and Communication Technology in Spatial Planning "INFOPLAN". Since 2009 Michele leads UrbanGIS lab. He coordinated geodesign studies in Italy and abroad.

Chiara Cocco is currently a Ph.D. candidate in Civil Engineering and Architecture at the University of Cagliari. Her research concerns the application of geospatial techniques in urban-regional planning and the development of geodesign methods and process analytics. She was coordination team member in many geodesign studies in Italy, Brazil, and the United States.

Elisabetta Anna Di Cesare is post-doc researcher at the University of Cagliari. Her research concerns geodesign and Strategic Environmental Assessment. She collaborated with the Department of Agricultural Science (University of Sassari), where she worked on governance processes in climate change adaptation, as part of the research activities for the preparation of the Sardinian Regional Strategy on Adaptation to Climate Change. She is currently research fellow at the University centre for research on transport and mobility issues (CIREM – University of Cagliari) where she works on the preparation of the Strategic Environmental Assessment of the Regional Cycling Plan of Sardinia. She is also professional consultant in urban planning and Strategic Environmental Assessment.

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A GEODESIGN COLLABORATION FOR THE MISSION VALLEY PROJECT, SAN DIEGO, USA

CHIARA COCCO[a], BRUCE APPLEYARD[b]
PIOTR JANKOWSK[c]

[a] Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: chiara.cocco@unica.it

[b] Department of City Planning
San Diego State University, USA
e-mail: bappleyard@sdsu.edu

[c] Department of Geography,
San Diego State University, USA
e-mail: pjankows@sdsu.edu

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ABSTRACT

Geodesign has been recently proposed as a structured decision-making workflow that if properly implemented allow to develop a forward-thinking, multidisciplinary and systems thinking design process. In 2018, the International Geodesign Collaboration (IGC) brought together more than 90 Universities around the world in researching geodesign as a design methodology to tackle some of the most pressing problems for sustainable development on a global scale, such as climate and demographic changes. Each partner institution applied the geodesign framework to develop alternative futures for a local study area. The results of the design workshops organized worldwide were shared and compared at the meeting held in Redlands on February 2019. Following the IGC instructions, the research team of the San Diego State University, California, USA set up an academic workshop involving a group of graduate and post-graduate students in designing a master-plan for a new satellite campus in the Mission Valley area in San Diego. This paper presents the local change assumptions, the methodology and the geospatial technologies used to represent and design the study area in two time periods (2035, 2050) using different development scenarios (Non-Adopter, Late Adopter, Early Adopter).

KEYWORDS
Geodesign; International Geodesign Collaboration; Collaborative Decision Process, Systems Thinking

1 INTRODUCTION

Urban-regional planning efforts at a global level are facing growing challenges mainly connected with climate and demographic changes. Such complex problems require collaborative systems approaches for design and decision-making (Nyerges et al., 2016). An ideal process is where experts and stakeholders engage in a design and learning process where they can interactively share ideas, iteratively improve upon them by considering new information and mutual interests, and finally reach a satisfactory level of consensus through negotiation. While complex decision processes are still often challenging to manage, novel design methodologies and digital technologies are now emerging that promote and support effective collaboration and systems thinking (Di Cesare et al., 2018; Nyerges et al., 2016).
In this context, a research consortium of more than 90 academic institutions worldwide was created in 2018. The International Geodesign Collaboration (IGC) aims to understand how the new planning and design methodology of geodesign can be applied to better address the urgent global challenges at various territorial dimensions and in different contexts around the world. The concept of geodesign is gaining momentum in the last decade with the aim to apply a holistic approach - based on geovisualization and geoanalytical techniques - to more traditional practices within collaborative design and geo-spatial planning fields (Lee, Dias, & Scholten, 2014; Steiner & Shearer, 2016). Since 2010, the Geodesign Summit is an international gathering that bring together architects and landscape architects, urban and regional planners and an array of professionals and academics interested in using geospatial technologies to create future scenarios and understand their outcomes. Geodesign international conferences are held in USA (annually since 2010), Europe (annually since 2013, South America (bi-annually since 2017), and Asia (2013), confirming the scale of the phenomenon. Precisely during the Geodesign Summit 2018 in Redlands, California, USA, and influenced by the 2015 Paris Agreement, Tom Fisher, Brian Orland, and Carl Steinitz introduced the global project "Improving Our Global Infrastructure: an International Geodesign Collaboration". Each partner involved in the collaboration developed a local planning study applying the geodesign workflow as proposed by Carl Steinitz in his framework (Steinitz, 2012). Participant teams shared several global assumptions and changes, a common working schedule, and specific instructions to achieve collaboration and comparability of project outcomes. Results and findings were finally presented and shared using a standard reporting format at the International Geodesign Collaboration meeting held in Redlands on February 23-25, 2019. This paper describes the San Diego State University (SDSU), California, USA, contribution to the IGC project as one of the US partner institutions. In line with the approach outlined above, 18 students from the Departments of Geography and City Planning

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participated in a 5-hour-long academic geodesign workshop where they had the opportunity to play a major role in the master-planning process of a 2.5 square kilometers area centered on the Mission Valley stadium site in San Diego. The study area is very timely since it is facing real issues related to land-use change.

The stadium was formerly occupied by the San Diego Chargers - a professional American football team that moved to Los Angeles in 2017. The area encompassing 53 hectares is located in the heart of San Diego's Mission Valley at the junction of Interstates 8 and 15 and valued between $73 million and $110 million. The city owns the land and promoted a local ballot (November 6th, 2018) to decide whether to privately lease the Mission Valley stadium property for new redevelopment (vote yes). San Diegans had a choice between two competing development initiatives: 1) Measure E plan supported by a group of local business leaders, philanthropists & soccer legends (SoccerCity Group); and 2) Measure G plan, the "SDSU West Initiative", promoted by San Diego State University and its boosters to build a satellite campus to the west. The SDSU proposal received the majority (55 percent) of votes and consequently a new campus including a river park, retail and housing units will be constructed starting in 2020.

The study involved several local change assumptions:

- currently, SDSU is landlocked and has approximately 35,000 students. The construction of the new campus will enable increasing the enrollments up to additional 13,000 students;
- the SDSU project vision looks toward environmental (Environmental Impact Report) and economic sustainability and seeks to create a collaborative and innovative environment where university, research labs and firms can share space and ideas (http://missionvalley.sdsu.edu);
- the population in the San Diego County will grow by nearly one million people by 2050, with 20% over 65 (now 12%), and more than 330,000 new housing units are required, with 84% of housing growth being multifamily. The "2050 Regional Growth Forecast" model (www.sandag.org) considers information on remaining housing capacity and constraints on development (steep slopes, habitat lands, floodplains, etc). Consequently, 860 new housing units (810 multi-family, 50 single-family) can be constructed in the Mission Valley Stadium Site accommodating 2,276 people;
- local and regional conservation programs tend to protect sensitive lands; currently 50% of the county is protected and 20,000 more acres will be preserved by 2050 (www.sandag.org).

Following the IGC instructions, the SDSU participant team set up the workshop and developed alternative futures for the stadium site within the "SDSU Mission Valley" project

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(http://missionvalley.sdsu.edu). In the following section, the tools used, the change scenarios and the workshop workflow are presented. In section 3, the negotiated design alternatives are analyzed, and in the last section, we summarize the conclusions of the SDSU case study and the future developments of the IGC project.

2 METHODOLOGY

To allow for comparison and aggregation of the various studies, the core team of the International Geodesign Collaboration has defined two future planning horizons 2035 and 2050 (target years of the Paris Agreement) and three development scenarios for the two time-stages. Each study area should be designed and represented following different approaches: Non-Adopters (NA) continue with business-as-usual until the final study date; Late Adopter (LA) follow a business-as-usual scenario in the first time stage (2020-2035) and consider technological innovations that should be available between 2035 and 2050 in designing proposals for the second of the time stages; Early Adopters (EA) include innovations within project and policies in both time stages. The general instructions reflected the local population changes and the resulting six scenario-driven change teams are reported in Tab. 1.

	DEVELOPMENT SCENARIO	TIME HORIZON	INNOVATION	FORECASTED
EA35	Early Adopter	2035	Available 2035	Forecasted (SANDAG)
EA50	Early Adopter	2050	Available 2035-2050	Rapid (+20%)
LA35	Late Adopter	2035	None	Rapid (+20%)
LA50	Late Adopter	2050	Available 2035-2050	Rapid (+20%)
NA35	Non-Adopter	2035	None	Forecasted (SANDAG)
NA50	Non-Adopter	2050	None	Forecasted (SANDAG)

Tab. 1 The six scenario-driven change team adapted from the IGC development scenarios

Ten relevant territorial subsystems were defined to shape the knowledge building and inform the design: Green Infrastructure, Blue Infrastructure, Gray Infrastructure, Energy Infrastructure, Agriculture, Commerce and Industry, Housing Lower Density, Mixed Used, Institutions and a tenth flexible system. Considering the specific local conditions, Agriculture was excluded and a dedicated system for University Facilities was added.

Following the geodesign framework (Steinitz, 2012), the knowledge-building process is completed with the creation of a synthetic representations of a suitability map, based on multiple criteria. The set of evaluation maps, one for each of the system, should orient the participants in creating projects and policies informed by the geographic context. Given the small size and the undeveloped character of the study area, two maps were developed to

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evaluate the suitability index respectively for re-development systems (e.g. Housing Low Density, Commerce and Industry) and for Blue and Green infrastructures (Fig. 1). Each map follows a five level color-code. Red color identifies areas already developed with respect to the specific system/s. Yellow areas are exposed to various risks (e.g. geomorphological hazards, flood risk) and are not appropriate to propose new projects. The locations considered by the expert the most suitable areas for development are indicated with three levels of greens; feasible (dark green), suitable (green) and capable (light green).

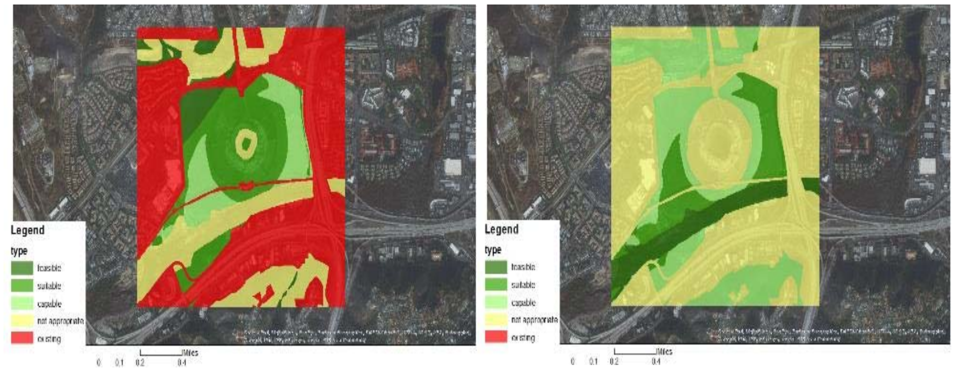

Fig. 1 The evaluation maps for re-development systems (left) and Blue, Green Infrastructure (right)

The spatial information used to create the knowledge base was retrieved from the Regional Data Warehouse (SanGIS). The GIS layers properly classified have been uploaded into ArcGIS Online and made accessible through an ESRI Story Map. The students had access to the platform one week before the beginning of the workshop. The expert (authoritative sources) and the experiential (field trip, background) knowledge influenced the design of initial proposals. In addition to the evaluation maps, for each of the system a list of requirements, resulting from the aforementioned local change assumptions and the SDSU requests described in the official web site of the project (http://missionvalley.sdsu.edu), was laid down:

- blue infrastructure: reduce hydrological risk, mitigate drainage impacts, restore the natural flow and improve water quality of the river, currently classified as “a water segment where regional standards are not met”;
- green infrastructure: create open spaces and a river park;
- energy: support the use of renewable energy sources;
- transport infrastructure: create hike and bike trails and improve the trolley line to promote sustainable travel;
- industry and commerce: locate tech office spaces to exploit research and highly skilled employees in the increasingly important tech hub of the city;

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- residential lower density: limit the construction of single-family housing and reach the LEED Silver certification for all new buildings;
- mix residential with commerce and services: promote mixed use development, combining mid-rise and high-rise residential communities with retail/commercial businesses;
- institutional: improve public services including waste recycling, healthcare, emergency management and recreational places;
- university facilities: housing and facilities to accommodate and support students, faculty, and staff.

In view of the relatively short time available during the workshop, the geo-survey platform Geoforage (www.geoforage.io) was used to collect ideas in the form of geo-referenced project diagrams, that could include technological innovations, in a pre-workshop phase. A total of 45 proposals for the new west campus were created by the students and collected into the platform in the six days preceding the meeting (Fig. 2).

An international study group of scholars and professionals have already selected a set of innovations specific for each territorial system including available or emerging technologies and climate-change-related design solutions (www.envizz1.com/global-systems-research). Major innovation considered by the students among those available in the website included:

- GRN 2035 3 Increased vegetation linked with stormwater infrastructure;
- GRN 2035/2050 6 Genetically modified trees and engineered trees;
- GRN 2035 12 Green roofs;
- WAT 2035/2050 2 Water retention;
- WAT 2035 8 Bioretention;
- TRA 2035 2 High speed rail;
- TRA 2035 3 Maglev high speed trains;
- TRA 2035/2050 5 Hyperloop transport;
- TRA 2035 14 Bikeshares and e-bikes for climate change mitigation;
- ENE 2050 7 Airborne wind turbines.

At that stage, the workshop took place as a 5-hour planning studio in the Department of Geography.

The 45 diagrams previously created were uploaded in the planning support system Geodesign hub that was used as a web-based design platform to create alternative futures for the new SDSU campus. The students were divided in six groups according to the development scenarios (EA35, LA35, NA35, EA50, LA50, NA50) and worked both independently and collaboratively using personal computers and logged into Geodesignhub platform.

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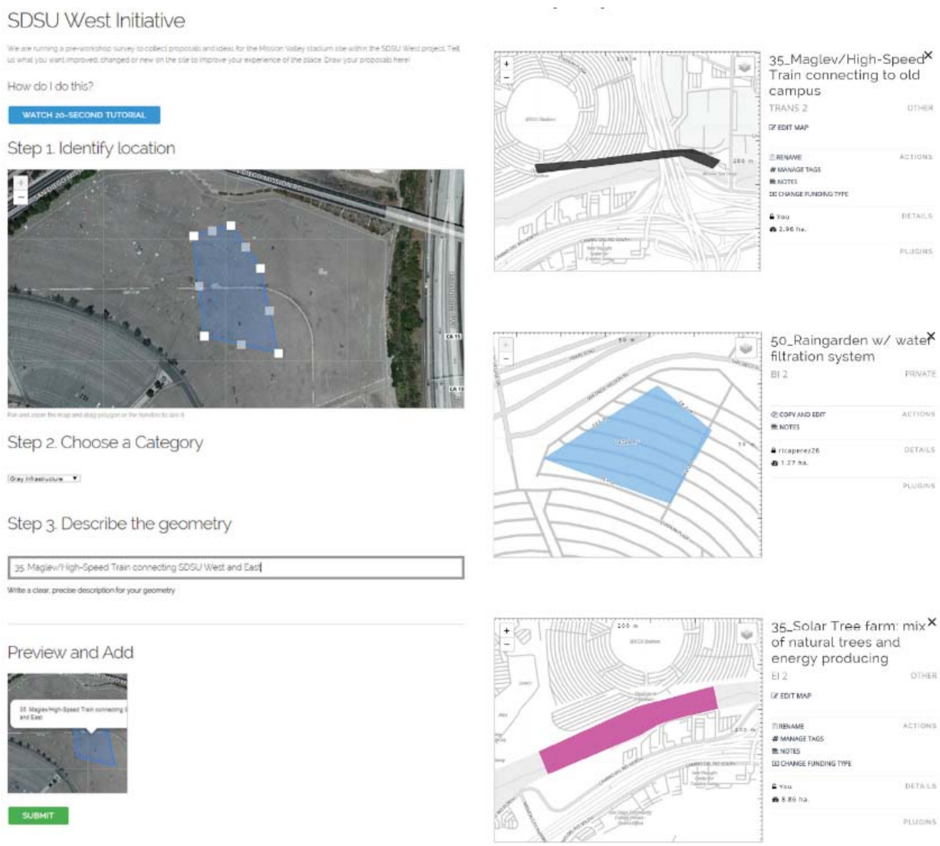

Fig. 2 The SDSU project in the geo-survey platform Geoforage

Each group was asked to select different combinations of diagrams to create a design alternative as the result of an early negotiation among the team members and in line with their development goals and interests.

In creating the alternatives, students had a choice to consider or not technological innovations and a high population growth rate following their specific development scenario and time stage. After three rounds of designs each of the six groups produced a plan alternative for the new campus. The final task of the workshop involved the six change teams grouped by development scenario (NA35+NA50; LA35+LA50; EA35+EA50) in a negotiation process to reach consensus on an integrated development strategy 2020-2050.

3 RESULTS

A brief description of the three negotiated design (Fig. 3) is reported below. The Early Adopter team focused since the initial design on the upgrading and improvement of the connection

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with the main campus. The high-speed train (TRA 2035 2) takes advantage of existing infrastructure of the trolley line and allows to reach the main campus in few minutes. The train station is also equipped with solar panel technology. The old stadium is preserved and restored to host collegiate and professional football teams. New areas for housing and research facilities surround the stadium to accommodate and support students, faculty, staff, as well as general public. The new residential areas include medium/high-rise units with ground floor retail/office spaces and a limited number of single family-units following the trend already adopted by the municipality to avoid sprawl. Green spaces occupy 15% of the design area and their extension increases up to 20% with the realization of a linear park in the 2050 development scenario. The use of innovations characterizes the new green areas and the energy production (e.g. GRN 2035/2050 6 Genetically modified trees and engineered trees, GRN 2035 3 Increased vegetation linked with stormwater infrastructure, ENE 2050 7 Airborne wind turbines). The development for 2050 further focuses on the transport network with the establishment of a dedicated ridesharing service to limit the use of the private cars and the creation of a trolley service to move inside the campus.

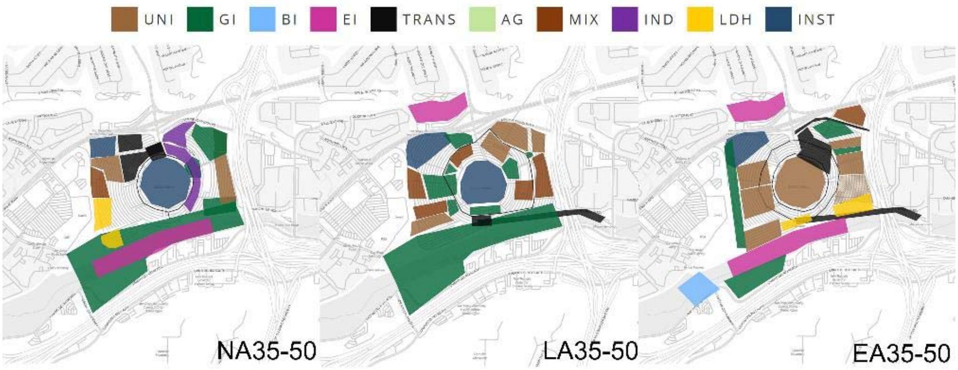

Fig. 3 The three negotiated design

The Late Adopter team started the design considering University Facilities and Institutional Services as the basis for the development of the new campus. The new research labs and public library use existing technologies (e.g. solar panel) to achieve energy autonomy together with the wind farm implanted in the north west part of the site. New mid-rise, high-rise and single-family residential communities surround the renovated stadium to accommodate and support students, faculty, staff, as well as general public. The river park plays an increasingly important role in the renovation of the site and particularly of the San Diego river. Starting with 6 ha it is extended to almost 30 ha in the 2050 development scenario. The LA2050 design includes the same transport project of the Early Adopter for a new high-speed train. The

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improvement of the connection with the main campus appears to be crucial to ensure the proper functioning of the academic activities and a greater variety of sustainable transportation options. Furthermore, the low-density residential development is dropped in favour of housing that is more compact. The Non-Adopter team started the design with considering the development of internal Transport and Green Infrastructures as high priority design directions. The pedestrian path surrounding the stadium highlights the car-free approach to the setting of the new campus. Bike racks, scooter charging ports, uber pick up points, and a bus station are included in the design to connect the campus to the existing transportation network. A 30-ha river park has been envisaged since the very beginning and coupled with a solar tree farm in the 2050 development scenario. The new residential areas are located along the west side of the site together with the new public stadium. The existing stadium is restored, and a new community centre and different event spaces are integrated. Small-scale businesses and university classrooms on the east side exploit ready-to-use smart technologies to improve building performance.

4 CONCLUSIONS

The San Diego State University decided from the outset to make public participation a key priority in developing the new campus plan, in order to guarantee a transparent and open decision-making process. This has involved about 100 public forums held so far and will continue to offer opportunities to participate with comments and suggestions. In line with this approach, the geodesign framework was proposed and applied to design plan alternatives with a group of students, future users of the place. Geodesignhub was used as collaborative design platform in the 5-hour meeting, while the geo-survey Geoforage was extremely helpful to collect individual design proposals and ideas in the pre-workshop phase. There was also a positive feedback to the StoryMap that proved to be a useful tool in the knowledge-building and opinion-making process. The integration of these web-based tools effectively supports in rapid creating design solutions - based on a holistic set of information - and in reaching a final agreement through negotiation.

On the international level, a comparative examination of the IGC projects developed worldwide by the multiple teams engaged will be conducted. Four discussion groups were developed at the International Geodesign Collaboration meeting to begin to analyze similarities and differences among groups of teams and their designs. The new knowledge based on critical comparison promise to be a significant learning opportunity for all the collaboration participants. The Collaboration ultimately aims to foster the application of the geodesign concept and framework in the creation of sustainable solutions to face the critical issues that cities and regions are grappling with worldwide.

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http://www.sangis.org/

www.geoforage.io

AUTHOR'S PROFILE

Chiara Cocco is currently a Ph.D. candidate in Civil Engineering and Architecture at the University of Cagliari and temporary visiting scholar at San Diego State University, Califonia, USA. Her research concerns the application of geospatial techniques in urban-regional planning and the development of geodesign methods and process analytics.

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Bruce Appleyard is an Associate Professor of City Planning/Urban Design at San Diego State University (SDSU) where he helps people and agencies to make more informed decisions about how we live, work and thrive. He is a renowned expert on street design, the future of transport, as well as how to integrate housing, land use, urban design and transportation to help places become more sustainable, livable and equitable. He is an author of numerous publications. He has also recently developed an online Smart Growth Equity Calculator to help the people take action to effectively coordinate transportation, housing, and climate action planning. The Robert Wood Johnson Foundation named Dr. Appleyard as one of their Top Ten Active Living Heroes for his work with communities. Dr. Appleyard holds a Doctorate (as well as a Masters and Bachelors) from the University of California, in the town of Berkeley where he grew up.

Piotr Jankowski is a Professor of Geographic Information Science and Chair of Geography Department at San Diego State University. His research focuses on models and methods of spatial decision support, participatory GIS approaches to planning and decision making, and sensitivity analysis in space-time models. He is the co-author of two books: 'Geographic Information Systems for Group Decision Making' (2001), 'GIS for Urban and Regional Environments: A Spatial Decision Support Approach' (2009), and his work has been published in over 100 peer-reviewed journal publications. He has researched and taught in Austria, Brazil, Germany, Ireland, Italy, New Zealand, and Poland.

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UNIVERSITY AND URBAN DEVELOPMENT: THE ROLE OF SERVICES IN THE DEFINITION OF INTEGRATED INTERVENTION POLICIES

***MAURO FRANCINI, SARA GAUDIO**
ANNUNZIATA PALERMO

Department of Civil Engineering
University of Calabria, Italy
e-mail: mauro.francini@unical.it
sara.gaudio@unical.it
annunziata.palermo@unical.it

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ABSTRACT

The role of Universities is of great importance in terms of territorial development as a stimulating element of physical and functional interventions aimed at encouraging economic, social and cultural growth. In particular, integration with the city and with the services is one of the main criteria for territorial planning characterized by the presence of university areas since, starting from this criterion, different organizational and typological dynamics related to housing complexes are triggered; with repercussions on management and use models. Starting from these assumptions, the present contribution describes an urban regeneration intervention that foresees the inclusion of a 'sport citadel' within the Campus of the University of Calabria, not only to improve the quality of life of those who benefit from such places, but also to create greater integration with the surrounding territorial context.

KEYWORDS
University; Services; Sport

* The other author is: Maria Francesca Viapiana.

1 INTRODUCTION

A study conducted by CRUI1 has highlighted the importance of contributions by Universities to cultural growth in the contemporary city. In particular, the study first investigated the concept of "contemporary city", with reference to the European model and the role of culture in this context, and then analyzed the evolutionary process of Universities in Italy, starting from the 1950s, and the influence that their presence has had in the city context. This study shows that, in recent decades, culture has become a central theme in urban development, highlighting the crucial role played by research and knowledge in the development or transformation of a given context. Obviously, this is not a univocal result, applicable to all contexts without distinction, but innovation, technology, urban planning and demography are issues of fundamental importance for the definition of a model of urban development characterized by the presence of a University and the peculiarities connected to it. Starting from these assumptions, and from the assumption that the territories that have the capacity to attract new talent within them are more strategically advanced (Hall, 1998), the role of the Universities is highly relevant (Amato, Varaldo & Lazzeroni, 2006), especially in contexts characterized by phenomena of social and economic degradation. For this reason, among the development goals of the universities, there are frequent attempts to be animators of a more intense integration with the local context, by representing in itself a stimulating element of physical and functional interventions aimed at encouraging economic, social and cultural growth, as well as the technological innovation of production processes and, of course, the creation of new professional skills. It is precisely through this integration, or contamination, that the quality and sustainability of the economic and social development of specific territorial contexts can be built and supported (Bagnasco, 2004). In this context, an important role for the physical and functional development of Universities is covered by the planning of specific interventions, also supported by appropriate consultation processes that must represent a fundamental moment, both to define the existing in a timely manner and to set adequate lines for development, with the consequent advantage of improving the quality of the choices and the competitiveness of universities2. Therefore, integration with the city and with the services is one of the general criteria for territorial planning characterized by the presence of university areas since, starting from this criterion, different organizational and typological dynamics of housing complexes are triggered, as well as repercussions on management and

[1] Conference of the Chancellors of Italian Universities.

[2] Lazzeroni (2014), Maggioni (2017).

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use models. In particular, university campuses must provide a close connection between student accommodation and services, by including spaces for collective activities in the functional program which are not only intended for the student population, in a spirit of openness and availability with the context. For this reason, the "functional areas" and the "environmental units" of the services are of great importance, i.e. the identification of the groups of functions that have a specific purpose and the spaces provided for an activity, or groups of activities, which are compatible with each other from a spatial and temporal point of view.

2 A MASTERPLAN FOR THE PHYSICAL AND FUNCTIONAL VALORISATION OF SERVICES IN THE UNIVERSITY OF CALABRIA

Considering the social and economic phenomena that characterize the context in which the University of Calabria (Unical) is located, its role assumes great importance in territorial development. It is therefore necessary to rethink an integration strategy inspired by strengthening the relationship between research, teaching and the local context, as well as improving the efficiency linked to the mobility of students, technical-administrative staff and academic staff. In this regard, it is considered useful to develop a master plan, an adequate tool to define the elements that characterize the context, both in terms of location and quality as these have already been used in other universities with excellent results.

The master plan allows the system to make interventions aimed at the enhancement of training and research activities related to innovation, knowledge transfer, and the regeneration of accommodation areas, ensuring an adequate functional mix with internal and external services connected to each other.

Moreover, this planning tool allows to take into account the assessment of users' needs and expectations, the potential of places, the resilience capacity of the area in which to operate, proposing new planning and programming tools, and consequently tools for socio-economic development.With this in mind, the master plan should be included in the Integrated University Performance Plan, in which the various programming aspects can also be evaluated, including: precise definition of indicators related to operational objectives of customer satisfaction and process/service, taking into account the relative reference targets, for the purpose of an efficient evaluation of the results; closer integration with financial planning; improvement of quality check processes; etc.

In this overview, some lines of development have already been implemented by the University of Calabria with specific actions to be completed:

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- the design of a 'Sport Citadel', also open to the community, which will allow diversified and environmentally sustainable uses;
- the adoption of new forms of innovative teaching, alongside traditional ones, through the construction of equipped classrooms, mainly for cooperative learning and e-learning, which, to date, are not present in the University, and which will enrich the total educational assortment;
- the creation of thematic squares to encourage socialization within the Campus, through the redevelopment and infrastructure creation of existing spaces.

In addition to these activities that have already been initiated, new development lines must be added, to be defined with a focus on promoting openness towards the surrounding area:

- upgrading and functional adaptation of the existing road network;
- provision of "new" accommodation and services to support the student population.

Regarding the first line, the radical reorganization of the internal viability and access road system to Unical is essential to create the necessary conditions for integration and, consequently, for the physical and functional development of the University.

These actions are on a territorial scale and in fact, have already been foreseen and in some cases have already been planned or are under construction. These must be associated with further interventions to be structured within the university area, necessary to reorganize the mobility system within the Campus, as it is currently inadequate in terms of security. With regard to the other development line, i.e. student and other accommodation, it is necessary that this is partially located outside the Campus, supported by adequate services and efficient connections. This could bring real benefits to the entire territorial context, both in physical and socio-economic terms, contributing to strengthen the relations between the University and the surrounding area. An interesting start could be the location of new university accommodation in the historical center of Cosenza, thus also contributing to regenerate places now considered peripheral, in order to turn them into accommodation and integration areas. This would be allowed not only by the inclusion of student residences, but also by means of the creation of related services, such as: study rooms, leisure rooms, opportunities for interdisciplinary cultural education, study assistance, etc. Therefore, integration with the territory must be at the basis of the design criteria of the new university accommodation, since the relationship between student housing and the urban and surrounding area is one of the pre-eminent aspects in defining not only the general settlement model, but also functional and typological organization models. These interventions, to be carried out preferably through the recovery of existing buildings, can also guarantee adequate levels of environmental and architectural sustainability, as well as integration with the identity of the places.

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3 AN INTERVENTION ACTION PLAN: THE UNIVERSITY SPORT CITADEL

Among the various planned actions, a significant role is played by sports equipment. In recent years, in fact, within the Unical Campus, the search for a better quality of life has favoured a general diffusion of different sports, both competitive and non-competitive.

Currently, students and university staff who want to play sports can do so in facilities in the Campus that allow group sports (basketball, volleyball, football, rugby, beach volleyball, etc.) to be carried out, single sports (archery, body building and fitness, boxing and martial arts, yoga, dance, etc.) and mind sports (bridge, chess, checkers, etc.).

The great success of these activities has registered a growing demand for participation, which has also allowed the achievement of important achievements, from a competitive point of view, in several championships and tournaments at various levels. At the same time, another precious activity for the promotion of sport has been carried out by the youth sectors which, with hundreds of small practicing athletes, create the indispensable incubators capable of ensuring continuity to all the competitive sectors.

The increase in demand has, however, highlighted the need for more sport facilities. Too often activities are limited due to the lack of adequate space. In addition, it is not possible to organize important university sport events that would bring important economic repercussions to the territory because of this limit.

In order to keep competitivity and participation levels high, as well as to improve them even further, the need for suitable sport facilities, both from a qualitative and a quantitative point of view, has been highlighted. For this reason, a 'Sport Citadel' was designed to support existing structures.

It is a multi-sports complex surrounded by greenery, on an area of approximately 12 ha. Its design will be modern and will allow diversified uses, both for competitive activities and for basic and social sport activities of various kinds, related to well-being and health.

Specifically, the design choices were based on the following parameters:

- flexibility and functionality, to obtain spaces that are versatile and suitable for different needs to use the entire area at all times. This objective will be pursued, in particular, through the creation of large green areas, which will constitute an "added value" for the entire sector;
- security of the area and facilities, both for day to day presence and in case of large public events, in compliance with current regulations;
- targeted architectural solutions, to present a formally balanced structure, that fits in the territory and is easy to understand.

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The proposed project solution has been identified, among the various possible solutions evaluated, such as the one that presents the best ratio between costs and benefits for the community, in relation to the specific needs to be met and performance provided.

In particular, it intends to foreshadow a large-scale center, where the integration between sports practice, recreational activities and the pursuit of health and well-being find equilibrium in a unitary architectural project. For this reason, a plan has been devised that can adequately meet the competitive needs, which is also a particularly qualifying service aimed at a wider and more diversified stakeholder, interested in activities other than competitive sports.

Specifically, the new University Sports Center provides for the implementation of the following interventions:

- a sports field connected to an athletic track;
- a multi-purpose sports hall, including multi-purpose playing fields;
- a gym, including squash courts, rooms for martial arts and fencing, as well as a fitness centre, consisting of a gym, a weights room, cardio-fitness rooms and fitness rooms;
- a water sports complex, including an Olympic-size pool and fitness pools;
- a range of outdoor equipment with lighting facilities for evening use, including an approximately 2 km long running track, football pitches of various sizes and several tennis courts.
- The intervention is completed by the construction of buildings for changing rooms, services and offices, and systems for facilities (air conditioning, photovoltaic, solar thermal, video surveillance, irrigation and recycling of rainwater).
- In addition, the area that is not directly affected by the plan will be made into a park for individual or collective use for children.
- Access to the Sport Citadel is guaranteed by the nearby roads, while within the sector there is a pedestrian route that connects all the spaces and structures. The Citadel also has a parking area that is directly accessible from both the main road and pedestrian paths.

The proposed plan promptly responds, therefore, to the needs of differentiated users and is, at the same time, economically viable to become a suitable space for hosting events "of" and "for" everyone, as a centre of social aggregation. The Sport Citadel has, in fact, also been designed in full respect of disabled peoples' needs , starting from a careful assessment of the type of barrier, the possible needs expressed by the people concerned, the potentials and limitations of people with disabilities and the type of mobility and instruments needed. To this end, all the solutions have been adopted to overcome any barriers and make these users self-sufficient, allowing them to take advantage of the Sport Citadel in its entirety.

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Fig. 1 Plan of the University Sport Citadel project - University of Calabria

The Citadel has also been planned so as to be environment friendly with the aim of achieving a high degree of eco-sustainability. In this regard, various constructive criteria have been adopted. The issue of energy saving has been addressed by providing that a significant part (at least 30%) of the materials and components that make up the structures[3] are local, encouraging the use of products with environmental hallmarks and using recycled material or material from renewable sources. As regards to the building envelopes, in particular, the components of the opaque enclosures use insulation material of adequate thickness, while for the transparent enclosures insulated glass panels are used. In addition to this, all the roofs will have photovoltaic and solar thermal systems. Furthermore, low emission heating systems are foreseen to reduce environmental impacts. Particular attention has been paid to the issue of water consumption, differentiating the needs based on two distinct items: consumption for indoor purposes and for irrigation purposes. With regard to the first aspect, the use of suitable hydraulic devices[4] has been planned in the facilities. In addition, rainwater will be collected, purified and reused as non-drinking water. The same collection system will also be used to

[3] Opaque and transparent envelopes, floor slabs, floors and walls, supporting structures.

[4] Airless aerators, flow reducers, double-button exhausts for toilets, etc

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irrigate the planned green areas. It should also be noted that only a small percentage of the intervention area (about 12%) will be waterproofed (areas occupied by built-up structures and access areas), while the remaining part will be used for outdoor sports facilities and greenery and will be extremely permeable. Finally, the project envisages appropriate measures aimed at acoustic well-being. In particular, building materials and furnishing elements that are soundproof will be used.

4 CONCLUSIONS

When we talk about "sport", if on the one hand we think of an "instrument" of aggregation and social inclusion, on the other it is still associated with the idea of a merely leisurely activity, separate and distinct from the rest of social and cultural activities, relevant in the educational and training process of individuals and the community.

Overcoming this dichotomy of thought is the intrinsic objective of the proposed project, which sees the inclusion of the Sport Citadel within the university campus to integrate and qualify activities transversal to research and to technical and cultural innovation.

Therefore, sport plays a significant role in the processes of urban and social transformation (Bale, 2002), becoming, in this case, a "device of social cohesion", capable of enhancing the potential of places and people. Sport is a "tool" for the regeneration of spaces as places that enable sports activities. The logic adopted by the project is, therefore, that of the so-called community hubs: physical spaces that place the people-community relationship in the center; spaces where everyone's needs and skills are considered, giving life to new bonds and social affiliations; places where the opportunities for exchange are multiplied, practices of proximity are intertwined, and future imaginaries are shared. In conclusion, this research project, translated into a direct operational intervention, considers people as a resource for improving proximity networks and considers communities as gyms for social experimentation.

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AUTHOR'S PROFILE

Mauro Francini is full Professor of Urban Engineering at the University of Calabria, his research activities include the study of models, techniques and tools for urban and territorial planning and management.

Sara Gaudio is Ph.D. student at University of Calabria. Her research activities deal with definition of urban resilience related to emergency planning, even through the development of new methodologies in GIS environment.

Annunziata Palermo is Associate Professor of Urban Engineering at the University of Calabria. She is interested in strategic planning of medium and low density urban and rural integrated systems, sustainable regeneration and urban and territorial resilience.

Maria Francesca Viapiana is Associate Professor of Urban Engineering at the University of Calabria. She is interested in urban design and planning with particular attention to the role of sustainability in regeneration processes.

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URBAN ENVIRONMENT. AN ANALYSIS OF THE ITALIAN METROPOLITAN CITIES

GIUSEPPE MAZZEO

Institute of Studies on Mediterranean Societies,
Consiglio Nazionale delle Ricerche
(ISSM – CNR), Italy
e-mail: giuseppe.mazzeo@issm.cnr.it
URL: https://www.issm.cnr.it/it/

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ABSTRACT

This paper provides an overview of the environmental situation in Italian Metropolitan Cities. The transition from a fossil city to a renewable city shows a critical state, also if the intersection of settled critical elements with new trends of the global world (above all in economy and technical innovation) can represent an occasion for these cities. The interest on urban environment results by the growing importance of the question. The cities are among the main generator of pollution and of greenhouse gas, and their impact is growing because they are growing in many parts of the world. The state of the environment, not positive, can be the basis for a deeper discussion on the steps to take to reduce the weight of the cities. These can be one of the main target of the future policies in the urban and metropolitan systems in Italy and in Europe. The non-recognition of the urban vulnerability is a risk for the urban systems that can be fought with a growing capacity to manage the changings and with an effective participation of the urban users. The paper deepens the results of a previous paper that considers the same urban system under the light of other main characteristics. The establishment of the metropolitan cities can be a step in this direction only if the consciousness of the environmental problems enter as main topic of the local and national transforming actions.

KEYWORDS
Metropolitan Cities; Environmental index; Sustainability; Planning

1 INTRODUCTION

The urban environment is a highly complex structure in which coexist elements of a series of technological, economic, productive, and environmental systems. The main actor within the urban structures is the man who interacts in a different way with each of these systems on the basis of local/time situations and of the conditions in which it performs their activities.
Towards the urban structure there are continuous flows of materials and goods that makes possible the carrying out of the various activities allowing the correct interrelations between the different systems. An urban environment operates when it is healthy, that is when all their elements are related to each other and none of them appears to be in a predominant position. In a situation in which each of these systems operates with the best characteristics typical of each sector, the influence on the urban system is increased, also affecting the overall quality. This makes it possible to merge the physical level of the city with the quality level that can be characterized by values such as urban liveability, environmental quality of the system, and overall healthiness of the urban environment (Marans, 2012; Pacione, 2003).
The urban system, seen as an environmental system, is a system in which raw materials enter the box that constitutes the system, they undergo a transformation and come out (Fig. 1).

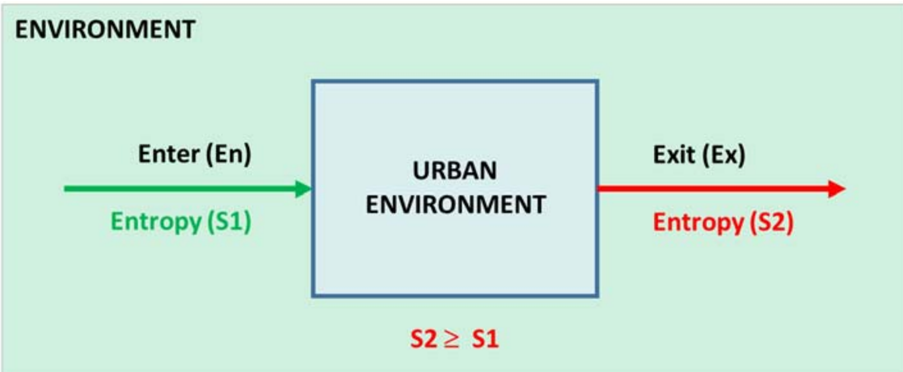

Fig. 1 Urban environment box and entropy

This process causes an increase in the total entropy of the environment (of which the urban environment is a partition). This is because the carrying out of activities within an urban structure requires work and therefore the use of energy, which, once the work has been carried out, is characterized by a lower quality, thanks to the overall increase in entropy.
Urban structures have a strong impact on the overall quality of the environment, due to the high work's concentration in it.

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Reasoning absurdly, one might think that the solution is to eliminate the cities creating a new anthropic structure. This is not possible because it is a structure not replaceable with others. Consequently, an urban structure can only be improved. It requires a continuous process of evolution in such a way that one work unit needs a lower consumption of raw materials and, therefore, a lower or, at least, zero entropy production.

We can achieve this possibility by increasing the efficiency of the urban structure, for example by improving mobility, or by replacing procedures for carrying out urban functions, or by replacing activities with others characterized by a greater efficiency. All these actions have strict relations with the management of urban space, with the reduction of urban vulnerability, and therefore with the planning and use of the territory itself (De Sherbinin et al., 2007).

2 ITALIAN METROPOLITAN SYSTEM

Italian metropolitan cities are a significant sample of an urban reality with particular characteristics. The interest they arouse derives from a contradiction that seems to be present in the sample of metropolitan cities. They are a significant example of the Italian urban system, but they are also a significant example of the potential errors that can be committed when a choice is made on the basis of poorly designed political motivations. In this case the error seems due with the excessive extension of the sample of metropolitan cities.

The issuing of the Law 56/2014 introduced the "metropolitan cities" into the organization of Italian local self-government. The system of metropolitan cities is formed by ten areas coinciding with the territory of the previous provinces (Rome, Milan, Naples, Turin, Genoa, Venice, Bologna, Florence, Bari and Reggio Calabria). In addition, special administrative Regions have identified Cagliari in Sardinia, Palermo, Catania, and Messina in Sicily. In the paper, we consider also the case of Trieste, a non-official metropolitan city. Tab. 1 shows some of the main characteristics of the metropolitan cities territories. From 2014 to now, attention to the development and strengthening of the new local authority has involved sectoral, in particular legal and budgetary, aspects. Elements such as new geographies at national and international level or the competitiveness of the territory and networks as a basic factor for development have been marginal in the construction of local policies. At the same time, the planning of metropolitan territories has not had better luck.

One of the key issues on the agenda is the current level of "resoluteness" in the application of the reform. The sensation is that it is slowly coming to be reduced due to the substantial problems of local authorities (connected above all to the amount of available resources that does not allow many possibility of manoeuvre), and to the changed national political landscape, poorly (and irresponsibly) inclined to carry out reforms conceived in a previous political season.

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Fig. 2 Italian metropolitan cities. In blue the cities identified by Law 56/2014. In green those identified by the special status Regions. In red Trieste, a long-term candidate but not a metropolitan city

At the same time, it is present a widespread lack of awareness of the enormous potential deriving from the application of the reform, also if the situation changes from case to case. The system of Italian cities confronts, in fact, with a highly competitive international landscape not allowing further loss of time along the path of innovation, the efficiency of the territory and the reduction of vulnerability related to environmental phenomena, as well as in the identification of the most appropriate development strategies.

This factor is of great importance and deserves special attention. The category of innovation, in fact, contains in itself various aspects ranging from the growth of the efficiency of cities, to the ability to take advantage of the redevelopment processes, to the overall sustainability of urban development processes, also in light of the impact of city on the phenomena of local and global warming.

The results of this analysis were that only a limited number of Italian cities have the characteristics to be "metropolitan". The dimension of the indicators and their combination brings to hypothesize that the extension of the sample to 14 cities is completely unjustified in relation to the characteristics of the cities themselves and their national and international relevance. The analytic formulation confirmed results that are well known, because the Italian

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metropolitan system presents well-established hierarchies based on qualitative considerations and on the economic, social, cultural and territorial performances of the cities.

	RESIDENT POPULATION. (2011, ISTAT)	RESIDENT POPULATION. 31/12/2018 (ISTAT)	∆ POP 2018 / POP 2011	POPULATION DENSITY. AB/KMQ. (2011, ISTAT)	OLD AGE INDEX. (2011, ISTAT)
Rome	3.997.465	4.355.725	358.260	745,33	144,25
Milan	3.038.420	3.234.658	196.238	1.928,40	159,34
Naples	3.054.956	3.101.002	46.046	2.591,30	89,12
Turin	2.247.780	2.269.120	21.340	329,25	204,14
Palermo	1.243.585	1.260.193	16.608	248,25	118,14
Bari	1.247.303	1.257.520	10.217	322,90	125,39
Catania	1.078.766	1.109.888	31.122	301,86	111,86
Florence	973.145	1.013.260	40.115	276,96	186,22
Bologna	976.243	1.011.291	35.048	263,68	185,06
Venice	846.962	853.552	6.590	342,50	169,13
Genoa	855.834	844.957	-10.877	466,70	239,53
Messina	649.824	631.297	-18.527	198,96	155,96
Reggio Calabria	550.967	551.212	245	171,62	129,55
Cagliari	550.580	431.955	-118.625	120,47	154,13
Trieste	232.601	234.638	2.037	1.094,59	247,29

Tab. 1 Metropolitan cities. Population data. Source: ISTAT

	Σ(Zx) ECONOMY	Σ(Zx) DENSITY / TERR. USE	Σ(Zx) MOBILITY	Σ(Zx) QUALITY	METROPOLITAN INDEX (MI)
Milan	+2,74	+1,40	+1,61	+0,56	+6,31
Rome	+0,50	+0,51	+1,59	+1,36	+3,96
Venice	-0,27	+0,02	+0,78	+1,09	+1,62
Turin	+0,82	+0,57	+0,12	-0,07	+1,44
Florence	+0,20	+0,28	+0,04	+0,80	+1,32
Trieste	-0,45	+0,46	+0,28	+0,40	+0,69
Bologna	+0,34	+0,22	-0,26	-0,02	+0,28
Naples	-0,22	+0,19	-0,24	+0,08	-0,19
Genoa	-0,13	+0,05	-0,22	-0,03	-0,33
Cagliari	-0,26	-0,72	-0,44	-0,20	-1,62
Bari	-0,38	-0,68	-0,54	-0,48	-2,08
Catania	-0,68	-0,60	-0,43	-0,71	-2,42
Palermo	-0,80	-0,57	-0,49	-0,87	-2,73
Messina	-0,59	-0,42	-0,92	-0,83	-2,76
Reggio Calabria	-0,83	-0,70	-0,88	-1,07	-3,48

Tab. 2 The sum of the average Z-score of the four sectors define the score of the Metropolitan Index (MI); Source: Mazzeo, 2018

The paper highlights that only three metropolitan cities seem to have all what it takes to be a metropolitan city: Milan, Rome, and Florence. Other cities that can be considered in this group are Turin, Venice, Bologna and Naples. In addition, the differences among Milan and

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the other cities are quite evident. Although not a metropolitan city, Trieste has many features to fit into this system, even more than others in the sample.

The results obtained from this analysis (Metropolitan Index, MI) identify the strength of some metropolitan cities and, at the same time, the weakness of others. In this category of the weak cities can be classified two types of it. The first cities are those that, according to Italian law, are classified as metropolitan cities but, based on international literature and on their own characteristics, are nothing more than regional centers, difficult to consider as metropolitan cities or as a city with a real metropolitan area. The seconds are those belonging to the Southern area of Italy and, in this case, the weakness is structural and derives from a long history of inability to plan a future.

3 METROPOLITAN ENVIROMENT

The carried-out analysis uses a system of 11 environmental indicators that can be associated with the urban sample consisting of 14 + 1 Italian metropolitan cities. The data system then forms an 11x15 matrix. The 11 indicators are reported in the Note 1 to the paper and are, in turn, classifiable as soil use indicators (3), mobility indicators (4), and efficiency indicators (4). Other considerations are included in Note 1.

Using the Z-score methodology (Diez et al., 2012), the same reported in Mazzeo (2018), we obtain an index for the sample of 15 metropolitan cities. We name it "Environmental Index (EI)".

We use the Z-score technique for to compare the different indicators. The first passage is the normalization of the data:

$$Z_x = \left(\frac{x - \bar{x}}{\sigma_x}\right) \quad (1)$$

In (1) Z_x is the normalized value of the variable x, $\bar{x}$ is the average value for the whole test sample (N is formed by the 15 metropolitan cities), and σ_x the standard deviation of the variable x of a population of N elements, defined as:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^{N}(x-\bar{x})^2}{N}} \quad (2)$$

Applying the formulas to the three groups of sectors, the original data are normalized making it possible a quantitative comparison based no more on a matrix 15 x 1 (the single indicator) but on a matrix 15 x n formed by the 15 metropolitan cities and the n indictors of one of the sectors. Tab. 3 shows the results, while Fig. 3 correlates the Environmental Index (EI) with the Metropolitan Index (MI), highlighting that there are considerable differences between the

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two. We can say, for example, that the size of metropolitan cities negatively affects the state of the environment. At the same time, the geographical position of the cities and their tradition of environment respect and urban quality has a significant influence on this index.

	Σ(Zx) SOIL USE	Σ(Zx) MOBILITY	Σ(Zx) EFFICIENCY	ENVIRONMENTAL INDEX (EI)
Venezia	+5,11	+6,57	-1,05	+10,63
Cagliari	+1,16	+0,71	+3,56	+5,43
Bologna	+1,07	+1,90	+1,66	+4,62
Reggio Calabria	+2,58	-1,86	+1,36	+2,08
Firenze	+0,08	+0,13	+0,87	+1,07
Trieste	-0,34	-0,80	+1,21	+0,07
Milano	+1,47	+0,54	-2,04	-0,03
Bari	-1,58	-1,68	+3,14	-0,12
Catania	-0,87	-0,12	+0,69	-0,29
Roma	-1,01	+0,04	-0,72	-1,69
Torino	-0,86	+1,75	-2,59	-1,70
Messina	-0,97	-1,37	-0,53	-2,88
Genova	-1,99	-2,55	+0,20	-4,34
Napoli	-2,16	-1,75	-0,87	-4,78
Palermo	-1,68	-1,52	-1,62	-4,83

Tab. 3 The sum of the average Z-score of the three sectors define the score of the Environmental Index (EI); Our processing on data Legambiente, 2018

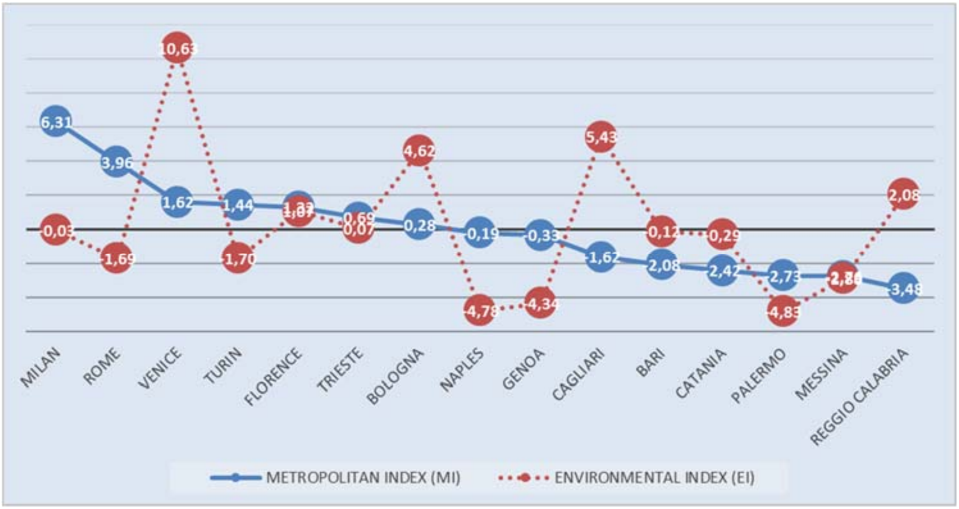

Fig. 3 Metropolitan Index (MI) and Environmental Index (EI); Position of cities based on Metropolitan Index (MI); Correlation Index: 0.12 (see Note 2)

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With regard to the environmental index, a second analysis was performed using a simple standardization of the indicators given by:

$$I_{nnorm} = \frac{100}{\sum(I_1 \dots I_n)} I_n \quad (3)$$

In this case too, the hypothesis underlying the analysis is that the higher are the standardized data the greater is the contribution to the environmental index of the element of the urban sample. Based on this simple standardization operation, we obtain an index that we call Environmental Performance (EP) for the sample of the 15 metropolitan cities.

The results in Tab. 4 and Fig. 4 are similar for the two indexes and they show a slight different classification from Tab. 2. Once again emerges the important position of the smaller cities (Venice, Bologna, Cagliari, Florence) and the greater criticality environmental of two categories of centers: those of greater size (Milan, in part, Rome and Naples) and a consistent sample of the cities of Southern Italy.

As in Tab. 3, the case of Venice emerges due to the characteristics of the city. Venice, in fact, is less affected by some negative environmental elements connected in particular to mobility and land use.

	SOIL	MOBILITY	EFFICIENCY	ENVIRONMENTAL PERFORMANCE (EP)
Venice	32,72	94,14	24,11	150,97
Bologna	24,67	42,55	38,47	105,69
Cagliari	28,04	25,27	40,48	93,79
Milan	27,72	32,81	24,41	84,94
Florence	21,19	33,79	26,30	81,27
Reggio Calabria	35,82	8,41	25,44	69,67
Trieste	19,80	23,63	25,05	68,48
Turin	17,97	29,22	18,91	66,10
Bari	9,70	16,72	38,66	65,09
Catania	13,86	14,69	34,09	62,64
Genoa	12,39	14,91	26,05	53,34
Rome	15,64	20,61	14,44	50,69
Messina	14,31	12,55	23,83	50,69
Palermo	14,02	15,71	18,82	48,55
Naples	12,15	15,00	20,94	48,09

Tab. 4 Enviromental Perfomance (EP) of the metropolitan cities. Our processing on data Legambiente, 2018

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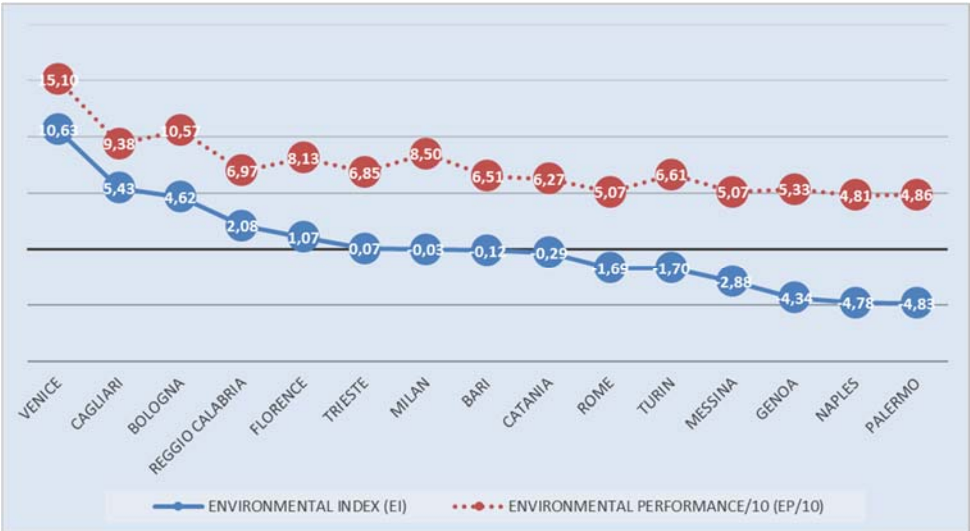

Fig. 4 Enviromental Index (EI) and Environmental Performance (EP/10); Correlation Index: 0.94 (see Note 2)

4 CONCLUSIONS

An environment represents a vital space for one or more species. The urban environment, in particular, can be considered a vital space for the man. This space involves various aspects: technological, biological, earth science, economic, social, historical, and political.

The functioning of cities and the processes of decision making are strictly connected with the urban environment.

The city is a consumer of food and raw materials: monetary exchange, energy and water enable its life influencing design, planning, social well-being, engineering. The results are waste, pollution, effects on climate, change of the natural hydrological cycle, also if management increases or decreases the efficiency of the consumption.

So, a series of elements enter in the urban environment circuit and a series of other elements come out of it (Fig. 1). Operation becomes more efficient when the same work is done using a smaller amount of input resources and causing the same smaller amount of resources to leak out (Estrada et al., 2017).

This operation reaches one of its maximum efficiency levels when the used resources are renewable and they can be used without consuming the natural capital and becoming lighter (Mazzeo, 2016).

The path to reach this goal is still long and the results obtained at the level of analysis of the Italian metropolitan cities are a testimony of this distance. The construction of the

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environmental index represents an attempt to specify at the level of the sample some aspects on which cities must confront and act.

Also the metropolization index provides some significant results. As they are constructed, it is possible to hypothesize a strong permeability between them. This means that many of the indicators are interchangeable. The inclusion of new methods for the implementation of urban activities has specific characteristics that can be a further push towards the construction of more sustainable management models of the cities themselves. If the Italian cities are vital and they work for hundreds of years it means that they have a capacity to adapt to technological and social changes that make them suitable for further transformations. The next step in the functioning of the cities themselves is the transition from the use of fossil energy to the use of renewable energy, as well as the transition from a society in which communication is still quite traditional to one in which it becomes fully digital and high speed. So the ability of Italian cities to respond to these aspects will ensure that they can continue to maintain their role within the overall system of European cities and thus occupy the role that is due. This role results not only as a testimony of a glorious past but as a testimony to the vitality of cities. Attention to the aspects that influence the environmental impact of cities is strong. Also the European Commission has increased its focus on urban issues, as a response to the fact that almost 80% of EU citizens lives in cities. The political importance of the issue is demonstrated by its inclusion in the 7th Environmental Action Programme (7EAP) under Priority Objective 8, entitled, Sustainable Cities: "Working together for Common Solutions". The overall objective of this policy drive is to enhance the sustainability of EU cities to achieve by 2050 that all Europeans are "living well, within the limits of the planet". Specifically the Action Programme states that by 2020: "… a majority of cities in the Union are implementing policies for sustainable urban planning and design…" and that the Commission should develop: "…a set of criteria to assess the environmental performance of cities, taking into account economic, social and territorial impacts". In this context, the institutional restructuring process that led to the constitution of Italian Metropolitan Cities had specific potentialities in itself, recognizable in curtailing of the territorial government, in growing of administrative efficiency, and in enhancing of competitiveness (Barbieri, 2015; De Luca, 2016).

NOTES

List of indicators referred to Tab. 3. Source: Ecosistema Urbano 2018, Legambiente.

01. (S) (1/n) Synthetic index (scale 0-10) of the consumption trend for land/residents and level of urbanization/residents, 2017.

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02. (S) (n) Usable green in urban area (sqm/ab), 2016.

03. (S) (n) Threes in public areas (number of three/100 residents), 2017.

04. (M) (n) Pedestrian road surface extension (sqm/residents), 2017.

05. (M) (n) Car motorization rate. Cars circulating/100 residents, 2017.

06. (M) (n) Cycle paths. Equivalent meters of cycle paths/100 residents, 2017.

07. (M) (n) Passengers f public transport (travel/resident/year), 2017.

08. (E) (n) Recycled waste. Share of recycled waste on total urban waste, 2017.

09. (E) (n) Dispersion of the aqueduct. Share difference between water introduced and consumed for all, 2017.

10. (E) (1/n) Fine powders (Pm10). Average annual values (µg/mc). Urban control units, 2017.

11. (E) (n) Photovoltaic and public thermal. Installed power (kW) on public buildings each 1.000 residents, 2017.

S = *Soil indicators*. M = *Mobility indicators*. E = *Efficiency indicators*. n = *Benefit indicato*rs. 1/n = *Cost indicators*.

Correlation Index was calculated using the following formula:

$$Correlation\,(X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}}$$

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WEB SITES

http://ec.europa.eu/environment/urban/index_en.htm

AUTHOR'S PROFILE

Giuseppe Mazzeo is a Civil engineer graduated at the University of Naples Federico II. Researcher at CNR since 1998. Contract Professor at University Parthenope of Naples and at University Federico II of Naples. He has worked within the Operational National Project (PON) "SEM - Smart Energy Master for the energy government of the territory" (PON04a2_E), research unit of University of Naples Federico II (2012-2016). He is full member of the National Institute of Urban Planning (INU). Author of over 100 published works on some of the key themes of urban planning, such as land use planning, urban transformations and environmental assessment. He has took part at numerous national and international conferences. Present research topics include: 1) the evolution of structures and functions of metropolitan areas; 2) the innovation in the urban plans, with special attention to the local sustainable planning; 3) the assessment of the environmental sustainability of the urban and territorial plans.

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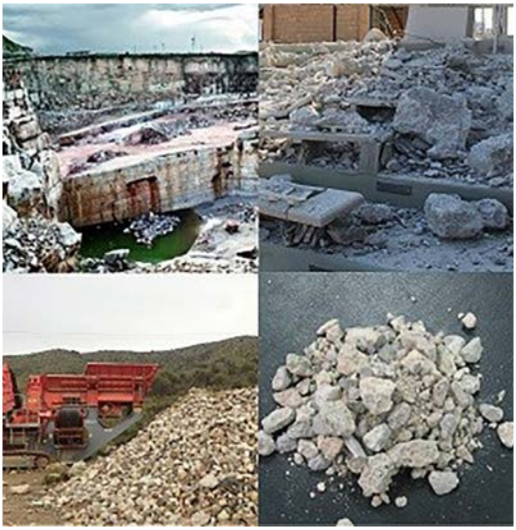

RECYCLED AGGREGATES

MECHANICAL PROPERTIES AND
ENVIRONMENTAL SUSTAINABILITY

***LUISA PANI, LORENA FRANCESCONI**
JAMES ROMBI

Department of Civil, Environmental Engineering
and Architecture
University of Cagliari, Italy
e-mail: lpani@unica.it
lorenafrancesconi@libero.it; james.14@tiscali.it
URL: http://people.unica.it/luisapani/

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ABSTRACT

This paper highlights the possibility of using structural concrete debris, also with modest mechanical performances (Rck ≤ 20 MPa), in order to obtain coarse recycled concrete aggregates to produce new structural concrete with higher performances. A specific case study concerned the recycling of the debris deriving from the total demolition of Cagliari football stadium concrete structures, to obtain coarse aggregates to produce new concrete. The results of the study point out the possibility of organizing recycling plants of secondary raw materials to produce coarse recycled aggregates deriving from onlyconcrete, with the same size distribution of natural aggregates, without necessarily having additional performance information of the parent concrete. The alternative use of recycled aggregates in place of natural ones for concrete production aims to preserve natural resources and, in consequence, to reduce the extension of landfills.

KEYWORDS

Recycled Aggregates; Mechanical Properties; Recycling

* The other authors are: Stefano Naitza, Ginevra Balletto, Giovanni Mei.

1 INTRODUCTION

It is well known that construction industries consume annually huge amount of aggregates, contributing to significant environmental losses. For this reason, the use of construction and demolition waste (C&DW) as alternative aggregate to produce new concrete limits the exploitation of natural resources and the extension of landfills.

Maximizing the amount of recycled materials among concrete components is a very effective and promising approach toward sustainable construction (Kovler & Roussel, 2011; Meyer, 2009; Rao et al., 2007). Available experimental data concerning concrete made with recycled concrete aggregate (RA) are highly variable and some authors (Padmini et al., 2009; Shi-cong Kou & Chi-sun Poon, 2015) claim that the quality of RA mostly depends on the quality of original demolished concrete used for recycling. Even if some results are contradictory, some general conclusions can be drawn about the effects of coarse recycled aggregate. For example, a recycled concrete (RC) with low to medium compressive strength can be easily obtained irrespective of the specific quality of recycled aggregates (Ajdukiewicz & Kliszczewicz, 2002; Etxeberria et al., 2007; González-Fonteboa & Martínez-Abella, 2008; Rahal, 2007; Tabsh & Abdelfatah, 2009).

The physical properties of RA strongly depend on the adhered cement mortar quality and amount (Etxeberria et al., 2007; Sánchez de Juan & Alaejos Gutiérrez, 2009). In general, the quantity of adhered mortar increases with the decrease of the recycled aggregate size (Etxeberria et al., 2007; Sánchez de Juan & Alaejos Gutiérrez, 2009). The crushing procedure also has an influence on the amount of adhered mortar. Due to the adhered mortar, RA has a lower density and higher water absorption, compared to natural one. Moreover, the presence of potentially un-hydrated cement on the surface of RA can further affect the concrete properties (Katz, 2003).

This paper shows that is possible to obtain structural concrete of strength class C30/37, using coarse RA obtained by crushing structural concrete with low compressive strength ($R_{ck} \leq 20$ MPa).

In this study, RA derives from concrete structures (foundations and cantilever beams) of the old football stadium located in Cagliari (Sardinia, Italy, construction year 1968). Before demolishing these concrete structures, tests were carried out to evaluate the mechanical performance of concrete. Part of foundations and cantilever beams have been demolished and crushed separately, to obtain two types of coarse RA, both with size 4 - 16 mm.

RC mixes have been produced using three different replacement percentage (30%, 50% and 80%) of natural aggregates with RA. A total of six RC mixes were produced, using separately the two types of coarse RA. In comparison an additional mix of normal concrete (NC) with

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only natural aggregates (NA) was produced. Further tests were carried out in order to obtain a full description of physical and mechanical properties of new made concretes, RC and NC. The final goal of this work is to strengthen the concept of sustainability in civil constructions combining the use of coarse RA to produce structural concrete with a low environmental impact.

2 EXPERIMENTAL INVESTIGATION

2.1 QUALITY OF PARENT CONCRETE

In the first phase of the research, the integrity and mechanical behavior of Cagliari football stadium concrete were analyzed. In a near future, the stadium will be demolished and created a new stadium with a modern design. The concrete structures chosen for the preliminary analysis are the cantilever beams and the foundation blocks. A total of 12 cored specimens were collected from both the foundation and the beams, respectively named C. Found and C. Beam. A preliminary visual inspection performed on the cored specimens did not highlight any abnormalities. In Tab. 1 the mean values of the tests conducted on the cored specimens are reported.

	DEPTH OF CARBONATATION (mm)	DENSITY (kg/m^3)	COMPRESSIVE STRENGTH (MPa)	ELASTICITY MODULUS (MPa)	TENSILE STRENGTH (MPa)
C. Found	10	2314	27.9	25335.3	2.04
C. Beam	31	2270	21.0	18041.6	1.49

Tab. 1 Mechanical performances of parent concrete

The experimental data show that the beams and foundations were made with two types of concrete and differ by mechanical properties, carbonatation state and composition. The mechanical behavior and the carbonatation state of the foundation are better than that of the beam. Moreover, definite compositional differences between the two materials are confirmed from petrographic analyses on thin sections. Under the polarizing microscope, the conditions of the concrete in both samples appear overall good. The samples are characterized by the presence of several types of aggregates, embedded in a fine cement matrix, which may be distinguished both by mineralogical composition and by size distribution. Polarized light microscopy analysis performed on sample C. Found revealed, in the fine cement matrix, the presence of a coarse fraction entirely made of centimetric angular fragments of micritic (cryptocrystalline) limestone. This component contrasts with a very varied siliciclastic fine-grained (millimetric to sub-millimetric) fraction, made of granite and metamorphic rock

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fragments, with quartz and feldspar free crystals; all the fragments are sharp-edged. Analyses on sample C. Beam indicate a more homogeneous siliciclastic composition, with a millimetric-centimetric fraction prevalently made of angular fragments of granite rocks with various types of metamorphic rocks (quartzites to metavolcanics), and a fine-grained, sub-millimetric fraction consisting of the same materials associated to free crystals of quartz, feldspars and biotite.

2.2 RECYCLED AGGREGATES

Two types of RA have been produced, called respectively recycled aggregate found (RA_F), obtained from crushed foundation blocks, and recycled aggregate beam (RA_B), obtained from crushed cantilever beams, both with size 4-16 mm. The two types of RA were subjected to all the tests complying with UNI EN 12620: 2008 and UNI 8520-1: 2015. In Tab. 2 the results are shown and in Fig. 1 RA size distribution is reported.
The analysis carried out showed that RA, even if obtained by crushing two different concretes, have very similar characteristics. In Tab. 2 it can be observed that only four parameters (Shape Index, Percentage of fines, Content of acid-soluble sulfate, Content of water-soluble sulfates) out of twenty-one are slightly different.

2.2.1 RESIDUAL MORTAR CONTENT IN RECYCLED CONCRETE AGGREGATES

In RA the adhered cement mortar to the original natural aggregate particles (RMC) influence significantly physical properties, workability, mechanical performances and durability of RC (Otsuki et al., 2003; Pani et al., 2011; Pani et al., 2013; Pani et al., 2013; Sánchez de Juan & Alaejos Gutiérrez, 2009).

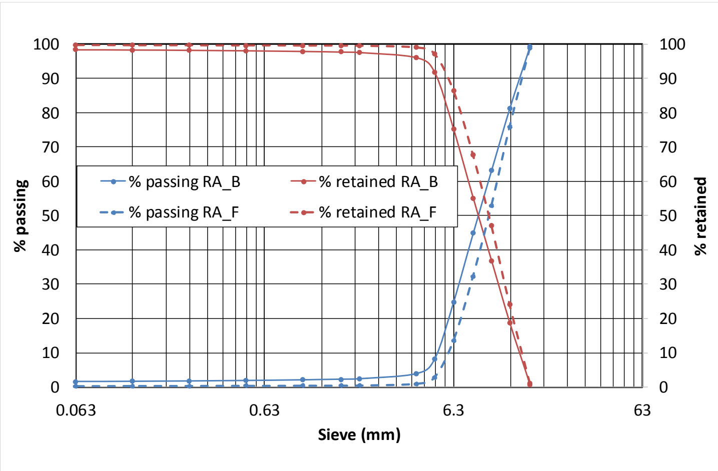

Fig. 1 Recycled aggregates size distribution

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Previous studies have attributed the reduction in compressive strength of RC (Tavakoli & Soroushian, 1996) and in modulus of elasticity (Salem & Burdette, 1998), compared to NC, to the presence of old mortar adhered.

The determination of the RMC is of critical importance to better understand/evaluate the properties of concrete incorporating RA. However, there is currently no standard method for the RMC determination.

The method used in this research, proposed by Abbas et al. in 2007, consists in submitting representative samples of the RA to daily cycles of freezing and thawing in a solution of sodium sulphate. The RMC obtained in RA_F and RA_B, divided into two fraction sizes (retained by 4 mm and 10 mm sieve), is shown in Tab. 3. The test shows that RMC is significantly similar for RA_F and RA_B.

PROPERTY	RA_F	RA_B
Size designation	4/16	4/16
Category grading	G_C 90/15, G_T 17.5	G_C 90/15, G_T 17.5
Flakiness Index	4	4
Shape Index	59	34
Saturated surface-dried particle density	2.39 Mg/m^3	2.38 Mg/m^3
Loose bulk density and voids	ρ_b = 1.23 Mg/m^3 v% = 45	ρ_b = 1.14 Mg/m^3 v% = 49
Percentage of fines	0.15%	0.59%
Percentage of shells	absent	absent
Resistance to fragmentation	39	39
Constituents of coarse RCA	X = 0; R_c = 74%; R_u = 27%; R_b = 0; R_a = 0; R_g = 0	X = 0; R_c = 78%; R_u = 22%; R_b = 0; R_a =0; R_g = 0
Content of water-soluble chloride salts	0.005%	0.005%
Content of acid-soluble chloride salts	0.325%	0.325%
Content of acid-soluble sulphate	0.43%	0.26%
Content of total sulfur	S < 0.1%	S < 0.1%
Content of water-soluble sulphates	SS = 0.148%	SS = 0.068%
Lightweight contaminator	absent	absent
Water absorption	WA_{24} = 7.0	WA_{24} = 6.7
Resistance to freezing and thawing	41%	42%
Resistance to magnesium sulphate	2.56%	0%
Presence of humus	absent	absent

Tab. 2 Recycled aggregate test results

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RESIDUAL MORTAR CONTENT IN %	RA_F	RA_B
Sieve Retained 4 mm	55.81%	49.67%
Sieve Retained 10 mm	45.82%	45.65%

Tab. 3 Residual mortar content

2.3 CONCRETE

CEM II/A-LL 42,5 R was used in all concrete mixes. Coarse natural and coarse recycled aggregates were used. Crushed natural granite was used as the natural aggregate. Two type of recycled aggregates (RA_F and RA_B) were used. Natural sand was used as the fine aggregate in all concrete mixes. A super plasticizer based on polycarboxylate was used in all the concrete mixtures. RC mixes were produced using different replacement percentages (30%, 50% and 80%) of coarse RA replacing coarse NA.A total of six RC mixes were produced, using separately the two types of coarse RA. In comparison an additional mix of NC with only NA was produced.

In Tab. 4 the proportions for each mix produced are shown. The mix of RC was designated to include type of coarse RA and aggregate replacement ratio. For example, the designation RC_F 30% represents a mix containing RA_F with replacement percentage 30% and RC_B 80% represents a mix containing RA_B with replacement percentage 80%.

	w/c RATIO	CEMENT (kg/m^3)	WATER (l/m^3)	FINE NA (kg/m^3)	COARSE NA (kg/m^3)	COARSE RA_F (kg/m^3)	COARSE RA_B (kg/m^3)	ADDITIVE (kg/m^3)	DENSITY (kg/m^3)
NC	0.463	400	185	847.49	880.06	-	-	2.91	2322
RC_B 30%	0.463	400	185	821.8	616.04	-	263.69	3.31	2293
RC_F 30%	0.463	400	185	821.8	616.04	263.69	-	3.31	2287
RC_B 50%	0.463	400	185	802.97	440.03	-	440.27	3.31	2298
RC_F 50%	0.463	400	185	802.97	440.03	440.27	-	4.00	2283
RC_B 80%	0.463	400	185	778.15	176.01	-	703.96	4.00	2268
RC_F 80%	0.463	400	185	778.15	176.01	703.96	-	4.00	2229

Tab. 4 Mix proportions of concretes

2.4 CONCRETE TESTS

The workability of the fresh concrete was measured using the standard slump test procedure. Test were performed soon after the mixing process was completed and then after 30 minutes. Values are shown in Fig. 2.Slump values of the RC mixes are very similar to NC. Compressive

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and splitting tensile strengths test wereperformedaccording to UNI EN 12390-3: 2009 and UNI EN 12390-6: 2010. The compressive strength test for each mix was determined at 14 and 28 days, while splitting tensile strength and modulus of elasticity were determined at 28 days.

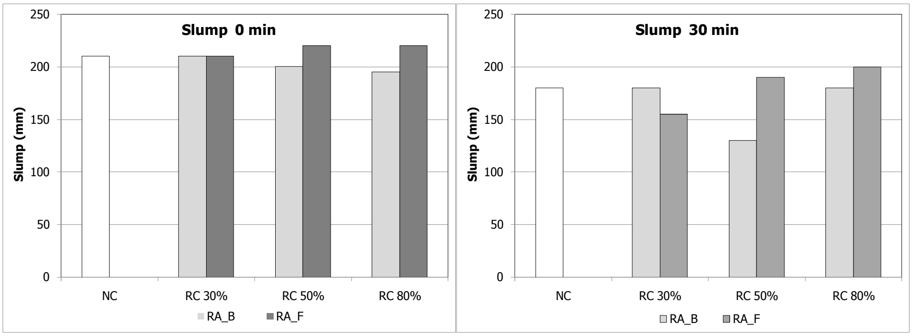

Fig. 2 Slump test immediately and 30 min after

The results of the average compressive strength at 14 and 28 days (Fig. 3) show optimal performance even when the percentage of coarse RA reaches 80%.

It should also be noted that the compressive strength of RC does not appear to be influenced by the parent concrete. Rather it results that, in some cases, the compressive strength of RC is higher than NC. Splitting tensile strength (Fig. 4) is greater or equal for all RC, compared to NC. This result was expected and can be explained by the greater roughness of RA, that produces an increase in tensile strength of concrete.

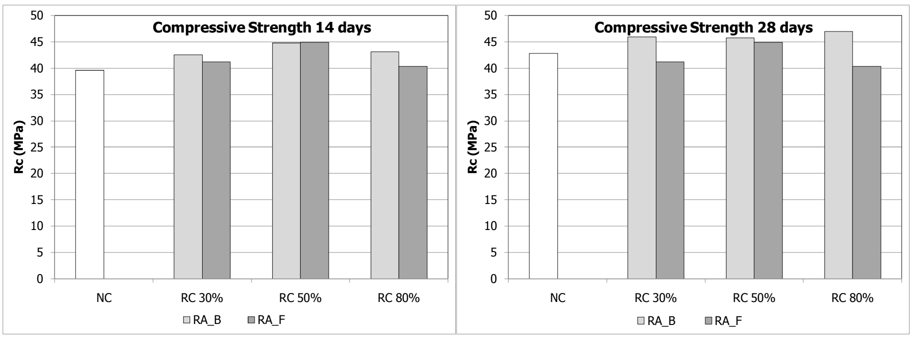

Fig. 3 Compressive strength of concrete at 14 and 28 days

The secant modulus of elasticity in compression (Fig. 5) appears slightly lower (limited to a maximum of 10%) for RC compared to NC. This result was expected and mainly due to the adherent mortar (Salem & Burdette, 1998). The durability tests on concrete are in progress.

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The first results obtained confirm the optimal performance of RC even when the replacement percentage reaches 80%.

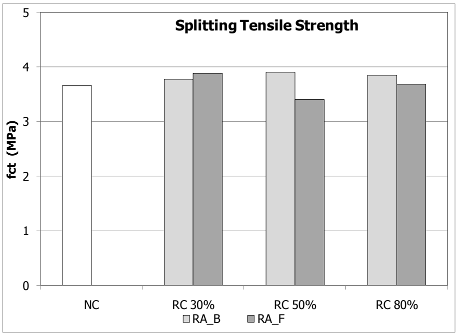

Fig. 4 Splitting tensile strength of concrete

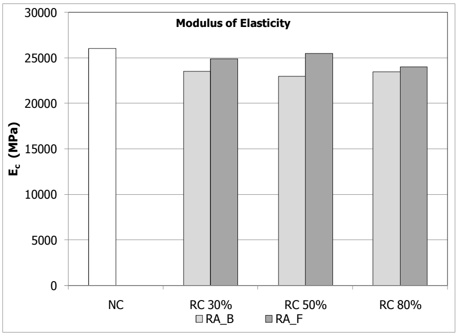

Fig. 5 Modulus of elasticity of concrete

3 ENVIRONMENTAL SUSTAINABILITY IN CIVIL CONSTRUCTIONS

C&DW materials, according to the Italian Legislation and stated in art.184 of the Legislative Decree 152/06, are considered part of special waste. The C&DW possess great potential for reuse, but are generally disposed in landfills, or abandoned abusively with serious environmental consequences. In Italy, the use of C&DW materials has been limited, after the processing of waste from secondary raw materials, loose fill material and for road foundations. In other European countries the resistive and profitable: they are in fact used for more nobleusessuchas structural concrete. The composition of C&DW is extremely variable depending by many factors: local building techniques, economic activity and technological development of the area, the type of raw materials locally available are factors that influence the composition of debris. The cost of waste disposal, although varying from area to area,

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depends strongly on the distance between the demolition site and the storage facility and is continuously increasing, given the progressive decrease in the number of landfills.
The recycling of the demolished material meets, therefore, both the needs of the operators in the sector, whose the possibility of inserting into the production process what was initially a waste, eliminating the cost of disposal, and the needs of the Public Administrations, facing the environmental issue. It is not possible to accurately identify the differences in price between RA and NA, normally the price of RA is about half of NA.
During demolition, generally, an undifferentiated stream of debris is produced, consisting of heterogeneous fractions, that make difficult any type of recovery operations and compromise a possible use for manufacturing concrete. In this perspective, the strategic role of waste mapping to allow maximum recovery of demolition materials (Baiani & Altamura, 2018) and a preliminary separation of the materials can be convenient, for a future re-use of waste. It would therefore be very useful to advise waste mapping and selective demolition techniques.
The resulto the RC characteristics produced with RA (Francesconi et al., 2016; Stochino et al., 2017) must encourage recycling plants to offer different iated materials immediately marketable, concrete production plants to supply RC to guaranteed performance and the Public Administrations to draw up Specifications for both RA and RC.

4 CONCLUSIONS

The present research has highlighted that:

- recycled concrete produced with coarsere cycled aggregates has shown equivalent mechanical performances then those of normal concrete, evenwhen the natural aggregates replacement percentage reaches 80%.
- the performance of recycled concrete is not related to the parent concrete mechanical characteristics.
- the results evidenced that the care in the study of the design of the concrete mix is fundamental for competitive recycled concretes.
- the durability tests on recycled concrete are in progress; preliminary results show the optimal performance of recycled concrete even in the long term.
- waste mapping and selective demolition should be promoted and enforced wheneve rpossible. These are: 1) absolute necessities in order to obtain RA for its use in construction, and 2) good practices for environmental sustainability.
- following the results presented and the extensive international literature on the topic, Public Administrations must produce specifications that allow the use of recycled concretes.

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AUTHOR'S PROFILE

Luisa Pani is Assistant Professor in Structural analysis and design, Teacher of Structural analysis and design to Faculty of Engineering and Architecture at the University of Cagliari. Research areas: Structural restoration, Experimental and theoretical behavior of normal, high and very high strength concretes, fiber reinforced concrete and concrete made with recycled aggregates.

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Lorena Francesconi is Ph.D. in Structural Engineering, main topics of research: the use of recycled aggregates to produce structural recycled concrete, study and characterization the behavior of C&DW and structural recycled concrete to verify the potential applications.

James Rombi Ph.D. in Structural Engineering, main topics of research: the use of C&DW materials and Granite by-products deriving from Sardinian quarry industry to be used in road pavement layers, study the behavior of C&DW materials in real working conditions to verify the potential applications.

Stefano Naitza is Assistant Professor in Economic Geology, Teacher of Economic Geology to Faculty of Sciences and of Geo-resources to Faculty of Engineering and Architecture at the University of Cagliari. Research areas: geology and genesis of mineral deposits; Critical raw materials; Geo-resources sustainability and recycling; Environmental characterization and assessment of pollution in past mining sites.

Ginevra Balletto is Associate Professor in Urban and Territorial planning. Research areas: geo-resource planning and recycling. She participated in the international competition for the concept of the new Cagliari stadium (2018), referent urban planning and environmental sustainability.

Giovanni Mei is Ph.D. in Geoengineering and Environmental Technologies, main topics of research: production, quantity, quality and useof C&DW.

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GEODESIGN FAST-WORKSHOPS EVIDENCES

ON FIELD APPLICATIONS OF COLLABORATIVE DESIGN APPROACH FOR STRATEGIC PLANNING AND URBAN RENOVATION

FRANCESCO SCORZA

School of Engineering, University of Basilicata
Laboratory of Urban and Regional Systems
Engineering (LISUT), Italy
e-mail: francesco.scorza@unibas.it
URL: www.lisut.eu

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ABSTRACT
The paper presents a critical overview of the main evidences deriving from the development of two GEODESIGN workshops on the same case study: urban regeneration programs in Gravina in Puglia. The field work experiences allowed to reinforce methodological awareness and its application with heterogeneous focus group. The methodological appraisal is mainly oriented to highlight positive evidences in workshop management. The case study is representative of disciplinary debate on Urban regeneration approach in fragile ancient-historic settlement and for the specific thematic focus (Systems) on which the territorial assessment process had been delivered (evaluation maps). Urban regeneration is a complex issue strongly characterized by case study structural features or bindings, actors and beneficiaries, promoters and owners. It is an effective interdisciplinary scope combining instances of architectural and technological disciplines but also social sciences and urban economy. We proposed such case study to two different focus group, whose participants were asked to negotiate strategic development scenarios starting from basic assumption and a thematic structure of context analysis. Geodesign meta-planning approach by C. Steinitz demonstrated its effectiveness as a tool to handle a "negotiation process" among different stakeholders for the achievement of a shared strategic scenario in a very short timeframe. Workshops were supported by GeodesignHub (an online platform by Geodesign Hub Pvt. Ltd., Dublin, Ireland), and were prepared according to Geodesign International Collaboration (IGC) standards.

KEYWORDS
Geodesign; Meta-planning; Strategic Design; Urban Regeneration

1 INTRODUCTION

At the end of the seventies, the "classical" period of the so-called systemic approach1, relevant elements of dissatisfaction about the transition from territorial analysis to critical stage of urban and territorial design persisted.

Such transition remained predominantly linked to the optimization attempt connected to Operative Research (Friend & Jessop, 1969) and to the flourishing production of simulation models (cfr. Wilson, 2016).

According to a "new rationality in planning approach", the rationality of decisions about citizens' needs and aspirations and the use of common goods and non-renewable resources must be considered as a citizen's right and so a prerequisite in the development of plan proposals. An approach whose structural methodological background (namely the "toolkit" (Las Casas & Scorza, 2016)) has to be focused on:

- collective learning processes: the awareness of the interaction of stakeholders and decision makers on a complex territorial system connected with relevant instances on social fabric, economy and environment;
- governance processes: that could be applied after the definition of objectives, means and activities, logical links between the achievement of the desired scenario and available means, an adequate system of indicators measuring effectiveness and efficacy.

Moreover the concept of sustainability has become a key theme of place/context based territorial development policies (Las Casas & Scorza, 2009) The "context" is identified not only with the natural or anthropized environment, but also with the system of public and private actors that will be involved in the transformations induced by the plan. Often, due to their different cultural background and their role in the decision-making process, they can have different views on priority development strategies. The core problem between territorial analysis (interpretation phase) and design is a problem of communication and shared understanding among heterogeneous actors. It may be faced – as sometimes solved - by effective collaboration between various parties involved in the design process (Ballal, 2015).

Similar principles appear to be particularly relevant with regard to the innovations that the European Directive 42/2001/EC promoted in the process of drawing up the plan with the introduction of Strategic Environmental Assessment (SEA), but they are not always implemented satisfactorily in planning practices (COWI, 2009; Fisher, 2010).The methodological enrichment brought by the SEA to urban and territorial planning process is

[1] Among the authors Mac Loughlin (1969) and Ghadwick (1971).

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very close to the concept of Geodesign, which is therefore able to provide a useful guide for a profitable innovation in practices (Campagna & Di Cesare, 2014). Recent developments in the disciplinary debate on urban and territorial planning - in the United States of America, but also in Europe and Asia - propose the concept of Geodesign as a possible methodological framework for the territorial project (Campagna et al. 2016; Steinitz, 2012). Such dissemination of the GEODESIGN approach had been traced in the framework of Geodesign International Collaboration: a spontaneous network of scholars and research institute oriented to reinforce and spread out potential application of geodesign methodologies in concrete case study applications.

The recent meeting in Reedland (CA) in Feb. 2019 signed milestone of such academic and practitioner community interested in GEODESIGN applications and advances. Geodesign can be defined as the process of integration of methods, techniques and tools of GEO territorial information sciences to support the design and planning of physical development DESIGN. It can be described as a multidisciplinary collaboration with direct interaction among design professionals, geographically oriented scientists, and the people of the place, using available information technologies (Nyerges et al., 2016).

Geodesign proposes an integrated collaborative and participatory approach starts from the conceptualization of the project and continues with analysis, simulation, development of alternatives, and evaluation of impacts and the choice (between the various phases). Central in Geodesign, is the role of methods and tools of geographic information sciences (Goodchild, 2010) which today (thanks to a great availability of data and processing services) allow the construction of dynamic cognitive frameworks constantly updated. The aim is therefore to explicate and strengthen the relationships between knowledge, decision and action in the project.

This paper, as a development of previous studies (Fiore et al., 2018b) aims at reporting evidences deriving from geodesign workshop’s experiences delivered on the same case study area: Gravina in Puglia. In particular we refer to two workshops: the first was held in Gravina in 2018, the second was held in Matera in 2019. Both experiences can be defined as semi-simulated workshop: in fact, instead of decision-makers, young students and professionals was engaged in the workshop.

Participants were characterized by a strong technical background and a specific site knowledge.In the following sections the description of the case study areas is presented by the means of evaluation maps (systems land suitability elaboration concerning the local planning issues), the results of the workshops are synthetically summarized and final conclusions present success evidences of the implementation.

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2 CASE STUDY AND EVALUATION MAPS

The Municipality of Gravina in Puglia is located in the Murgia area between Puglia and Basilicata, at the limit between the calcareous plateau of the Murge and the "Fossa Bradanica". It is therefore included in a territorial function system between Matera (European Capital of Culture 2019) and Bari, which is going through an intensive tourist development perspective.

Fig. 1 S. Maria Assunta Cathedral, Historic center view of Gravina in Puglia

The historical center is characterized by a vast beauty of the traditional urban environment, with partially restored historic buildings, and a settlement in a unique landscape scenery: the Gravina. Various forms of settlements along the slopes of the Gravina on the calcarenitic outcrops have developed over the centuries.

Fig. 2 Fondovito and Piaggio neighbourhood in Gravina in Puglia

These settlements, which use the terraces as well as natural and artificial cavities, are the result of a close union between the geomorphological conditions of the places and the economic and social needs of the populations.

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The peculiar morphology of space has suggested the idea of recovery that takes shape through the principle of excavation and subtraction: ARCHITECTURE IN LEVING, consisting of digging and building in the same place, creating a sort of positive and negative: a city under the city. In fact, in ancient times, it was excavated in domestic quarries to use the material produced to build the above dwellings, such as the cave house, or cavati.

The historic center is therefore characterized by the presence of important neighborhoods that are in a state of neglect and degradation, with the presence of abandoned buildings that show structural weaknesses. These situations have caused over the years: depopulation, environmental degradation, the isolation of some areas and, at the same time, the inaccessibility to them.

The historic center has been the subject of urban regeneration in recent years, with specific interventions in three main areas of the historic center: on Via Giudice Montea – Cavati, along the monumental axis and in the Fondovito neighborhood.

According to GEODESIGN methodology, local context analysis were organized in 10 Systems. Each system represents a key layer we adopted to organize project knowledge. In the following Fig. 3 the 10 suitability maps (evaluation maps) are shown.

The basic planning assumption is related to three main current development issues for the "Gravina in Puglia" municipality:

- tourism development;
- protection and enhancement of cultural and environmental heritage;
- recovery of residency.

In facts, the municipality of "Gravina in Puglia", through a process of urban regeneration, aims to improve the habitability and liveability of the historic centre with targeted actions in the field of mobility, green infrastructures, protection and enhancement of natural environment, social policies and housing.

The potential project categories discussed during the workshop mainly regard:

- accessibility and sustainable mobility (promoting pedestrian and excursion practicability) through the recovery of paths, historical and internal roads to the historical centre;
- increase of territorial security (urban resilience);
- defence and enhancement of historical, architectural and environmental heritage;
- redevelopment, re-use and establishment of new urban functions in public and private building stock;
- sustainable tourism (favouring the establishment of tourist, cultural, commercial and handicraft activities).

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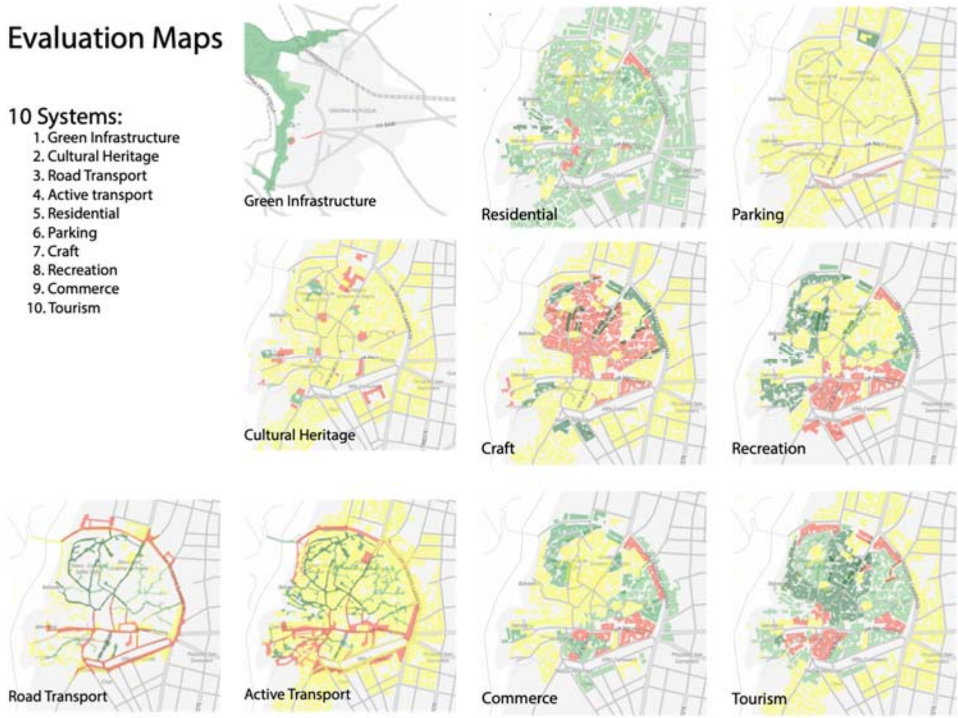

Fig. 3 Evaluation Maps on 10 Systems for Geodesign workshop

3 WORKSHOPS REPORTS AND FINAL REMARKS

The two workshops were started in different contexts: the first one, held in Gravina, had been developed in the research carried out by Pietro Fiore for the preparation of his Master thesis, the second was organized by Prof. Piergiuseppe Pontrandolfi in Matera Campus as a seminar for architecture students. Both were conducted in a very short time frame: about 6 hours. Such organization depended on specific instances of participants (difficulties in attending 2 days agenda) or deriving from the framework structure of organization (i.e. the university seminar has to be schedule in 1 day at least).

In the following list, the main positive aspects characterizing the two experiences are quoted. They are key points deriving from the methodological framework of GEODESIGN and from the perception of participants' satisfaction/engagement in active participation in the workshop:

- GEODESIGN as a method (and as a process) works! In fact, according to very synthetic presentation and introduction on the methodological framework and case study assumptions given at the very beginning of the activity, participants mainly understood

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the procedure and handle the tools proposed by conductor during workshop implementation;

- GEODESIGN HUB, as a fundamental ICT tool, works! The success of the process depends on the easy-to-use feature of Geodesign Hub platform. It is an online framework, provided by H. Ballal (Ballal, 2015), fully oriented to procedural implementation of Geodesign Workshop. Each participant registered an individual account managing his own interaction in the process, and progressively groups of users are managed through the platform and the final stage of negotiation was supported by;
- Short time frame is nice but …. The workshop delivered in a very short time frame demonstrated that the strongest and effective features of GEODESIGN as a method. In fact, 1 conductor is sufficiently able to handle all phases of the workshop in a framework of participants enough committed with the general scope of the territorial application. On the contrary, during field activities, it becomes more and more important to dedicate time on the explanation of local contexts analysis. Even if evaluation maps represents an understandable way of managing synthetic and thematic elaboration for the design phase, participants expressed the willingness to go in deep and to understand more about those analytical processes and assumptions which allowed to deliver such suitability maps.

The following picture represents in a schematic way the workshop results. More than to explore details of designs selected/negotiated by the groups of participants, it was useful to understand how, starting form blank page the workshop, in almost 6 hours, participants delivered a synthetic strategic development scenario, integrating several domains of interventions (the 10 systems), operating in an interaction environment basically focused in the identification and discussion of specific "designs". The territorial dimension is a fundamental feature for each design: you have to draw it on the map. This represents a critical stage of the conceptual elaboration which drastically simplifies the proposal and the comparison between competitive ones. In fact, the participant in order to provide a potential solution to a specific need of the context, he has to produce not a generic narrative (potentially vague) of an intervention category, but a place-based intervention. This approach allow the benchmark with other proposal and at least facilitates the capacity of participants to agree on a common set of designs to be included in their shared scenario.

The research development looks at reinforcing application structure of the methodology over real decision-making process concerning territorial transformation. A specific feature of the contribution that the LISUT group intends to develop in the wider framework of Geodesign International Collaboration is to combine (at least integrate) GEODESIGN with Logical Framework Approach methodology. The second represent a rational structure in order to

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identify and organize in a cause-effect relation the territorial problems at the basis of a planning activities, producing synthetic tools for the strategic program structure identification and monitoring. GEODESIGN represents the effective way to manage interactions in decision making process on a collaborative and inclusive participatory structure. Combination of such approaches promises to be effective with potentials to be applied extensive as a fundamental component of the planning toolkit.

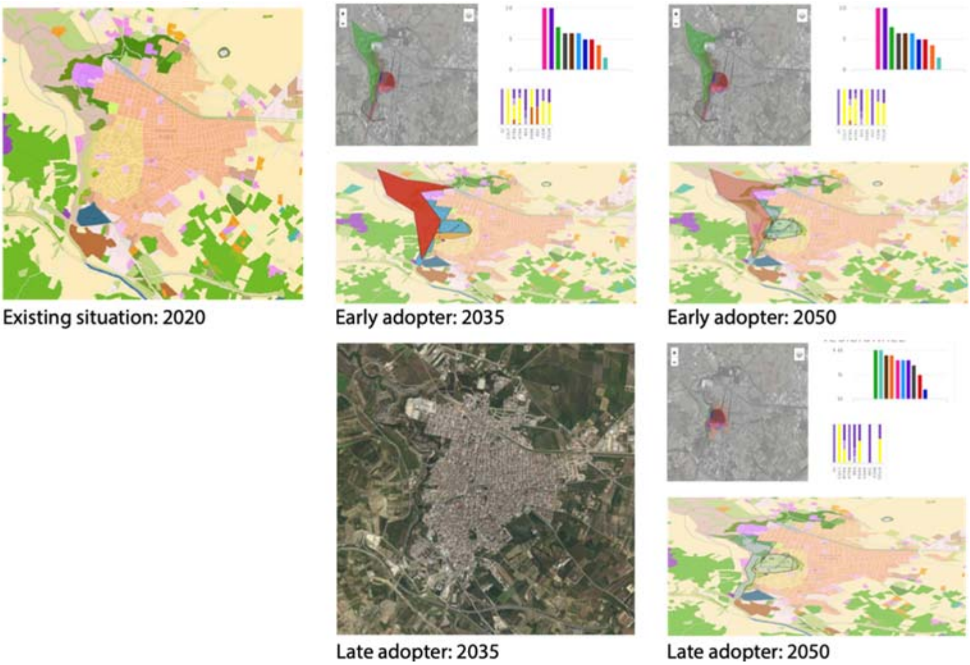

Fig. 4 Strategic design delivered in the Geodesign workshop in Gravina in Puglia

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AUTHOR'S PROFILE

Francesco Scorza is Assistant Professor of Urban and Regional Planning at University of Basilicata. Main research interests are in regional development, urban and regional planning, impact assessment of plans and projects, advanced KMS, spatial analysis, participation, sustainability, technologies as DSS. Coordinator for the participation of UNIBAS in International Geodesign Collaboration (IGC).

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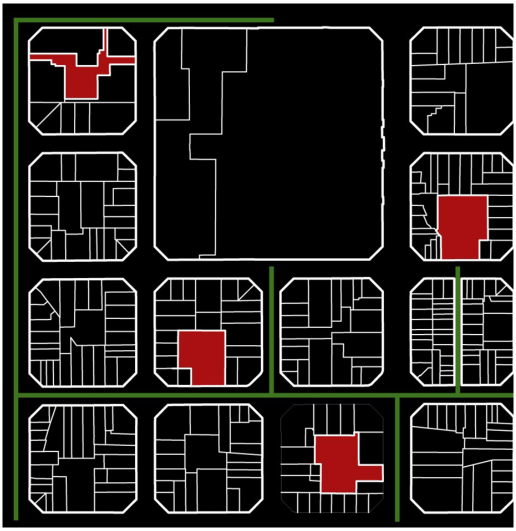

GREEN INFRASTRUCTURE AS A TOOL OF URBAN REGENERATION, FOR AN EQUITABLE AND SUSTAINABLE PLANNING

AN APPLICATION CASE AT L'EIXAMPLE, BARCELONA

CLARA ALVAU MORALES, TANJA CONGIU ALESSANDRO PLAISANT

Department of Architecture, Design and Urbanism University of Sassari, Italy
e-mail: claralvau@tiscali.it
tanjacongiu@uniss.it
plaisant@uniss.it

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ABSTRACT

Green infrastructure concept, as a possible solution to tackle some territorial challenges, is mainly applied on a territorial scale, while on the urban one it's still little explored. This study questions the green infrastructure value as a spatial device in urban regeneration processes, proposing a reinterpretation and an operative method of project action. The proposed green infrastructure model incorporates and combines the environmental and sustainable components, with those of urban life organization (activities and services, transport, quality of open and built-up area) and helps to improve their quality and mutual relationships. The description of specific requirements and the definition of indicators by which to measure the context starting conditions and the transformation effects, guide the decision-maker in carrying out the interventions, mainly through the requirements of multi-scalarity, accessibility, environmental sustainability, spaces and services quality and comfort and urban resilience. The model is applied to the districts of L'Esquerra de l'Eixample in Barcelona, characterized by high population density, pollution problems and lack of greenery. It acts on three interconnected different scales: urban, through linear interventions that build connections and continuity; neighborhood, with smaller but distributed interventions on block interiors; local, linking the scattered elements in the territory portions through paths. An integrated system of public spaces, services and green areas is thus outlined, guaranteeing access to urban opportunities by developing a system of connections alternative to motorized traffic able to connect the population with natural and anthropic resources and with the urban settlement new life centers.

KEYWORDS
Urban Green Infrastructures; Ecosystem Services; Connectivity, Accessibility and Mobility

1 INTRODUCTION

The Green Infrastructure (GI) concept (Andreucci, 2017; Angrilli, 2010; Benedict, 2006; EC, 2013; Natural England, 2009), even if appeared in the literature in fairly recent times (Benedict, 2002; EC, 2009; Landscape Institute, 2009; Natural England, 2009; Trust for Public Land, 2000), has been implemented widely on a territorial scale by demonstrating the great effectiveness of this approach, in facing the major challenges for the sustainability of people and their living environment. On the contrary, on an urban scale, despite the numerous studies emphasizing the constitutive elements and its benefits (Angrilli, 2003; Benedict, 2006; EEA, 2011a; Gill, 2007; Hansen, 2017; Landscape Institute, 2009; Zanon, 2003), it turns out to be a less explored approach, as the implementation in real urban contexts generated various difficulties due to the complex and composite nature of cities. In this paper, we propose a new concept of urban green infrastructure which brings together the multiple components of built environment and, through a multifunctional and interscalar approach (Andreucci, 2017; EEA, 2011a; Lafortezza et al. 2013; Landscape Institute, 2009; Scudo, 2003; Shashua-Bar, 2000) goes beyond the original conception of a network of existing and new natural spaces. With this purpose, the proposed green infrastructure model incorporates and combines the spatial components with ecological functionalities, with some important elements of urban life organization (activities and services, transport facilities, open and built-up areas, ...), with the aim of improving their single specific qualities and enhancing their mutual relationships. The new green infrastructure identifies a system of well-connected natural and human-made elements, which constitute a new base at support of society, economy and territory and necessary for the generation and fulfillment of efficient urban ecosystem services (COM, 2009; EEA, 2010). According with this conception, an operative method for planning and design the revisited concept of green infrastructure at urban scale is proposed together with an application in two districts of Barcelona (Spain). The methodological and operational discussion offers the opportunity to highlight the great potential of the proposed spatial model as an operational tool for urban regeneration processes. The article is structured as follows: in the first section, we introduce our formulation of urban green infrastructure with respect to the cultural evolution of the concept. In section two we describe an operative method of project action centered on GI concept, intended to guide urban regeneration processes at urban scale. The method consists in the identification of 4 dimensions to act, declined in targets to be pursued, requirements to be met and corresponding possible lines of action. A set of indicators to be considered for measuring both the starting conditions of the context and the effects of transformations is also provided. Finally, the practical application in the district of the Esquerra de l'Eixample in Barcelona, gives

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evidence to the potentialities of the proposed planning model as a multidimensional generator of relationship from the urban to the neighborhood scale.

2 METHOD

The main qualities of GIs are their multi-functionality and intercalarily, that is the ability of the model, on the one hand to provide different linked functions and advantages on the same area, on the other the applicability and replicability of this model on different spatial scales (Allen, 2012; Bolund, 1999; City Council of Vitoria-Gasteiz, 2014; EC, 2013; EEA, 2014). The importance of this approach in the urban environment comes up immediately if we think of the number of environmental problems that affect the livability of cities: heat island effect, environmental and noise pollution, lack of green areas, and water management. However, the quality of life in cities also depends on the availability, efficiency and effective accessibility to urban opportunities.

In other words, the livability of cities depends on a sensible and efficient organization of the ways people practice the urban space. Therefore, there also arises the need to integrate within the GI urban elements and hubs of social, cultural and commercial activities such as public services and offices, open and built-up spaces, libraries markets, schools, sport and cultural associations, gyms, commercial activities of different scales, medical clinics, museums, etc. All these elements are apparently extraneous to the traditional conception of a GI but represent instead the daily life in all its urban diversity and variety. As such we believe they can establish a synergy with the green components, thus giving shape to a new concept of GI. This need to expand the urban GI concept and include new structural elements, comes from a detailed analysis on the requirements that recent urban regeneration models, like Arup (2013), 100 Resilient Cities, Community hub, PPS, take into consideration: all together they provide an exhaustive overview of the contemporary urban condition , but above all they highlight fundamental requirements to lead a process of urban regeneration.

The model we propose gives prime importance to the integration of four dimensions of urban life which refer to four different research areas: environmental quality, protection of nature and biodiversity, quality of life and social capital and organization of urban settlement. Such dimensions are currently studied and planned as separate domains. We focus our attention on the mutual correspondences and the operative interventions to make them interact.

The four dimensions structured into targets, requirements and indicators, led to the definition of an experimental interpretative and planning model which elects Urban Green Infrastructure as an operational approach for urban regeneration. The model combines elements and

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indicators common lyutilized and experimented in previous studies on GI with others aspects established ex-novo with the aim of achieving multifunctionality and transversality.
The set of indicators included in the model takes into consideration on the one hand features typical of conventional concept of green infrastructure such as green areas for mitigation of pollution ordecline of built environment,; on the second hand indicators refer to other structural components of the city that in our opinion are essential to increase urban liveability and well-being, because of the relationships established at different scales with the first group of elements. For example, the availability, variety and accessibility to facilities and public spaces that enhance the opportunities for social interaction and healthy lifestyles.

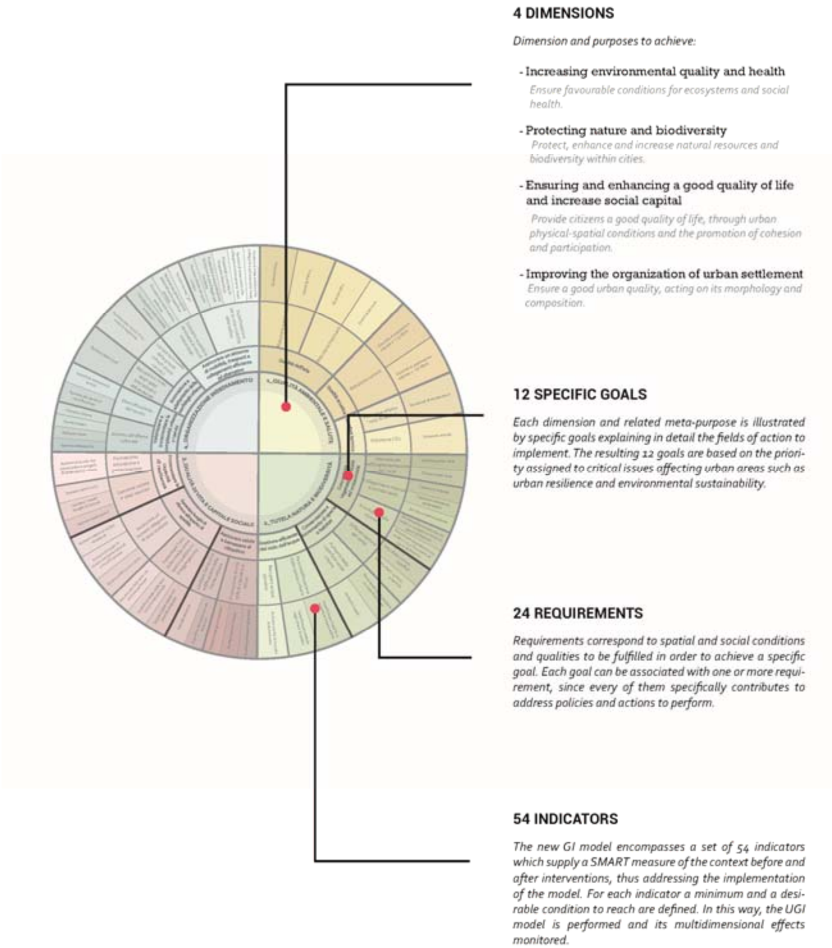

Fig. 1 Model structureproviding a description of the new urban green infrastructure approach (own elaboration)

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3 CASE STUDY

3.1 STUDY CONTEXT

The model has been implemented in the neighborhood of *Esquerra de l'Eixample* in Barcelona. This district is characterized by highlevels of building and population density, air and noise pollution, traffic congestion and lack of open spaces and greenery (see Fig. 2).
By considering the high density of people and buildings, (390.6 inh/ha against the city average of 158.7 inh/ha) and the opposite low level of greenery, it's clear the predominance of massive buildings, mainly private, over public open space. As a consequence, he borough presents alack of pro-capitagreen areas (1.47 m^2/inh, against an urban average of 7.1 m^2/inh) as reportedby the Statistics Department of Barcelona which recommends a minimum standard of 5 m^2/inh. (2018).
With regard to air pollution, the particulate and NO2 values (PM10 and PM2.5) result both above the maximum limits regulated by the World Health Organization, while more than 70% of the population is exposed to noise values higher than those allowed during daytime (and 75% higher than nighttime threshold) (Aspb, 2017; City Council of Barcelona, 2012).
Public spaces are limited in number and extension (1.12 m^2/inh. against an urban average of 7.85 m^2/inh. - minimum value 10 m^2/inh.) together with pedestrian areas (only 11% of the total area) in favor of motorized mobility (Statistics Department of Barcelona, 2018). Despite these unfavourable measures, the neighborhood presents several potentialities to be enhanced and made fruitful by mean of a UGI project.
For example the regular street and block pattern together with the plentiful space devoted to mobility offer a high connectivity between functions and the possibility to diversify transport modes in favour of sustainable ones which result more convenient and pleasant; the presence of scattered courtyards accessible to the public which accommodate local services and the reclamation of small-scale public places by local non-profit organisations and groups of residents represent tangible evidences towards the construction of a system of public spaces which combine urban resilience-oriented functionalities typical of GI with increasing opportunities of access to urban amenities and social cohesion. The integration of these dimensions in a new UGI enhance the city antifragility (Blecic and Cecchini , 2016).

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MODEL				INDICATORS VALUES						
DIMENSIONS	GOALS	REQUIREMENTS	INDICATORS	ESQUERRA DE L'EIXAMPLE	EIXAMPLE	BARCELONA	REFERENCE	UNIT	YEAR	SOURCE
Protecting nature and biodiversity	Vegetational vertical and horizontal connectivity	Innovation in green implementation	Number of green walls	0	13	156	-	Unit	2018	Own elaboration
			Number of green roofs	5	14	126	-	Unit	2018	Own elaboration
		Natural connections and green corridors	Tree cover	6.2	-	-	-	Ha	2018	Own elaboration+Departament d'Estadística i Difusió de Dades de Barcelona
			Tree cover on total green	41.80%	-	-	-	%	2018	Own elaboration
			Wealth of tree species	18	-	-	-	Unit	2014	Agencia d'Ecologia Urbana de Barcelona. 2014
		Resources accessibility	Population percentage with green > = 1000m² at less than 300 m	50.43%	-	-	-	%	2017	Own elaboration
			Population percentage with green> = 3.5 ha at less than 750 m	24.70%	-	-	-	%	2017	Own elaboration
	Conservation and increase of species and habitats	Differentiation of green	Number of urban and community gardens	12	44	392	-	Unit	2018	Departament d'Estadística i Difusió de Dades de Barcelona
			Number of urban parks	1	4	86	-	Unit	2018	Departament d'Estadística i Difusió de Dades de Barcelona
		Increase of the green urban surface	Public green percentage on total area	5.75%	6,52%	27,85%	-	%	2018	Departament d'Estadística i Difusió de Dades de Barcelona
			Green per capita	1.47	1.83	7.1	5,0 MIN	m²/hab	2018	Departament d'Estadística i Difusió de Dades de Barcelona
	Efficient management of the water cycle	Permeabilization of urban space	Permeable surface on waterproof surface	5.75%	6,52%	27,85%	-	%	2018	Departament d'Estadística i Difusió de Dades de Barcelona
			Permeable surface in internal blocks	28916	-	-	-	m²	2018	Jardins interiors d'illa de l'Eixample Barcelona
		Rainwater recovery	Number of rainwater collection tanks	4	4	35	-	Unit	2018	Barcelona sostenible
Ensuring a good quality of life and increasing social capital	Ensuring health and wellbeing for citizens	Promotion of a healthy and active lifestyle	Number of outdoor sports areas	2	4	44	-	Unit	2018	Departament d'Estadística i Difusió de Dades de Barcelona
			Number fitness trail	2	4	33	-	Unit	2018	Departament d'Estadística i Difusió de Dades de Barcelona
			Number of playgrounds	20	90	871	-	Unit	2018	Own elaboration
		Limit the excessive construction of the urban plot	Surface intended for residential use	132.3	372.1	2590	-	Ha	2016	Departament d'Estadística i Difusió de Dades de Barcelona
			Population density	390.6	356.3	158.7	-	ab/ha	2016	Own elaboration
	Ensuring outdoor spaces quality	Increase the use of the streets as a public and aggregation space	Number of streets with pedestrian priority	1	-	-	-	Unit	2018	Own elaboration
			Total area of the areas with pedestrian priority	2.8	8.7	126.8	-	Ha	2016	Own elaboration
			Percentage of areas with pedestrian priority	3.25%	3.22%	5.60%	-	%	2018	Departament d'Estadística i Difusió de Dades de Barcelona
		Ensure an adequate number of public spaces	Public space per capita	1.12	2.15	7.85	10 MIN	m²/hab	2016	Own elaboration
			Number of intergenerational and multifunctional meeting places	18	-	-	-	Unit	2018	Own elaboration
			Number of recovered internal blocks	15	45	77	-	Unit	2018	Jardins interiors d'illa de l'Eixample Barcelona
	Increasing resilience capacity	Social cohesion and egalitarian spaces	Number of associations	450	933	6611	-	Unit	2018	Own elaboration
			Number "casals" (meeting places)	6	25	240	-	Unit	2018	Own elaboration
			Number of civic centers	2	6	51	-	Unit	2018	Own elaboration
		Training, education and participation	Number of schools participating in urban sustainability projects	13	33	350	-	Unit	2018	Own elaboration
Improving the organization of urban settlement	Enhance and increase urban complexity and services	Access to cultural opportunities	Number of libraries	2	9	68	-	Unit	2018	Own elaboration
			Number of museums	0	14	69	-	Unit	2018	Own elaboration
			Number of theaters	4	19	107	-	Unit	2018	Own elaboration
			Number of cinema	4	13	39	-	Unit	2018	Own elaboration
			Proximity to "bicing" station or parking	100%	-	-	-	%	2018	Own elaboration
			Proximity to alternative transport network	100%	-	-	-	%	2018	Own elaboration

Fig. 2 Operationalisation of the UGI: selection of indicators and their measure in the study context (own elaboration

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3.2 PROJECT ACTIONS STRATEGY

In order to implement the proposed new model of UGI, the project actions have been subdivided into three categories (activator, supporting and completing projects) and three intervention scales (urban, neighborhood and local scale). A constant attention to the processuality, multifunctionalty and multiscalarity of actions lead the implementation of the revisited model of urban green infrastructure.

Fig. 3 Project strategy

The activator projects trigger the district regeneration process because of their potential to activate new spatial and social relationships by responding to specific needs of inhabitants at the local and metropolitan scale.

These projects are drawn from the policy programs of the municipality.

They include urban-scale and neighborhood-scale interventions.

At the urban scale two axes play a structuring role by connecting the neighborhood with important nodes of services at the metropolitan scale: the north-south axis, Carrer Borrell,

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connects Av. Diagonal to the Old Town by Sant Antoni neighborhood; the west-east axis, Av. de Roma, connects to Sants railway station and the rest of the city.
These roads, currently used for vehicular traffic, become new tree-lined boulevards that link residents to possible destinations through a space suitable for walking, cycling and resting that encourage social relationships and simultaneously mitigates urban disturbances. The road section is redesigned making space to non-motorized mobility and areas for collective use. Interventions incorporate ecological and social functionalities respectively aimed at reducing environment decline processes such as soil permeabilization, noise and air pollution, greenery fragmentation and enhance public health and well-being (easier access to green areas, public spaces and playgrounds and greater capacity of outdoor activities, socialization, physical activity).
At the neighborhood scale, a pivotal role is assigned to the ongoing urban reclamation process of block interiors, endorsed by the City Council of Barcelona (2013) and some associations of citizens. A number of block interiors have been converted into new small-scale public spaces, often encompassing community services and green areas (job placement, welfare, recreation center, sports equipment, playgrounds, parks…)with the attempt to increase the supply of urban facilities, getting ecosystem services available and closer to as many residents as possible. Moreover, the involvement of group of citizens in the rehabilitation and maintenance of the network of block interiors enhance the social potential of these UGI components as meeting and cohesive places at the neighborhood scale. As such they act as activating elements of social and spatial connections.
The supporting projects reinforce the effect and benefits generated by the activator ones and support them through actions aimed at consolidating and improving the former. They find strength and advantage from the activator projects, configuring themselves as an integral part of the overall project.
They include interventions at the local scale.
Interventions take advantage of the linearity and continuity of the urban fabric of the district, to increase the connectivity of the nodes of services important at urban and local scale. A regular network of tree-lined multimodal streets combining all transport modes ensures a safe, comfortable and convenient access to the existent and new urban centralities. In this way the accessibility to urban services increase because of the major number of alternatives available to reach opportunities as well as the propension of people for interaction and healthier lifestyles.
The Complementary projects take on a transversal nature by relating, involving them in the process, the precedents with the interventions already planned, whether in the neighborhood

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or in the adjacent territory. Complementary projects include, even interventions not belonging to the study area, but which may be influenced by the proposed design process.
They include intervention on a neighborhood and local scale.
Both on a neighborhood and local scale, following the criterion of replicability and interscalarity, the extension of the application of the model to the rest of the neighborhood and district is expected. Therefore, other block interiors are identified, able to complete the processes and dynamics triggered within the neighborhood, through the pursuit of the same requirements previously taken into consideration and the relative identification of other internal paths that relate, as they do was described in projects of support, spatiality, entities and subjects within a smaller scale.
On an urban scale, the project is framed on linearity and continuity.
On a neighborhood scale, on and capillary interventions.
On a local scale, the two previous methodologies are integrated, partially acting in a linear way, combining the different elements scattered throughout the urban area.

3 CONCLUSIONS

The proposed model operates on different levels in a transversal way, leveraging on some aspects and factors that drive the urban renewal and support a different organisation of urban services and a better quality of life. It acts in particular on:

- plan of physical-spatial relationships;
- green infrastructure as an interscalar and intersectoral tool;
- green infrastructure as a relationship element, through an approach based on the diversification of the shape, not only linear.

It acts in a transversal way on the problems and critical issues of the context, integrating and relating to different scales and spheres of action, in a simultaneous and integrated manner. It also acts on the physical connections, between the elements present in the context, differentiating and adapting the type of intervention and its form: linear, capillary, mixed.

- Green infrastructure as an element of activation of social capital

If there were no stakeholders, with participation and attachment to the place, by virtue of a care, quality and redevelopment of the spaces, the interventions would take on less force. The development of social relations guarantees the resilience and continuity of the process, so that, paradoxically, projects on a local scale, where the subjects are closely involved in the process, in a direct and daily manner, could become stronger and more resilient than those managed directly by the municipality.

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- The green infrastructure as an element of coordination of the planning interventions of urban policies

With the aim of proposing a model of urban regeneration, there's the need to think of an integrated management model, which takes into account the different projects in progress, which integrate them and provide a design hierarchy, based on the effects that will determine and will trigger in the context, so as to be able to program a gradual and complete intervention, coordinated in a heterogeneous and transversal manner. We propose a reinterpretation of the conventional concept, by virtue of an operational method of orientation of the design action. Starting from a concept of green infrastructure exclusively referred to the environmental components, their ecosystem services and their importance in the urban context, we finally arrive at the structuring of a spatial device, a guide as, a guide for decision-makers to support urban regeneration processes. It takes into account 4 dimensions (management, natural, social and settlement) closely related to each other with a contextualised and precise approach, making this tool able to manage the urban context, its problems and solutions. In conclusion the approach allows to focus not only on the different and interrelated dimensions, but rather in the actual management of the features, social, urban, or political. Therefore, through the construction of environmental connections, first of all, spatial, social, between projects and the management of planning processes aimed at guaranteeing good living conditions in the space.

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AUTHOR'S PROFILE

Clara Alvau Morales, was born in Barcelona (Spain) in 1994 and raised in Alghero, Sardinia. "Con-divisione di spazi e frammenti", in which, starting from the new urban model of the city of Barcelona "La Superilla", was proposed an extension of the model, which allows the application of this also in irregular and deferred fabric of Cerdà , with a final evaluation of 110/110 and praise. Afterwards she started the European master and degree in "Planning and policies for the city, the Since April 2017 she did a 4-month training period at the "Z Studio" in Alghero, where she collaborated with the professionals appointed to draft the first Municipal Urban Planning Plan (PUC) of Alghero and the Littoral Use Plan (PUL) of the city, with subsequent presentation to the municipal administration. The master thesis is being finalized, dealing with the theme addressed in this paper.

Tanja Congiu, temporary Assistant Professor of Transports at the Department of Architecture, Design and Urban Planning - University of Sassari. Civil engineer and Phd in land use and transport planning, her research activity focuses on mobility and transport issues with a particular concern for the interactions between built environment configuration, sustainable transport policies and trends in travel behavior. Recent studies deal with methods and tools to measure, assess and enhance urban walkability intended as one central quality in the design of urban realm. Consultant for local authorities in transport planning at different spatial levels based on sustainable mobility solutions.

Alessandro Plaisant is an associate professor of the Department of Architecture, Design and Urban Planning, the University of Sassari, where teachs Urban Planning and Analysis of urban systems. He held a Ph.D. at the University of Cagliari, after spending eight months as a fellow at the School of Anthropology, Geography and Environmental Studies, the University of Melbourne, focusing his research on decision-making processes in public policymaking, strategic planning, policies and pluralism-oriented tools. Among his recent publications: Urban regeneration of peripheral areas: the critical role of the connective space in an italian city. (Aa.Vv) Urban Design Journal, 2018; Risk Prevention and Management. A Multi-actor and Knowledge-Based Approach in Low Density Territories (Aa.Vv.), Computational Science and its Applications (ICCSA 2017), in Gervasi, O., Murgante, B. et. al. (Eds.), Springer (ISBN 978-3-319-62397-9), Switzerland.

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THE VALUE OF WATER ECOSYSTEM SERVICES TRADE-OFFS AND SYNERGIES OF URBAN LAKES IN ROMANIA

***DENISA LAVINIA BADIU**
CRISTIAN IOAN IOJĂ
ALINA CONSTANTINA HOSSU

Centre for Environmental Research and Impact Studies, University of Bucharest, Romania
e-mail: denisabadiu@gmail.com
URL: https://ccmesi.ro/

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ABSTRACT

The United States Environmental Protection Agency (EPA) provides an interesting definition Blue infrastructure in the form of lakes, rivers and wetlands have re-emerged as important ecosystems in the urban environment, with a high capacity of providing co-benefits and improving human health and well-being. Along with green infrastructure, water surfaces such as urban lakes can help tackle environmental challenges that cities are facing, such as climate change, water scarcity and pollution or surface runoff management. Urban lakes contribute with a wide range of ecosystem services, from provisioning and regulating to cultural services but how this co-benefits are valued is not entirely comprehended. Our analysis tries to understand how local people value ecosystem services and disservices associated with urban lakes in order to establish the baseline knowledge for urban planning. We used a survey applied both online and face-to-face to collect data regarding the public perception on 4 case study lakes. To establish and group the most important ecosystem services and disservices associated with urban lakes, we applied a Principal Component Analysis. We found that local people greatly appreciate regulating services but they also acknowledge several issues that are determined by management practices. The evaluation of ecosystem services provided by urban lakes offers valuable knowledge that can facilitate the urban planning process towards a smart, sustainable and resilient city.

KEYWORDS
Urban Lakes; Ecosystem Services; Trade-offs; Local Knowledge

* The other authors are: Mihai Răzvan Nită, Gabriel Ovidiu Vânău.

1 INTRODUCTION

Mounting levels of urbanisation have defined the last decades and have led to environmental challenges that affect the health and quality of life of residents (Wigginton, 2016). As a consequence, open public spaces such as green or blue infrastructure are regarded as valuable solutions to tackle global challenges such as excessive land use transformations, water management issues and climate change (Kammen & Sunter, 2016).

Climate change is often associated with industrial and urban activities and the main cause for that is the issuance of greenhouse gases from transportation and energy production (Kelly & Zhu, 2016). In this context, blue-green infrastructure has the capacity of providing ecosystem services in a transformed environment, in order to mitigate environmental issues and to improve people's wellbeing. Urban blue infrastructure includes rivers, lakes and wetlands that are located within an urban environment and can provide one or several functions.

Urban lakes are natural or artificially developed areas that have the capacity of providing basic resources for local people such as fish or water supply for drinking and various other activities (Breuste et al., 2013; Rodríguez et al., 2006). Besides direct benefits, urban lakes provide regulating ecosystem services that contribute to a healthier and safer environment, by mitigating climate change effects, water and air purification and flood control (Gómez-Baggethun et al., 2013). In addition to this, lakes in urban environments improve landscape aesthetics and by providing recreation areas can contribute to social cohesion, mental and physical health (Vierikko & Niemelä, 2016).

In order to improve and to maintain the provisioning of ecosystem services of lakes, urban planners and authorities have to also take into account the disservices or problems that can occur and to find solutions to better manage them.

Disservices associated with urban lakes can relate to: fostering wild or semi-wild animals, seen as disease vectors (Lyytimäki et al., 2008) or increased risk of flooding in the proximity of shore lakes (Lewis et al., 2017).

Another disservice associated with urban lakes can refer to unmanaged areas that can become unsafe for visitors (Gómez-Baggethun & Ruiz-Pérez, 2011). The supply of ecosystem services or, in the contrary, the emergence of environmental issues, depend on the management capacity and how urban lakes are governed.

Water ecosystems can be developed within cities to minimize flood risks (Li et al., 2017) or surface runoff (Walsh et al., 2012) or to provide space for recreation or other cultural activities (Allan et al., 2015; Voigt & Wurster, 2015).

So for urban lakes to be regarded as a nature-based solution for tackling environmental challenges and to improve the supply of ecosystem services, either provisioning, regulating

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and cultural, urban planners and responsible actors have to manage them as attractive and safe public spaces. For the purpose of an efficient planning, improved knowledge on the most relevant ecosystem services and disservices is needed.

Our study aims at (1) identifying the most important ecosystem services of urban lakes and (2) establishing the most important disservices of urban lakes that could lead to trade-offs.

2 METHODOLOGY

In order to collect data regarding the public perception on ecosystem services and disservices of urban lakes we used a survey, applied both online and face-to-face, in the proximity of 4 case study lakes: Morii Lake, Herastrau Lake (Bucharest), Ciurel Lake (Targu Jiu) and Portile de Fier (Orsova).

The lakes chosen for the case studies cover a diversity of landscapes and functionalities. Morii Lake is an anthropic dam lake along the Damboviţa River, located in a mixed functional area (collective and individual dwellings, industrial spaces, flooding areas, abandoned lands), with a surface of 246 hectares. Herastrau Lake has a surface of 76 hectares and is part of one of the largest urban parks in Bucharest and it was developed on a former swamp area. Ciurel Lake is a 56 hectares lake, located in a smaller city than Bucharest.

Its right lakeshore is represented by residential and industrial functions while the left one is neighboured by green areas. Portile de Fier is the largest lake in Romania and is located near diverse constructions and forested and aquatic natural areas.

Respondents were asked to answer to an 18-item questionnaire, on a 5-point Likert scale (1, very low importance – 5, very high importance). The survey covered information on the respondents' profile and on the way, they value 29 ecosystem services and 18 disservices associated with urban lakes.

The questionnaires were carried out between May-October 2017, both using an online platform and also in the proximity of urban lakes. To ensure a proper sample, we applied the questionnaires in days with favourable weather conditions, between 8.00 am – 22.00 pm (Iojă et al., 2011; Sanesi & Chiarello, 2006).

We distributed 323 questionnaires from which we validated a number of 314, containing replies for all 18 items. To establish and group the most important ecosystem services provided by urban lakes, we applied a principal component analysis.

The purpose of the analysis is to reduce the number of variables to a lower number of principal components that would better explain the variance of data and to identify the most important services and disservices generated by urban lakes (Fig. 1, Fig. 2).

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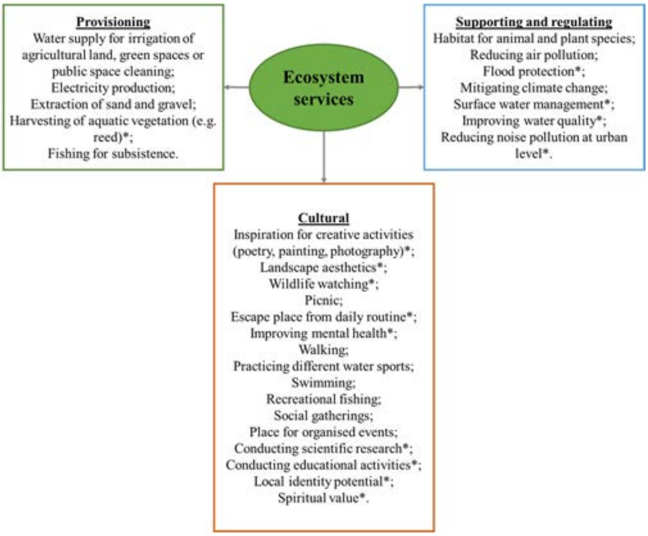

Fig. 1 Ecosystem services, provided by urban lakes, selected for analysis

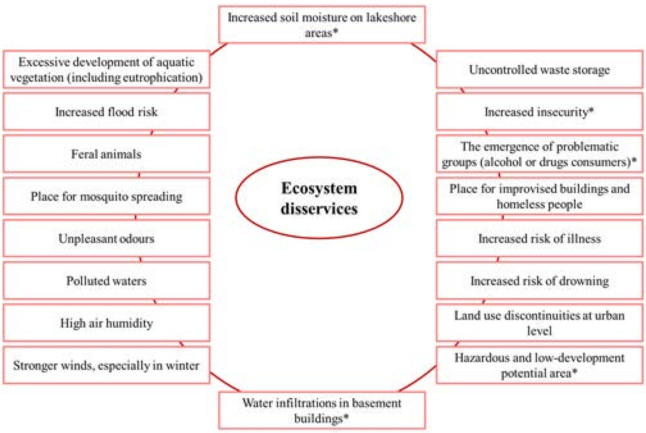

Fig. 2 Ecosystem disservices determined by urban lakes, selected for analysis (removed in the first stage of the analysis because they did not have a significant contribution to the resulted principal components)

To determine the most important ecosystem services we applied the principal component analysisbased on Eigenvalues >1 extraction method with Varimax orthogonal rotation for ecosystem services grouping and Oblimin oblique rotation for ecosystem disservices grouping (Abdi & Williams, 2010). To test the adequacy of the data and of our sample size we usedKaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity (Jolliffe, 1986). A value of 0 for Kaiser-Meyer-Olkin Measure of Sampling Adequacy test indicates the fact that the sum of partial correlations is greater than the sum of correlations

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and makes the use of principal component analysis inadequate. A value of 1 for the aforementioned test demonstrates an adequate sample size of our data. We considered the Kaiser-Meyer-Olkin Measure of Sampling Adequacy for every individual variable and we removed those with a value less than 0.5 (Field, 2009). We also checked the Bartlett's Test of Sphericity result to check the correlation between variables (Field, 2009) and we eliminated the variables that are completely uncorrelated with each other, leaving only the variables with a correlation coefficient of over 0.3 (Tab. 1, Tab. 2). We then carried out the principal component analysis without the removed variables.

3 RESULTS AND DISCUSSION

The principal component analysis of the most important ecosystem services was applied based on 13 variables. The result of the Bartlett's test was statistically significant x^2 (23) = 670.936, p<.001 and the value for Kaiser-Meyer-Olkin Measure of Sampling Adequacy shows that the data sample size was adequate for analysis (KMO = .740). We obtained 4 principal components (with eigenvalues scores higher than 1 that explain 60% of the variance). Also, as the scree plot in (Fig. 1) shows that adequate for interpretation are the first 4 components. The variables with the highest importance and contribution for each component are presented in Tab. 1. For the analysis of most important ecosystem disservices we used 14 variables to apply the principal components analysis. The Bartlett's test was statistically significant x2 (78) = 964.465, p<.001 and the value of Kaiser-Meyer-Olkin Measure of Sampling Adequacy demonstrates the fact that our data is suitable for analysis (KMO = .851).
As the scree plot shows (
Fig. 3), the applied procedure retrieved 3 principal components (with eigenvalues scores higher than 1) that explain 51% of the variance.

	COMPONENT			
	1	2	3	4
Reducing air pollution	.778			
Mitigating climate change	.727			
Habitat for animal and plant species	.634			
Picnic	.598			
Extraction of sand and gravel		.786		
Water supply for irrigation of agricultural land, green spaces or public space cleaning		.729		
Electricity production		.683		
Swimming			.791	
Recreational fishing			.774	
Practicing different water sports			.618	
Social gatherings				.857
Walking				.735

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Tab. 1 Resulted principal components of most important ecosystem services

	COMPONENT		
	1	2	3
Hazardous and low-development potential area	.785		
Increased flood risk	.726		
Increased risk of illness	.639		
Feral animals	.588		
Excessive development of aquatic vegetation (including eutrophication)	.498		
High air humidity	.485		.416
Polluted waters		-.796	
Uncontrolled waste storage		-.723	
Unpleasant odours		-.687	
Increased risk of drowning		-.682	
Place for mosquito spreading		-.621	
Stronger winds, especially in winter			.717
Place for improvised buildings and homeless people			-.434

Tab. 2 Resulted principal components of most important ecosystem disservices

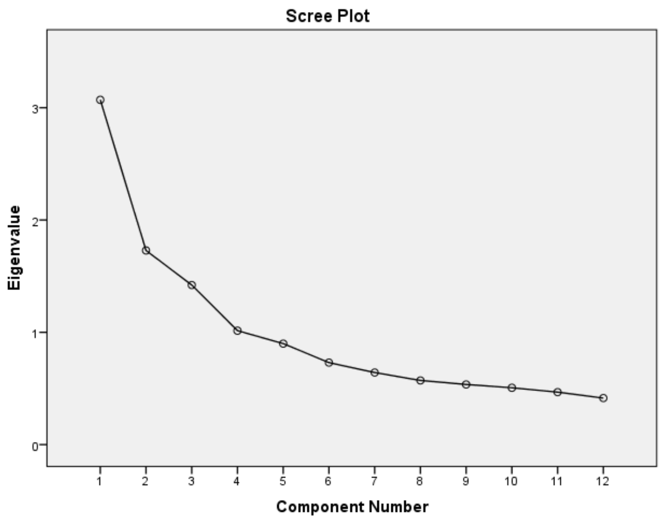

Fig. 3 Resulted scree plot for ecosystem services assessment

3.1 ECOSYSTEM SERVICES

The four components can be interpreted according to the ecosystem services they include. Component 1 gathers important regulating ecosystem services (reducing air pollution, mitigating climate change, habitat for animals and plant species) which may not be directly perceived by the public but are considered important for the urban ecosystem because of their capacity to regulate physical or chemical flows and processes for an improved quality of life.Regulating ecosystem services resulted as being of great value for visitors of urban lakes

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as it is also reflected by other similar studies, where local people support and promote measures that would contribute to the protection of natural ecosystems near cities, to ensure habitat conservation and a proper ecological functioning (Baur et al., 2016). Component 2 includes ecosystem services that can be used directly by inhabitants in the form of provisioning services. Thus, urban lakes can contribute to people's sustenance as a proximal water source. It can represent water supply for industry, agricultural or different household activities. For example, many cities all over the globe rely on their local water resources for domestic supply and energy needs (Larsen et al., 2016; Lundy & Wade, 2011). Moreover, urban lakes can provide food resources for sustenance, in many developing countries (Cosgrove & Loucks, 2015) but not exclusively (Vanham et al., 2016). The third component refers to recreational activities involving direct contact with aquatic ecosystems. Urban lakes provide space for swimming, recreational fishing and water sports. Component 4 is based on other cultural ecosystem services provided by urban lakes, than the ones included in the previous component, such as walking or social gatherings. Numerous studies have found cultural services to be highly relatable to how local people perceive the benefits of city waters (Brancalion et al., 2014). And while it is clear that urban lakes can provide for local inhabitants a place for social gatherings, recreation or sports, efforts have to be put into a proper management of these resources, in order to enhance their attractiveness (Haase, 2015).

3.2 ECOSYSTEM DISSERVICES

While urban lakes clearly provide ecosystem services for local people and private or public entities, it can also be a source of issues. The first component we obtained includes problems specifically caused by the presence of lakes in the urban environment, rather than the human impact generated in the proximity of these aquatic ecosystems. From the visitors' perception, urban lakes' most important problems are determined by the fact that they are mostly considered hazardous and with a low-development potential, areas with a prevalent occurrence of unwanted animals, eutrophication and excessive air humidity (Tab. 2). Our results are similar with several studies that emphasize the negative aspect of urban waters in cities, such as flood occurrences or a certain level of unsafety (Oubennaceur et al., 2019; von Döhren & Haase, 2015).

The second component includes mostly problems caused by human activities, such as: polluted waters, uncontrolled waste storage with associated unpleasant odours or increased risk of drowning.

The third principal component is comprised by problems that can lead to a downgrade in the quality of living spaces of neighbouring residents and to a decreased attractiveness for

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visitors: stronger winds, especially in winter and place for improvised buildings and homeless people.

4 CONCLUSIONS

The evaluation of ecosystem services provided by urban lakes offers valuable knowledge that can facilitate the urban planning process towards a smart, sustainable and resilient city (Ahern, 2013; Gómez-Baggethun & Barton, 2013). Besides mitigating the issues associated with urban lakes, urban planners have to ensure an enhanced setting for ecosystem services provisioning, that can tackle environmental challenges, such as climate change adaptation, water security or human health (Haase et al., 2014). Our study shows that, as urban lakes contribute with numerous ecosystem services and co-benefits for people, whether provisioning, regulating or cultural, they are also a source of problems or disservices. Considering this, urban planners and decision makers are faced with the challenge of managing and governing urban lakes in a way that makes them safe, attractive and inclusive. The relevance of our analysis is sustained by the fact that co-benefits are not entirely understood and comprehended by authorities and urban inhabitants and there is still a lack of information of how urban blue ecosystems are perceived. Thus, our work recognizes the value of local knowledge and provides a base for a sustainable urban planning and public policy formulation, all of which require to consider the needs of inhabitants with regard to ecosystem services.

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AUTHOR'S PROFILE

Denisa L. Badiu is a researcher at the Centre for Environmental Research and Impact Studies, University of Bucharest. She defended her PhD thesis at the University of Bucharest regarding the multi-functionality and connectivity of urban green infrastructure in Romania. Her research activities involve urban blue-green infrastructure, ecosystem services and nature based solution. She has been a member of several international and national research projects and has published, as main author, 6 scientific articles.

Cristian I. Iojăis the head of Regional Geography and Environment Department, Professor at the Faculty of Geography at the University of Bucharest and senior researcher at the Centre for Environmental Research and Impact Studies. He earned his PhD title in Geography at the University of Bucharest. In 2015 he obtained the Habilitation in Environmental Sciences and in 2017 in Geography. His research activities are focused on environmental conflict assessment in natural and urban ecosystems, green infrastructure, consequences of urbanization on ecosystems services supply and urban sustainable planning. Cristian Iojă has coordinated over 9 national research grants and has published 9 books and over 20 scientific articles.

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Alina C. Hossu is a researcher at the Centre for Environmental Research and Impact Studies, University of Bucharest. She obtained her PhD title in Geography, at the University of Bucharest. Her research is focused on environmental policy and planning, ecosystem services, collaborative decision making and environmental conflicts.She has been a member of over 4 national research projects and has published over 8 scientific articles.

Mihai R. Nițăis a researcher at the Centre for Environmental Research and Impact Studies and Associate Professor at the Faculty of Geography, University of Bucharest. He earned his PhD in Geography in 2011 at the University of Bucharest. His main research topics include green infrastructures, environmental conflicts and environmental impact assessments. He has published 4 books and over 20 scientific articles and has been the principal investigator of 2 national research projects and member in the research team of 10 international and national projects.

Gabriel O. Vânău is a researcher at the Centre for Environmental Research and Impact Studies and Lecturer at the Faculty of Geography, University of Bucharest. His main research topics include land planning, protected areas management, ecosystem services, sustainable development and climate change mitigation. He has authored 7 books and book chapters, 17 scientific articles and has been working in the research team of 29 international and national projects.

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A BLUE INFRASTRUCTURE: FROM HYDRAULIC PROTECTION TO LANDSCAPE DESIGN

THE CASE STUDY OF THE VILLAGE OF BALLAO IN THE FLUMENDOSA RIVER VALLEY

***GIOVANNI MARCO CHIRI, PINO FRAU ELISABETTA SANNA**

DICAAR, University of Cagliari, Italy
e-mail: g.chiri@unica.it
URL: http://people.unica.it/giovannimarcochiri/

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ABSTRACT

The United States Environmental Protection Agency (EPA) provides an interesting definition of 'green/blue' infrastructure (GI): 'an approach to ecosystem management that relies on constructing landscape features that function similarly to natural systems thereby increasing the functionality of built or urbanized ecosystems. GI systems use vegetation, soils, and natural processes to manage storm water and maintain ecosystem functions. GI systems are intended to also provide social and economic benefits that enhance urban liveability. They typically operate alongside blue infrastructures, defined as all the systems which channel water, whether they are surface or underground streams, marine or inland waters. The synergy between green and blue infrastructures does not only produce strategic environmental value, but it also plays a central role in the management of rainwaters during floods, the collection and storage of water, the prevention of floods, the defense against sea-level rise, the mitigation of natural risks and the reduction of environmental temperature. Two aspects of green/blue parks are of notable interest: the first one consists in their potential in enhancing the resilience of territories affected by environmental critical phenomena, by limiting their impact and restoring rapidly their initial conditions with minimal damages. The second one consists in their dual value as infrastructures for the mitigation of hydraulic risk, designed to preserve communities that are vulnerable to that risk, and as a public space, exploitable in the time laps between the critical or disastrous events. The case study of Ballao (Sardinia) along the Flumendosa river offers the opportunity to test practically the approaches suggested by the international best practices.

KEYWORDS
Green Parks; Blue Parks; Flood; Resilient Landscape

* The other authors are: Davide Pisu, Francesco Marras, Giovanni Maria Sechi.

1 INTRODUCTION

This study gave rise to and was developed alongside the PROTERINA-3Évolution project, an evolution of the work realized during the EU 2007-2013 program, with the PROTERINA-Due, RESMAR and PROTERINA-C projects. That is, therefore, a project conceived to enhance the attitude of institutions in preventing and managing, jointly, the risk of flood. The general aim of the project is to reinforce the response capacity of territories to the risk of flood through the 'construction' of awareness among institutions and communities. The addressees -whether direct or indirect- are the competent authorities in the field of civic protection, soil conservation and cycle of waters, the agencies which are involved in forecasting and monitoring activities in regard to meteorological phenomena and the citizens actively engaged in the decisional processes. The specific aims of the PROTERINA-3Évolution project are:

- to promote actions of prevention and protection: to enhance the effectiveness of preventive measures -both structural and not- against the risk of floods, through the transfrontalier and transregional involvement of institutions and communities that are willing to be actively engaged in a process of awareness-raising within their territories (OB.1);
- to empower event forecasting and monitoring systems: to strengthen monitoring networks and integrate the acquired data with early-warning models, capitalizing the results of the former programs (OB.2);
- to develop resilient communities: to increase the transfrontalier capacity of adaptation to climatic change through the deployment of resilient communities (OB.3).

The activity of the DICAAR research group within the PROTERINA-3Évolution project is specifically aimed at the development of guidelines on the construction of blue infrastructure consisting of urban parks serving the scope of flood peak reduction, the drafting of guidelines on flood-proofing operations, consisting of micro-scale actions on public buildings such as state schools, libraries and social centres, with the purpose of mitigating flood risk and identifying safe spots and, finally, the exchange of expertise with the river basin authorities of the other regions taking part in the PROTERINA project (for Italy the river basin authorities of Liguria and Tuscany, and for French partners their competent authorities). In this context, an extremely relevant role is given to the analysis of the risk of flooding in the territory of the municipality of Ballao, which even for events having low return periods shows large areas, even urbanized, affected by flooding phenomena from the Flumendosa river, which overflows its banks. The development of a bi-dimensional hydraulic model will be shown below. It will be used, firstly, to analyse the hydraulic risk in the current state of the territory and, secondly,

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as a support for the definition of actions which can enable the mitigation of river flooding, thus preventing it from affecting urbanized areas, as far as possible. Such actions have the dual purpose of serving as systems for the prevention and protection from hydraulic risk during disastrous events and as public spaces open to the collective use, for leisure and play time, during the rest of the year.

Designing a blue infrastructure entails a reflection on its dual nature of tool for the mitigation of hydraulic risk -which constitutes the main reason for its construction- and as a landscape design tool for the correct fruition of spaces throughout periods with no critical events. If, on one hand, measures concerning the ban on building in areas at hydraulic risk may sometimes be sufficient to limit the risks and the vulnerability of communities, on the other hand, such measures often preclude the collective use of large areas of the territory. Furthermore, this kind of approach has a tendency to marginalize these places that are rapidly subject to decay. For this reason, it is necessary to consider their dual use: these areas must be considered, on one side, as part of an hydraulic infrastructure, namely spaces destined to the protection and safeguarding of the built space and, on the other side, they act -in the longer run- as public spaces open to collective use.

2 METHODOLOGY

Through the study of best practices in the field of blue park design, once again intended as public recreational spaces designed to be flooded during heavy rains and inundations, it was possible to identify four common measures to mitigate the risk, the application of which we deem to be essential for the success of the project.

The authors in line with the premise have defined the following methodology:

- the creation of expansion basins: flow-storage reservoirs and retarding basins;
- the creation of embankments and the modelling of topography;
- the establishment of paths on higher ground and safe spots;
- the restoration of riparian vegetation.

2.1 THE CREATION OF EXPANSION BASINS: FLOW-STORAGE RESERVOIRS AND RETARDING BASINS

The analysed case studies highlighted that the management and control of water flows play a crucial role within the park, not only from a merely functional point of view in relation to the mitigation of the risk, but most importantly in terms of quality of the landscape and the public space open to citizens.

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Best practices highlight, in particular, that the introduction of expansion basins as flooding areas along riverbanks may represent an effective measure for the mitigation of floods, being at the same time an opportunity to create new habitats or new public spaces. Expansion basins are areas designated for the temporary or permanent conservation of water flows during rain and flood events. These are generally designed in two forms: flow-storage reservoirs and retarding basins. The formers, typically retain water only during storms, releasing it lately at a controlled rate, until they are completely empty, or they reach a reserved volume. The latter, located along the river, have typically the possibility to receive amounts of water exceeding the river flow capacity, independently from heavy rainfall events. On a perspective strictly inherent to the design of blue parks, expansion basins as flooding areas along riverbanks are preferable, because they not only have a limited impact on a territorial scale, but they also may create the opportunity to use a multidisciplinary approach to the project, which may aim at multiple tasks: hydraulic risk mitigation, environmental restoration, management of water resources and public space. The retention of even modest quantities of water allows for the creation of a moist environment in which birdlife can thrive together with vegetation that can tolerate short periods underwater. On the other hand, expansion areas along river banks allow to create wetlands that not only contribute to the valorisation of ecological corridors and to the creation of new habitats in support of biodiversity, but also represent an opportunity to enhance the perception of the landscape, making it more attractive.

2.2 THE CREATION OF EMBANKMENTS AND THE MODELING OF TOPOGRAPHY

Embankments are infrastructures that allow for a passive protection of the territory. They prevent the overflowing of watercourses and hamper every connection between the river and the surrounding territory. They are normally constituted by soil barriers that may be located at a minimum distance from the riverbed or, where possible, they are located at a long distance from the riverbed (setback levee). The distance of the riverbank form the watercourse has a significant impact on the dynamics of the river, inasmuch as it will be consequently more or less free to invade the floodplain during flood events. The more the barrier is distant from the river, the more its freedom of movement increases, thus leading to a reduction of the hydric level and, consequently, to a slowdown of its flow. The enhancement of the flow capacity of the riverbed through the setback of embankments is not always possible, because often the river is located near urban areas or farmlands. From the point of view of landscape architecture, best practices show us that embankments can be imagined not only as defensive systems, but also as elements, which define the public space. Barriers, if modelled on the surrounding territory following the height required by the various hydric

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levels provided for critical events having different return periods, allow for the establishment of a network of pathways which can be used even during flooding's.

2.3 THE ESTABLISHMENT OF PATHS ON HIGHER GROUND AND SAFE SPOTS

As best practices show, in the design of blue parks the definition of paths based on expected water levels has a central importance. The connective systems within the park must be designed, in fact, at a higher altitude than the one required for the maximum expected level, so that in any condition a way out is guaranteed in case of flood. Paths on higher ground, as well as safe spots located over critical levels, can be further preserved from floating materials and soil transported by water through vertical protection systems.

2.4 THE RESTORATION OF RIPARIAN VEGETATION

Riparian vegetation represents an important and delicate interface between water streams and the surrounding territory. The root system performs, in fact, a strong stabilizing action both with respect to soil erosion and to hydrodynamic stress. It is nonetheless necessary to consider also the flow resistance of vegetation. Equilibrium is reached when vegetation has a diversified structure, composed by shrubs capable of a certain degree of flexibility and capable of reducing the action of resistance to the water flow, while allowing for mitigation of erosion, and by an arboreal system composed of young trees having a balanced diameter/height ratio. As a matter of principle, the diameter should in any case be progressively lower while approaching the riverbed and when the width of the river decreases. Thus, during floodings, riparian wood performs an important flow modulation function, delaying the reaching of the maximum level by amplifying the retarding action of expansion basins. For this reason, the choice of vegetation types in expansion basins has an important role: in conjunction with the morphology of the territory, it can amplify the beneficial effects of lowering the level of water. Clearly, the collateral effect is the containment of the stream speed: the water that leaves the riverbed flows in the riparian wood where, thanks to the increased roughness determined by vegetation, it suffers a significant slowdown.

Starting from these intuitive elements concerning cause-effect relationships, rather than defining abstract lines of principle we chose to investigate a case study through a pilot project and, from this, we derived methodological statements as generalizable as possible. Through this methodological approach, the following project attempts to find a difficult balance between a hydraulic infrastructure project for risk mitigation and a landscape design project made by conceiving the design action as the most delicate act of modification, capable of integrating itself moderately among the topographic and orographic signs.

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3 THE CASE STUDY

The case study of the municipality of Ballao (Sardinia) shows a series of particularly significant phenomena related to the risk of flood, but at the same time it shows considerable opportunities in terms of hydraulic infrastructure design and public space, integrated in a landscape system. The area is located between the 'RiuBintinoi' stream and the corresponding riverfront, the Flumendosariver in the North and Via Roma in the East. This area is occupied by a series of residential buildings, located between the urban streets 'Via PeppinoMereu', 'Via Raimondo Piras', 'Via BenvenutoLobina', 'Via Aldo Moro' and other streets accessible from 'Via Sassari'. The closing element of this urban system consists of an aggregation of neglected buildings, formerly the town's abattoir and a depot, still used by the municipality. The last fragment of urban continuum is represented by a parking lot -accessible from the 'RiuBintinoi' side-, at a height of 83 meters above the sea level. Globally, the area covers 4 ha, of which only 1.5 not urbanized. As mentioned above, the aim was to realize an embankment which may serve the function of defining an area for the controlled flooding, located on the right bank of the Flumendosa river, as shown in the previous images, that may be open to recreational and sports uses for the community of Ballao and of Sarrabus/Gerrei.

From a landscape point of view, the hypothesis of constructing a hydraulic bank widely oriented along the riverbed was rapidly excluded due to the clear impact on the environment that this would have generated. This would have constituted a physical and visual barrier between the town and the river and, furthermore, this approach would not have been consistent with the principles of blue park design previously described. For this reason, we decided to focus on a barrier for the protection of the urban area consisting of component in bulk materials over the bank. The total height would be lower than 2.2 meters, with a length of 125 meters starting from the intersection with via Roma and following parallel to the riverbed to reach via Sassari, thus extremely distant from the river (setback levee). The planimetric position of the hydraulic protection intervention is synthetically shown in Fig. 1. The intervention can be built in two phases with reference to events with a return period from 10 to 50 years. The embankment is sized for the containment of the 10 years return period flood, and its peak is in fact at the same height of the parking lot, 83 m above the sea level. In a second phase, for the protection of the 50 years return period flood we designed a series of precast concrete barriers, conveniently shaped and waterproofed to raise the elevation above the parking lot located in front of the old abattoir.

The track of the new topographic sign was chosen in such a way as to create a direct connection -currently only potential- with the opposite bank of the RiuBintinoi. In fact, in the northern boundary of the village is already operating the 'Parco intervacua's', which even though it is easily accessible through the secondary roads of the town, at the moment does

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not have any relationship with the area on which this study is focused. The two parts may, on the contrary, be easily connected through a walking/cycling bridge on the RiuBintinoi stream, thus operating a whole large river park along points of contact between the Flumendosa river and the town of Ballao. This system, which may be further investigated in a specific forthcoming study, may constitute a greater green/blue infrastructure within a territorial scale, not only capable of reorganizing the elements of the landscape in an harmonious continuum, but also capable of providing physical support for the attraction of events, activities and demonstrations of public interest to the benefit of the local community. On the top of the newly built embankment, new cycling and walking paths will be traced. These will allow for the closing of a circuit along the river and the edge of the village. The plan design of the hydraulic infrastructure has, therefore, a double reason. On one hand, it constitutes the necessary barrier for the protection of the urban area from floodings of the Flumendosa river and, on the other hand, the new topographic sign joins existing lines and elements of the landscape in order to constitute an organic system, even though it is made of different parts, investing it with meaning and public function. The main development of the embankment is parallel to the riverbed, but it bends at about two-thirds of its length to reach via Garibaldi. Here the track of the new embankment crosses the rural area defining an average height of 2.2 meters. In the point of junction between its two lines, the embankment bifurcates and, in that point, a narrow corridor consisting of a wooden pier extends itself towards the centre of the flooding area and descends to the lower point, with the purpose of measuring the terrain from the water level of the 10 years return period flood to the ground below. There, a stair and a wooden hut mark the end of the path. The stair will allow to descend to the ground when it is not flooded, whilst the hut will offer protection from the sun and the rain, allowing visitors to stay and enjoy the landscape. The width of embankments varies accordingly to ground altitude, but they have approximately the same section all along the river. The sides of the embankment will be covered with grass and shrubs having mostly superficial roots. The paths will be paved with stone chunks or self-locking blocks which may offer a safe support to the pedestrian and cycling traffic. As mentioned above, in the second phase, a series of precast concrete barriers -properly sized and waterproofed-will be installed on the top of the embankment in order to create a protection from the 50 years return period flood. Indeed, the desired height of the embankment, sized for the 50 years return period, is equal to 2.5 meters from the lowest point of the area object of this study. Through the concrete barrier, the height of the embankment is increased by 0.8 meters reaching a total of 3 meters from the lowest point and thus leaving 0.5 meters free on the 50 years return period.

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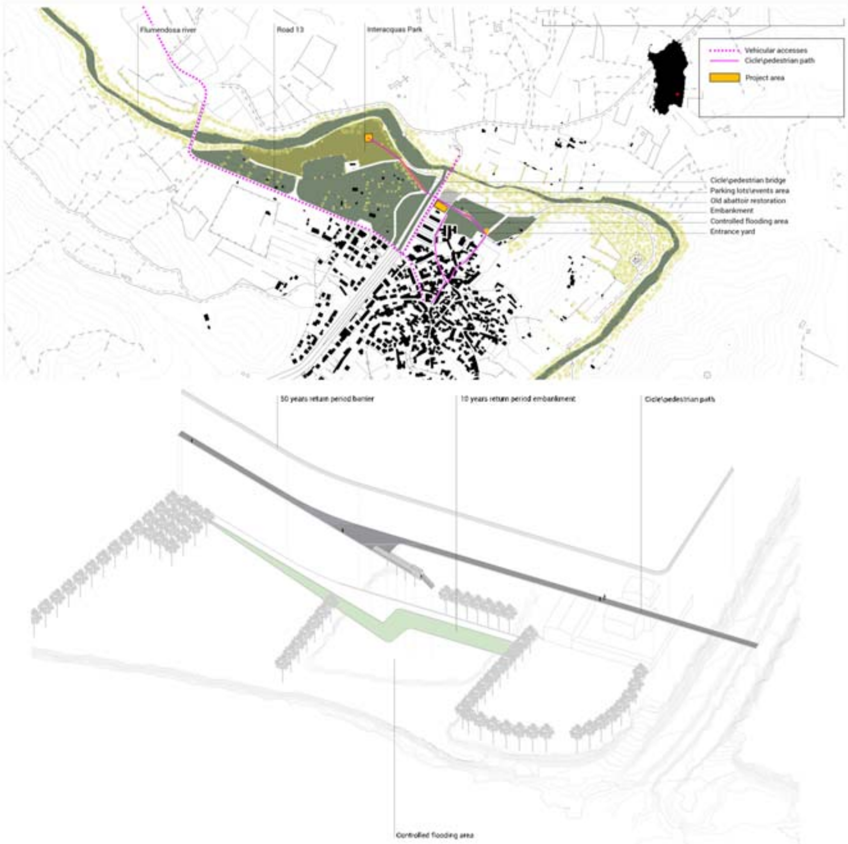

Fig. 1 General plan of the blue park and components of the landscape project

This element, which will be investigated in a separate detailed study, may be modelled in order to provide seats, bicycle racks, parapets and support for path lights. If the 10 years return period flood is taken into account, the area subject to critical events in case of flood consists of a depression comprised between the beginning of the embankment and the parking lot near the abattoir. Via Bintinoi is not subject to the 10 years return period flood. If we consider an event having 50 years return period, instead, the area subject to flood comprises all the area near the new embankment, the parking lot, and a portion of via Bintinoi until it reaches via Peppino Mereu. Finally, we must consider that, in order to complete the works of protection from 50 years return time period events, the current Hi4 -the maximum hydraulic hazard zone- could be redefined, allowing for the relocation of the old abattoir to public uses: this operation may constitute the last part of the project, allowing for the complete regeneration of the area comprised between the urban margins and the Flumendosa river.

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4 CONCLUSION

Drawing on a series of international best practices, the application of the methodology described above has allowed for the development of the project of a hydraulic protection system in close proximity to an urban settlement alongside two general goals: the first one consists in its potential in enhancing the resilience of territories affected by environmental critical phenomena (such as floods) by limiting their impact and restoring rapidly their initial conditions with minimal damages.

Fig. 2 Cross-section of the embankment

Fig. 3 Aerial view in normal conditions and during a 50 years return period

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The second one consists in their dual value as infrastructures for the mitigation of hydraulic risk, designed to preserve communities that are vulnerable to that risk, and as a public space, exploitable in the time laps between the critical or disastrous events. The project for the Flumendosa valley in the town of Ballao (Sardinia), shows that the two aspects, strictly connected to the liveability and environmental quality of the territory, are not conflicting. Rather, in order for the project to have a positive impact on the environment and on the landscape, they should be combined and be designed to operate as hydraulic devices during disastrous events and as rural public spaces in the time between them.

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AUTHORS' PROFILES

Giovanni Marco Chiri is Associate Professor of Architecture and Urban Design (ICAR14). He was member of groups involved in programs such as the PRIN program and coordinator of several international workshops. He was lecturer at the feasibility study for the Museum of Nuragic and Contemporary Art (Independent Region of Sardinia), the Pre-feasibility study for urban regeneration of the District of Sant'Elia in Cagliari (Independent Region of Sardinia), the Preliminary Design for the EEUR2012 campus in Cagliari (regional office for the right to education in Cagliari) and designer of the Plan of La Maddalena with Enrico Corti (Municipality of La Maddalena). He was also consultant for the work of urban design of the Zhaoqing planning & urban design Bureau (Guangdong-PRC) and winner of the competition to redevelop the commemorative Arch Square and the lakefront in Zhaoqing (Guangdong-PRC). In 2009, he turned to the study and assessment of microclimate efficiency in the urban fabric and the testing of methodologies and interdisciplinary processes of urban design. He is involved in projects of international cooperation in Kenya, in the rehabilitation of the Eduardo Mondlane University Campus in Maputo (Mozambique), in the Plan of Urban Rehabilitation of the Hospital area, Botanical Gardens and Amphitheatre in Cagliari, and he is also providing scientific support to the Independent Region of Sardinia in the Iscol@ Project. He is currently a member of the UNICA scientific board-Ministry of Defense for the rehabilitation of the coastal forts of La Maddalena.http://people.unica.it/giovannimarcochiri/

Elisabetta Sanna is a fully qualified architect, with a postgraduate Master in Landscape Architecture, attended at the UniversitatPolitècnica de Catalunya in Barcelona. She has been operating for about four years in the field of landscape and territorial design, joining national and international competitions concerning the redevelopment of public spaces, the design of parks and playground areas. She worked in Berlin at internationally renowned offices, such as Topotek 1, Man Made Land and Lavaland with which she worked as Project Leader for competitions and projects such as the'AspernSeestadtNordpromenade' in Vienna.

Pino Frau gained a First Class Honors Degree in Civil Engineering at the University of Cagliari, with a thesis entitled: 'Comparison of One-dimensional and Two-Dimensional modeling of flood events by using HEC-RAS - Application in the Posada river valley area". After graduating, he started his collaboration with the Civil and Environmental Engineering and Architecture Department (DICAAR) at the University of Cagliari. The internship focused on the use of Two-Dimensional modeling in the areas affected by river flooding as a consequence of flood events. During that internship, his areas of expertise included the application of the HEC-RAS modeling in both rural and urban areas in order to develop evacuation plans for the population, the valuation effects, in fluvial hydrodynamic, of the attribution of the roughness value based on the soil and the vegetative covering used. He won two research grants at the University of Cagliari entitled 'Analysis and Application of Two-Dimensional Models for the Assessment of Flood Risk and the Preparation of Emergency Plans downstream through large dams.' After winning two research grants at the University of Cagliari, he is currently collaborating with the Sarrabus Municipality Consortium and the Sardinian Regional Agency of Hydrographic District.

Davide Pisu is a practicing architect, PhD student and lecturer of Architectural and Urban Composition at the University of Cagliari and, previously, he was a visiting lecturer and PhD student at the University of Hertfordshire. His professional activity is focused on housing, public buildings and public spaces, and he has a long-standing professional relationship with the architectural practice C+C04 Studio. His research focus comprises architecture for information and knowledge and the relationship between architecture and normativity. His works are published on Autoportret, C3 Korea and 'backtobasics' a series of books on fundamental architectural themes. He is currently completing a dissertation entitled 'Norm and form: Perverse effect of architectural regulations.' As a part of his PhD research, he is investigating the normative sphere of the architectural domain.

Francesco Marras Ph.D. Architect of the Faculty of Engineering and Architecture of Cagliari, hefocuses on the themes of architectural and landscape design. His research fields are: recovery and redevelopment of hydrogeological risk areas, new forms of settlement and habitat for rural landscapes,

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modern reclamation architecture, management of water in public spaces. He is a post-doc researcher of the DICAARand he is performing a research on the regional rural landscape. He is responsible for the optional course 'Water Module. Ecologies, Techniques and design', which focuses on the role of water management in projecting architecture. He performs architectural research and he also participates in competitions, achieving important results, such as the first prize in the European 13 competition, held in the site of Saint Polten in Austria, and in the Agrarian High School of Muravera and the Kindergarten of Villaspeciosa in Italy. In 2018 he founded TZH studio, a group of architects who work in the field of architecture in rural landscapes.

Giovanni Maria Sechi is an Associate Professor of Hydraulic Constructions (ICAR/02). In February 1983 he was appointed university researcher at the same University and from October 2000 he has been Associate Professor of Hydraulic Construction Engineering. Winner of a research grant from the CNR -the Italian National Research Council- in 1984-85 he was a visiting researcher at the Civil Engineering Dept. of the Colorado State University. He is currently working at the DICAAR – UNICA - Hydraulic Engineering Section. From November 2004 to 2010 he was Director of the CINSA, the Interdepartmental Center for Environmental Science and Technology of UNICA.He is a member of the IAHR, International Association of Hydraulic Engineering and Research, of the EWRA, European Water Resources Association, the Italian Hydro-technical Association, the AIRO, Italian Association of Operations Research, and of the CSSA, Italian Center for Water Supply Systems.In September 2005 he was assigned to the Executive Committee of the EWRA, the European Water Resources Association.His research activity was focused in particular on the development of efficient algorithms for the optimization of large-sized water resource systems, also taking into account conditions of uncertainty and the use of non-conventional resources. He has also worked on probabilistic modelling of extreme hydrological events. He was coordinator of the research unit of the University of Cagliari in the VAPI project by GNDCI-CNR (Italian National Research Council).

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[+]MUNICIPAL MASTERPLANS AND GREEN INFRASTRUCTURE

AN ASSESSMENT RELATED TO THE METROPOLITAN AREA OF CAGLIARI, ITALY

SABRINA LAI[a], FEDERICA LEONE[b]
CORRADO ZOPPI[b]

[a] Assessorato della Difesa dell'Ambiente,
Regione Autonoma della Sardegna, Italy
e-mail: slai@regione.sardegna.it

[b] Department of Civil-Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: federicaleone@unica.it
zoppi@unica.it

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ABSTRACT
Recent research has proposed a GIS-based methodology to map a regional green infrastructure (RGI) by assessing patches' suitability to be included in the RGI on the basis of four components as follows: natural value, conservation value, landscape value, and recreational value. This study builds upon such research with the aim to identify planning policies that can foster the enhancement of the RGI by increasing one or more of its components at the sub-regional scale. To this end, the RGI suitability map is overlaid with the planning schemes of the municipal master plans of three towns belonging to the Metropolitan City of Cagliari (Italy), and multiple linear regressions are performed. Results from this analysis show to which extent the zoning types identified in the city masterplan are related to high or low RGI suitability values, hence allowing for detecting those zoning types that should be targeted by the metropolitan city plan, if the RGI is to be improved, and for identifying appropriate planning actions to pursue this goal. The outcomes of the study imply that the eligibility of a land parcel to be part of the RGI depends on a number of factors strictly related to planning policies entailed by the zoning schemes of the municipal masterplans, such as presence and spreading of conservation and safeguard areas within the urban fabrics, improved accessibility of historic and natural landmarks, planned use of nature-based solutions within the regulating codes of municipal masterplans, improvement of habitat quality in the spatial context of rural areas. Main limitations of the proposed methodology can be recognized in the fragile theoretical foundations concerning the assessment of the value of recreational areas, and in the need for structured integration of nature-based solutions into the assessment of eligibility of land parcels to be included in the RGI.

KEYWORDS
Green Infrastructure; Ecosystem Services; Natura 2000 Network; Environmental Planning

1 INTRODUCTION

The concept of green infrastructure (GI) arises within the international debate at the end of the 1990s as a distinctive approach to landscape planning (Mell, 2016). GI is considered as a reference category in the contexts of several disciplines, e.g., landscape ecology (Jongman & Pungetti, 2004), greenway planning (Fábos, 2004), and management of water resources (Ahern, 2007). Moreover, different functions of GI are identified, e.g., biodiversity conservation (Benedict & MacMahon, 2006), or benefits provided to local communities and to civil society as a whole (Kambites & Owen, 2006). Therefore, several definitions of GI are available in the literature. Among many, Benedict and McMahon's (2006), Wright's (2011), Weber et al.'s (2006) and the European Commission's (European Commission, 2013) are the most relevant. Benedict and McMahon (2006) define GI as the ecological system that supports environmental, social and economic health, emphasizing the socio-economic approach to GI. According to Wright (2011), although connectivity, multifunctionality and green areas represent the core ideas as regards the category of GI, a deterministic definition is somewhat questionable because, on the one hand, such definition would be inconsistent with a progressively evolving conceptual framework concerning GI, and, on the other hand, its intrinsic interoperability would imply the opportunity of using the GI conceptual framework in a number of research and technical fields related to environmental and spatial studies, which would entail a preference to a flexible, non-deterministic definition. Weber et al. (2006) stress the environment-related character of the GI concept, conceived as a system of natural and semi-natural areas spread over the landscape. Broadly speaking, from the above-cited literature GI can be understood as a network of natural and semi-natural areas that play a key role in supporting ecological, social and economic activities.

Under this perspective, this study aims at proposing a methodological approach to include and implement GI within spatial planning at the city level, hence it addresses an outstanding gap concerning scientific and technical research on GI.

The study builds upon a few recent articles, related to Sardinia, concerning the identification of a spatial taxonomy of areas eligible to be part of a regional green infrastructure (RGI) (Cannas et al., 2018; Lai et al., 2018) on the basis of four factors, namely the natural, conservation, landscape and recreational values.

It aims at defining and analyzing the relationship between the RGI, identified through the implementation of the methodology proposed in the above-cited articles, and the rules of municipal masterplans (MMPs).

In order to achieve this goal, a methodology based on the overlay mapping of the spatial taxonomy of areas eligible to be part of the RGI and the zoning layouts of MMPs, and on the

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analysis of correlations between the spatial taxonomy and the zoning rules, is proposed. Correlations are identified through regression analysis. The methodology is applied to the MMPs of three municipalities belonging to the Metropolitan City of Cagliari (MCC; Sardinia, Italy). The outcomes of the study offer important suggestions as regards the definition and implementation of the planning policies of the MCC, based on the general goal of strengthening the GI-related characteristics of the towns located within the metropolitan boundaries, with a view to a future expansion of the RGI within the MCC.

This study is structured as follows. Section 2 describes the proposed methodological approach and the spatial context for the implementation of the case study, that is, the towns of Cagliari, Assemini and Capoterra.

The results coming from the regression analysis which explores and detects correlations between the RGI and the spatial zoning rules of the MMPs of the three towns are presented in Section 3. In Section 4, implications for spatial planning policies related to the urban contexts of the MCC are discussed. Finally, directions for future research and concluding remarks are proposed and discussed.

2 MATERIALS AND METHODS

2.1 CASE STUDY

Municipalities are, in Italy, in charge of programs and plans, ruling on land development and land-use changes, hence they draft, adopt and approve their own MMPs, which simultaneously lay down a strategic policy for the concerned territory and provide the setting for the management of small-scale land-use transformation (Commission of the European Communities (CEC), 2000).

Due to the hierarchic nature of the Italian planning system (CEC, p. 35), MMPs must conform to a number of higher-level plans, the most prominent of which are regional plans, and especially the Regional Landscape Plan (RLP).

This study takes the towns of Assemini, Cagliari and Capoterra, in Sardinia (Italy) as case studies. Each town is a municipality, with its own elected local government and mayor, and it is also part of the MCC, recently established under national law no. 2014/56 and regional law no. 2016/2 (Fig. 1).

Cagliari, with its approximately 150,000 inhabitants and 85 km^2 in size, is the regional capital and the metropolitan center; Assemini (having around 27,000 inhabitants and 118 km^2 in size) and Capoterra (with about 23,000 inhabitants and 69 km^2 in size) are two medium-sized towns both geographically and economically close to the regional capital, since they belong

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to the same travel-to-work area, in that a good share (approximately 30 percent (ISTAT, 2019)) of their populations commutes to Cagliari on a daily basis.

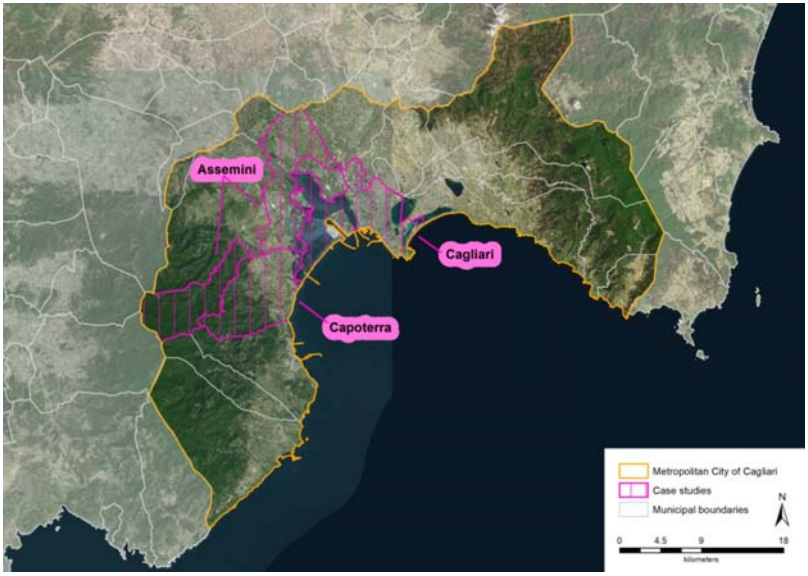

Fig. 1 The study area

Within both the municipalities of Assemini and Capoterra, an MMP recently approved and compliant with the Sardinian RLP is in force; their planning documents and zoning schemes, approved in August 2015 and May 2016, respectively, are available on the municipalities' official web pages[1,2].

As for the municipality of Cagliari, a much older MMP, dating back to 2004, is in force; such plan was approved under the former landscape planning system, hence the complex and conflictual process of adjustment to the RLP (Zoppi & Lai, 2010) has not taken place yet. The planning documents and zoning scheme for the municipality of Cagliari are available on its official webpage[3] and geoportal[4].

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[1] The MMP of Assemini is in force since 27 August 2018. The documents are available online at https://comune.assemini.ca.it/amministrazione/amministrazione-trasparente/pianificazione-governo-del-territorio/piani-programmi-16.

[2] The MMP of Capoterra was published on the Official Journal of the Regional Administration of Sardinia on 26 May 2016. The documents are available online at https://www.comune.capoterra.ca.it.

[3] Available online at https://www.comune.cagliari.it/portale/it/at18_puc.page.

[4] Available online at https://sit.comune.cagliari.it/?filtro=puc#13/39.2238/9.0906.

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2.2 ZONING SCHEMES

For each of the three municipalities, the zoning schemes were retrieved and analyzed in the light of their respective technical implementation norms. Next, the schemes were simplified on the basis of the provisions contained in the norms, so as to reduce as much as possible the number of zone types, for instance, by joining together sub-zones belonging to the same zone type, or by merging zones with similar planning or building rules. This simplification led to identifying ten types of planning zones; out of the ten types, listed in Tab. 1, type "E" is not included in Cagliari's zoning scheme, while types "GS" and "IC" are not included in Assemini's and Capoterra's ones.

ZONE TYPE	DESCRIPTION
A	Historic districts
B	Residential completion zones
C	Residential expansion zones
D	Industrial and commercial zones
E	Agricultural zones
G	Collective service zones
GS	Collective service zones: green parks significant at the city level
H	Conservation and safeguard zones
EZ	Enterprise zones, named "IC" in the MMP of Cagliari
S	Public spaces reserved for collective activities, green areas, or parking lots at the district level

Tab. 1 Homogeneous zones identified by the zoning rules of the municipal masterplans of Cagliari, Assemini and Capoterra: simplified zone types

2.3 METHODOLOGY

This study builds upon a methodology applied in previous studies (Cannas et al., 2018; Lai et al., 2018; Arcidiacono et al., 2016; Lai & Leone, 2017) where a potential RGI is mapped taking an Italian region as a case study: Lombardy in Arcidiacono et al. (2016), and Sardinia in Cannas et al. (2018), Lai et al. (2018) and Lai and Leone (2017). In the Sardinian case, the suitability of each patch of land to belong to an RGI is assessed based upon four factors expressing as many functions provided by a GI, as follows:

- natural value (NatVal), which represents habitats' quality notwithstanding pressures and threats exerted on biodiversity;
- conservation value (ConVal), which accounts for the fact that green infrastructures are, in the definition provided by the European Commission (2013) and quoted in Section 1, "a …. network of high quality natural and semi-natural areas";

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- recreation value (RecVal), which provides an indication of the extent to which landscapes are attractive for recreational uses and hence provide recreational ecosystem services;
- landscape value (LandVal), which accounts for the quality of landscapes as implied in the RLP's normative framework.

The suitability of each patch of land to belong to an RGI is then assessed by summing up the above four values, which all vary in the range (0–1), and it is therefore represented by the total value (TotVal): the higher TotVal, the greater the suitability.

The suitability map representing the Sardinian RGI (Fig. 2) is next overlaid with the zoning schemes of the MMPs provided in Fig. 3. Through a spatial intersection between the two layers, for each resulting polygon a vector having components (Zone, NatVal, ConVal, RecVal, LandVal, TotVal) is produced, where "Zone" represents the zone type assigned by the MMP and can take one of the ten values listed in Tab. 1.

Next, for each of the three municipalities here taken as case studies a multiple linear regression is performed:

$$TotVal_k = \beta_{0,k} + \beta_{1,k}A + \beta_{2,k}B + \beta_{3,k}C + \beta_{4,k}D + \beta_{5,k}E + \beta_{6,k}G + \beta_{7,k}GS + \beta_{8,k}H + \beta_{9,k}EZ + \beta_{10,k}Area \quad (1)$$

where

"k" is the municipality;

explanatory variables representing the zoning scheme ("A" to "EZ", see Tab. 1) are dichotomous, or Boolean, variables; each dichotomous variable can take only two values, 1 or 0, according to the following rule: if a patch is classed under the A zone type, the variable A equals 1, otherwise it equals 0; if a patch is classed under the B zone type, the variable B equals 1, otherwise it equals 0, and so on; each coefficient estimated by regression (1), β_i, i = 1, …, 9, identifies the change in TotVal related to a patch in case it is classed under the zone type identified by the variable associated to the coefficient β_i (i.e., A, B, etc.) with respect to the basic condition that the parcel of land under consideration was classed as "S" zone type; the coefficients estimated by regression (1), β_i, i = 1, …, 9, define a taxonomy of the zone types based on the quantitative contribution to TotVal expressed by the values of β_i, i = 1, …, 9;

"Area" is the size of the parcel of land under consideration, resulting from the spatial intersection between the zoning map and the RGI suitability map; results from the multiple linear regression are finally used to develop, for each municipality, an ordered list of the planning zones; for each municipality, the order depends on the value of the coefficients β_i, i = 1, …, 9, of regression (1).

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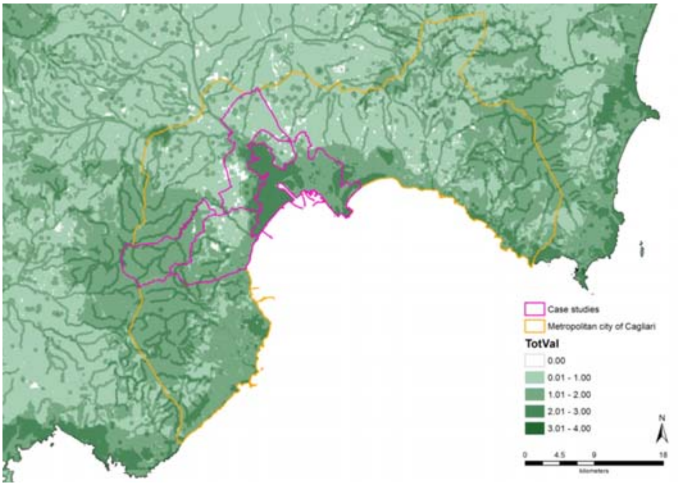

Fig. 2 Map of the total value, which identifies the eligibility of patches to be included in the Regional green infrastructure

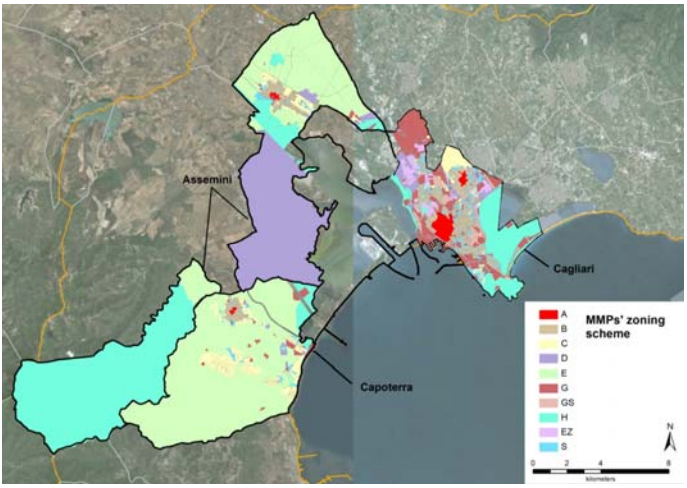

Fig. 3 The zoning layout of the MMPs of Assemini, Cagliari and Capoterra

3 RESULTS

The estimates of the regressions related to Cagliari, Assemini and Capoterra define the features of the effects of a zone type on the eligibility of a patch to be included in the RGI. Indeed, each coefficient of the dichotomous variables estimated in the regressions identifies the effect on the eligibility of a patch to be included in the RGI as a consequence of it being classified as a homogeneous zone type from "A" to "H," or as "EZ" or "GS" (only for the MMP

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of Cagliari, which does not show any "E" zone type) types, with respect to the basic situation of a patch being classified as "S" homogeneous zone type.
This estimated effect equals the difference in TotVal, everything else being equal. Accordingly, a ranking of the homogeneous zone types can be defined, on the basis of the estimated effects, from the highest to the lowest.
The zone types which mainly help to characterize a patch as being eligible to be part of the RGI are (i) the "A" type, that is, historic and artistic center, featured by environmental values related to the built environment, with the exception of Capoterra, whose "A" zone is, by the way, less attractive and valuable than Cagliari's and Assemini's corresponding areas; (ii) the "E" type, which identifies rural and agricultural areas, characterized by the lowest levels of soil sealing and land take (this type of zone is not present in the zoning layout of the MMP of Cagliari); and, above all, (iii) the "H" type, which is characterized by patches which the MMPs identify as worth protecting because of their environmental and landscape-related features. The effect on the eligibility of the "GS" zone type, which identifies open spaces and recreational areas, that is, almost-totally unbuilt areas, and which is only included in the zoning layout of the MMP of Cagliari, is consistent with the effect of the "H" zone type as well.
Tab. 2 highlights the ranking of the zone types as regards their influence on the eligibility of patches to be included in the RGI, and the corresponding means of NatVal, ConVal, LandVal and RecVal, in order to identify the factors' influence in a comparative way.
With reference to the "A" and "H" (and "GS," in the case of Cagliari) zone types, the average values of LandVal are comparatively high, since they are always higher than 0.6. The average values of NatVal of the "E" zones are lower than the "A" and the "H" zones' values, even though they are higher than the remaining zones. Moreover, the "H" zones show the highest average values of ConVal in all of the three cases, although there is room for improvement, since they are never higher than 0.3.
On the other hand, the conservation value on average equals zero as regards patches located in the "A" zones, whereas it is very close or equal to zero in already-urbanized areas or in areas characterized by ongoing advanced urbanization processes, such as "B," "C," "D," "G," "EZ" and "S", which is consistent with expectations, since it is very unlikely that habitats protected under the provisions of European Union rules can be found in these areas.
The results of the regressions show that the "A," "E" and "H" zone types are the most important in terms of impact on the eligibility of patches to be part of the RGI.
Moreover, Tab.2 stresses that there is still large room for improvement as regards all the zone types. For example, the almost-totally urbanized areas classed as "B,", "C," "D," "G, "EZ" and "S" zone types show non-null NatVal and RecVal, and often comparatively not so low, in each of the three MMPs, especially with reference to the recreational profile (RecVal), which gives

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credit to possible scope for improving RGI-related features of areas located in the three towns of the MCC.

ZONE TYPE	CAGLIARI					ASSEMINI					CAPOTERRA				
	Rank	Average Values				Rank	Average Values				Rank	Average Values			
		NatVal	ConVal	LandVa	RelVal		NatVal	ConVal	LandVal	RelVal		NatVal	ConVal	LandVal	RelVal
A	2	0.432	0.000	1.000	0.573	4	0.000	0.000	0.722	0.087	NS				
B	6	0.030	0.000	1.000	0.261	6	0.038	0.000	0.200	0.065	5	0.049	0.000	0.027	0.068
C	NS					NS					NS				
D	7	0.233	0.000	0.952	0.039	2	0.644	0.162	0.636	0.010	NS	NS	NS	NS	NS
E	NP					3	0.482	0.028	0.352	0.006	3	0.529	0.061	0.523	0.010
G	NS					NS					2	0.448	0.057	0.639	0.019
GS	3	0.607	0.024	1.000	0.262	NP					NP				
H	1	0.675	0.204	1.000	0.195	1	0.748	0.187	0.647	0.005	1	0.696	0.282	1.000	0.038
EZ	4					NP					NP				
S	5	0.101	0.001	1.000	0.225	5	0.316	0.000	0.258	0.030	4	0.288	0.022	0.513	0.034

Tab. 2 Ranking of the homogenous zones based on the contribution to TotVal implied by the regression results, and average values of the four factors which determine TotVal, related to each homogeneous zone (NP: the homogeneous zone is not present in the MMP's zoning rules; NS: the regression p-value entails that the coefficient is non-significant)

Particularly relevant is the improvement margin related to agricultural areas ("E" zone type) and to the protection areas ("H" zone type) as regards all of the four values.

This implies that the ruling framework related to these zone types would be worth exporting to other parts of the municipal land in order to increase the eligibility of patches to be included in the RGI.

4 DISCUSSION AND CONCLUSIONS

The study analyzes the relations between the land uses, defined in the MMPs of three local municipalities included in the MCC, and the RGI whose identification is based on the methodology proposed by Lai and Leone (2017).

According to the results presented in Section 3, the "H" zones are the areas that mainly positively affect the eligibility of patches to be part of the RGI in the three study areas. In

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particular, in relation to "H" zones, the average values of the four factors show the following similar trends (i) NatVal is higher than 0.5; (ii) ConsVal and RecVal are lower than 0.5; and (iii) LandVal equals 1 (maximum value) in the case of Cagliari and Capoterra and is lower than 0.7 in the case of Assemini. As a consequence, there is plenty of room for improving two out of the four factors (ConVal and RecVal).

ConVal is mainly influenced by the presence of habitat of community interest. "H" zone types are conceived as areas of particular environmental and natural interest; thus, they may represent buffer zones to protect high-quality sites, such as Natura 2000 sites, or steppingstones along migration routes. A possible policy recommendation aims at extending the environmental protection regimes related to habitats and species beyond the boundaries of protected areas by identifying those patches that, in relation to their characteristics, could be suitable for species and habitats. Therefore, advancements of scientific knowledge related to habitats and species within "H" zones and awareness-raising activities are preliminary necessary steps in order to increase the size of protected areas. In line with this recommendation, Maiorano et al. (2007) suggest that integrated management of Natura 2000 sites and of their neighboring areas may improve the effectiveness of conservation measures within protected areas due to control over human-induced activities in the surrounding areas.

Acting on elements that influence RecVal shows more room for improvement than ConVal due to its lower values in relation to "H" zones in the three study areas. RecVal is calculated on the basis of geotagged information retrieved from the social media Flickr, representing the attractiveness of a certain area to visitors in a defined time period. Several studies (Heagney et al., 2018; Amoako-Tuffour & Martinez-Espineira, 2007; Font, 2000) show that recreational attractiveness of an area, conceived of as the demand for recreational activities, is influenced by different factors, such as accessibility and accommodation availability. Therefore, a possible recommendation concerns making these areas more accessible through infrastructures that, on the one hand, support slow mobility (such as cycle and pedestrian paths) and, on the other hand, do not increase habitat fragmentation. In fact, increased fragmentation of habitats is likely to result in decreasing values of ConVal and NatVal.

In relation to NatVal, although its average values are quite high (between 0.67 and 0.75) in all of the three case studies, there is still some room for improvement. NatVal is mainly influenced by land uses and threats to habitats, identified through standard data forms of regional Natura 2000 sites. From this standpoint, two types of policy actions should be taken into account as particularly effective: reduction of threat and mitigation of land-taking processes. Both these actions can include measures aiming at restoring ecosystems, also through the use of nature-based solutions (NBSs). The concept of NBSs was coined by the European Commission (2015) to define techniques and solutions based on the use of nature

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in urban areas. NBSs are designed to address effectively several social challenges in terms of effective resources management, and, at the same time, to provide economic, social and environmental benefits. NBSs are more efficient and cost-effective solutions than traditional approaches (Lafortezza et al., 2018). The European Commission (2015) identifies a series of NBSs to make cities more livable and sustainable, such as the restoration of abandoned and degraded areas, the use of permeable surfaces and of rain gardens to manage and control rainwaters within urban settlements. For example, in the city of Cagliari a significant and troubling phenomenon, represented by agricultural uses and informal settlements, characterizes a particular "H" zone type, called "AR—Is Arenas" within the regional "Molentargius-Saline" park. In these areas, specific measures to mitigate threats caused by urban settlements are necessary.

Moreover, due to the positive influence of "H" zones on the eligibility of patches to be part of the RGI, both the increase of the existing "H" zones and the definition of new "H" zones at the expense of other zones could represent a possible policy action.

In relation to Capoterra and Assemini, "E" zones also influence positively the eligibility of patches to be part of the RGI. The average values of NatVal, ConVal, LandVal and RecVal are lower than those that can be found in "H" zones and, for this reason, there might be more room for improvement, in particular in relation to NatVal and ConVal. Natural value is mainly influenced by the quality of land covers, frequently threatened by intensive agricultural use and by habitat fragmentation due to rural settlements and infrastructure. He et al. (2017)in a recent work, where they study the impacts of land covers on habitat quality, suggest improving habitat quality through agricultural policies that promote a more sustainable use of land, with particular attention to isolated rural settlements. In relation to ConVal, as promoted by the 2014–2020 Sardinian regional Rural Development Program, a possible policy could include sustaining agri-environment-climate commitments, comprising, among others, incentives to support those farmers who allocate part of their farmland for wildlife (e.g., establishing grass swards along wetlands, keeping unharvested conservation lands for wildlife, or maintaining hedgerows and drywalls for small vertebrates).

In conclusion, the proposed methodology can be regarded as a tool in support of decision-makers that can be exported to other European contexts, where Natura 2000 Network is established in compliance with the Habitat Directive. The main advantage of the proposed methodology is its flexibility, which makes it possible to add new values in order to include normative, social and economic aspects that characterize other European contexts. A first most significant limitation concerns the assessment of place attractiveness (RecVal) based on social media only, although some research has argued that social-media retrieved information can be used as a reliable proxy for visitation data (see, for instance: Heikinheimo et al., 2017;

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Wood et al., 2013; Sessions et al., 2016). A second limitation stems from the fact that the methodology for assessing natural value (NatVal) does not take NBSs (such as green roofs or green walls) into account, hence possibly underestimating the natural value in built-up areas. These limits could be addressed in future research.

NOTES

+This article is extracted from: Lai, S., Leone, F, & Zoppi C. (2019). Assessment of municipal masterplans aimed at identifying and fostering green infrastructure: A study concerning three towns of the Metropolitan Area of Cagliari, Italy. *Sustainability, 11 (1470)*, 17 pp. doi: http://dx.doi.org/10.3390/su11051470.

Sabrina Lai, Federica Leone and Corrado Zoppi have made substantial contributions to the study's conception, background and design remarks (section 1). The methodological discussion proposed in section 2 is by Federica Leone. Sabrina Lai took care of the database and results presented in section 3. Moreover, Sabrina Lai has drawn the maps of the three Figures reported in the study. The discussion and concluding remarks of section 4 are by Corrado Zoppi.

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AUTHORS' PROFILES

Sabrina Lai is a Civil engineer, Sabrina Lai is Research Doctor in Land Engineering (Italy, 2009), and MSc in International Planning and Development (UK, 2008). She is currently an officer at the Regional Administration of Sardinia, Department for the Environment, Division for Nature Protection and Forestry Policies.

Federica Leone, Building engineer, is Research Doctor in Land Engineering (Italy, 2013), and MSc in International Planning and Development (UK, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Corrado Zoppi, Civil engineer, is Doctor of Philosophy in Economics (USA, 1997), Doctor of Research in Territorial Planning (Italy, 1992), and MSc in Economic Policy and Planning (USA, 1990). He is a Professor at the University of Cagliari (Sector ICAR/20 – Spatial planning). He is presently teaching at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari in the Undergraduate and Graduate Programs in Environmental and Territorial Engineering and in Sustainable Tourism Management and Monitoring (Regional and Urban Planning, Strategic Planning and Environmental planning).

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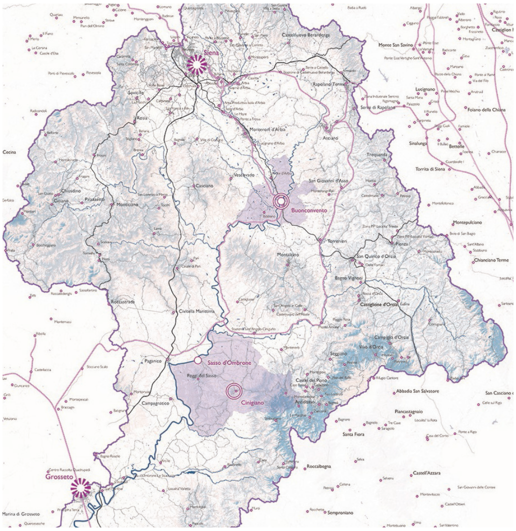

THE OMBRONE RIVER CONTRACT

A REGIONAL DESIGN PRACTICE FOR EMPOWERING RIVER COMMUNITIES AND ENVISIONING BASIN FUTURES

CARLO PISANO, VALERIA LINGUA

Department of Architecture
University of Florence
e-mail: carlo.pisano@unifi.it
valeria.lingua@unifi.it
URL: http://www.regionaldesignlab.com

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ABSTRACT

By their very nature physical networks and natural infrastructures and, in particular, rivers have always had the prerogative of connecting peoples, landscapes and cultures, embodying a great historical, economic, social and environmental wealth. At the same time – due to their supra-local character and their geographic configuration – they have often highlighted a great difficulty in applying tools related to their management (Danese, Chicca, 2007).
The paper aims to describe the methodology used for the definition of a River Contract based on the Regional Design operational approach. It traces the path of research-action that led the local community of Buonconvento, a small Tuscan town in the province of Siena, to activate networks of social capital useful to build the coastal community.
In this particular institutional and scientific context, the River Contract represents an opportunity to build a more equitable and sustainable future, encouraging the dialogue and the association of the entire coastal community. Understood, in fact, as a pact for the rebirth of the river basin, the River Contract calls institutions and individuals to a non-sectoral vision to be managed in collective forms.

KEYWORDS
Strategic Planning; Participation; Scenarios; Pilot project; Regional Design

1 INTRODUCTION

On the 21st of October 2013, the Municipality of Buonconvento was flooded, along with several other municipalities touched by the river Ombrone and its tributaries (in particular the Arbia River). This event caused the flooding of the historical citycentre and the twentieth-century expansion, the destruction of the regional railway line and a bridge that led to the isolation of a whole settlement for more than six months.

Following this event, the "Committee for the enhancement of the landscape and environment of Buonconvento" (Comitato per la valorizzazione del paesaggio e dell'ambiente di Buonconvento), thanks to a previous experience of local mobilization concerning the installation of a biogas plant that would have had a significant impact on the landscape (Lingua, 2010, 2014), has undertaken a long process of confrontation with the institutions responsible for the governance of the territory and the river basin, to understand what could be the most appropriate ways for a quick restoration of the bridges and the road and railway network. A framework of complex competences (Land Reclamation Consortium, Civil Engineering Department, District, Municipalities) was outlined, in which emerged the need to activate integrated policies for soil and water protection and the enhancement of the territory and the environmental resources. This need was further strengthened by a second flood event, which took place on the 24th of August 2015.

The succession of alluvial episodes with a "theoretical" fifty-year return time has contributed to further increase the sense of citizens weakness towards these catastrophic events, as well as the sense of mistrust towards the institutions responsible for the management of the river and, in general, to the government of the territory. These facts made clear the need to know and make the river known to the populations that overlook it and to transform the external perturbations in an opportunity for the community growth, not just locally but at a territorial scale (Floridia, 2016).

To meet these needs, the Committee has identified the River Contract as a proactive path towards an integrated concept of sectoral policies in a multifunctional vision of the river, and the Regional Design Laboratory of the Department of Architecture of the University of Florence as partner in the definition of a research-action pathway aimed at conveying the institutional interest towards the process and, at the same time, improving the perception of the river by citizens residing along its shores. The research was then supported by the operational methodologies of *Regional Design* (Lingua & Balz, 2019; Neuman & Zonneveld, 2018) for building up a collective image of the riparian community and defining a shared vision of its territorial development, in reference to both the local specificities and the river basin as a

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whole, in relation to a renewed perception of the river as resource and opportunity rather than a risk.
This paper unravels the path that has led to the definition of the Ombrone River Contract as an empirical pretext to discuss both the social premises and the methodologies within which approaching a River Contract as an occasion to build up and make operational a shared vision of a "larger-than-local" context as the one of a river basin. Born as a bottom-up proposal by the local Committee, when joined by the University of Florence the process has been developed as a research-action practice. The joint action of the Committee and the University, operating at different scales (local vs regional) kicked off by the local community of Buonconvento to activate networks of social capital within the community itself and with the neighbouring cities and associations of the whole river basin. The methodology developed for the definition of the basin visions, based on the *Regional Design* operational approach, has been conceived as an opportunity to involve local communities of the entire coastal area around a non-sectoral vision and to reflect on the ways to make the River Contract operational in collective forms. After a brief description of the territorial context of the Ombrone river basin, with a particular focus on the community of Buonconvento (section 1), section 2 details the methodological framework and section 3 presents the preliminary results of this research-action process; the last paragraph rounds off the contribution with a set of conclusions underlining the research prospects and operational application of *Regional Design* methods and techniques in processes of activation of River Contracts.

2 METHODOLOGY

The River Contract has the intrinsic objective of integrating and territorialising sectoral policies into a multifunctional vision of the river, through a process that coordinates and supports local participation in constructing a new sense of community linked to the definition of a shared vision. The River Contract as defined in Italy by the National Chart of River Contracts (V National Table of River Contracts, Milan 2010) aims to bring together the different actors of the territory into an integrated, multidimensional, multidisciplinary approach (Ingaramo & Voghera, 2016). The institutions and authorities which are directly involved in the management of the river and the territory, the inhabitants and all the different stakeholders are linked in a pact that foster a non-sectorial vision in which the river is perceived as an environment of life (European Landscape Convention - 2000) and therefore as a common good to be managed in collective forms.
The process leading to the formation of a River Contract has already been undertaken in several river basins both in Italy and in Europe (Voghera & Avidano, 2010). The innovative nature of the Ombrone project lies in the kick off from the bottom, from the riparian citizens.

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As a consequence, the local reality becomes the starting point for a process that links different scales of action and operating methods. In managing this link among scales and actors, a *Regional Design* approach has been developed.

From a general perspective, the *Regional Design* approach uses visioning as an act of explanation of current and future scenarios through the definition of an horizon (Secchi, 2003). Therefore, referring to a large scale design (in this case, the fluvial region), together with the 'analytical' and 'normative' dimensions of planning concepts (Davoudi, 2003), *Regional Design* represents the process of explication of the third dimension, the 'argumentative' one (discursive), through which the spatial representations assure the analytic process of co-production of knowledge and, at the same time, attribute meaning to the definition of strategies and actions, through their spatial transposition (Balz & Zonneveld, 2014). In the Ombrone project, the research has followed different trajectories and models enriched by the contribution of different experiences and expertise. As summarized in the methodological diagram (Fig. 1) the work is composed of two parallel and strongly linked processes: the participatory process – developed with experts[1] and technicians, with citizens and schools – has in fact integrated the visioning process defined in the scientific research field, binding it to the reality and local ambitions. Furthermore, following a transcalar methodology (Ingaramo & Voghera, 2016), the scale of the work, from the analysis to the project, has followed an oscillating trend from the large scale of the "scenario construction" up to the scale of the detailed projects of "case studies", and then returned to the evaluation of the results for the entire river basin, passing through the definition of the more technical thematic maps, useful to foster the participatory process. It was therefore important to find an instrument able to ground on a shared vision the choices of valorisation of the territory and the landscape, composing conflicts and interests at the local level through negotiating processes, building a dialogue between the socio-economic political and planning instruments with those of local government. One of the methodologies proposed in the research is based on the "scenario construction" (Secchi, 2003), a technique of pre-vision of the future often investigated both in research experiences and in professional practice (Gabellini, 2010; Magnaghi, 2007; Secchi, 2003) The scenarios are intended as hypothetical and opposing stories of the future that answer the question: "what would happen if ..." (Secchi, 2003).

The scenario is therefore a collection of hypotheses that question the future, and which allows to deal with and discuss about the future (Cavalieri, 2013; Pisano, 2016; Viganò, 2010). In this sense, the scenario has the capacity to assist the correct reconstruction of problems: a

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[1] The partecipatory process, entitled "Osiamo!Verso ilcontratto di fiumeOmbrone", was financed by Toscana Regiona (L.R. 69/2007) and coordinated by Micaela Deriu and Fabio Ferlanda.

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problem setting service, able to isolate issues and place them in a reciprocal relationship. Through the construction of scenarios is therefore possible to separately study and discuss different thematic systems – hydraulic, naturalistic, economic and social aspects – in order to ground and specify conflicts and interests.

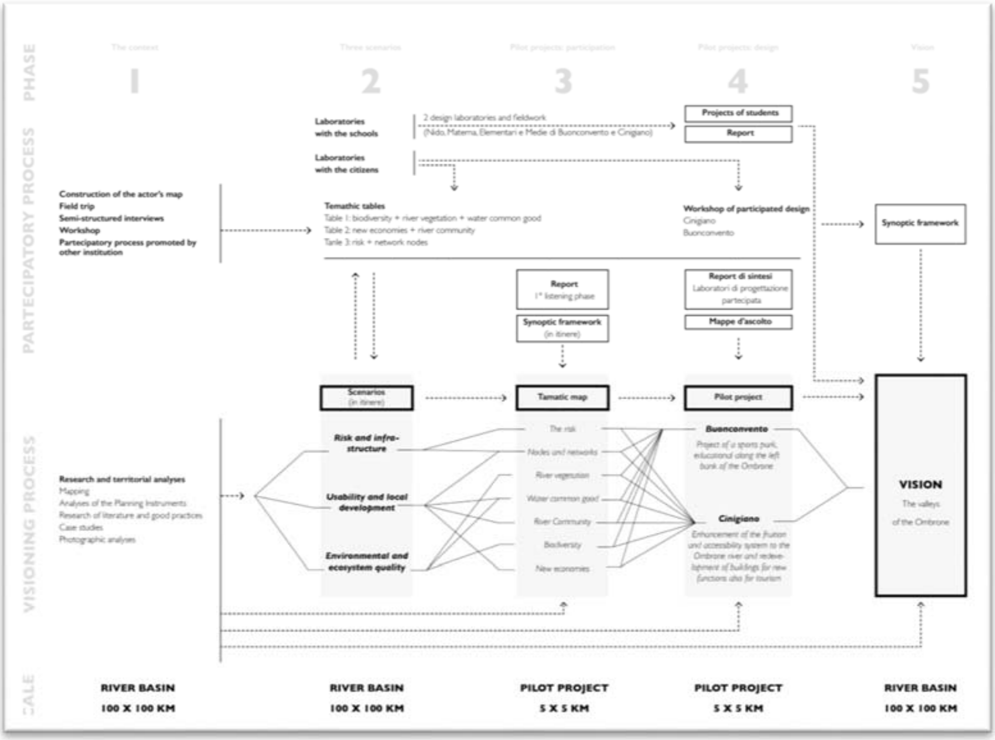

Fig. 1 The methodological structure of the research

The purpose of the River Contract is however to foster a process in which the different aspects, related to the river management, can coexist and integrate with one another. This quest for integration and convergence between the themes, expressed in scenarios, was approached at the local dimension through the use of the pilot projects methodology. Included in several theoretical framework, such as Landscape Urbanism (Steiner, 2011), DIY Urbanism (Sawney, 2015) and Tactical Urbanism (Lydon, 2015) – pilot projects are meant as community engagement and as instruments to learn about how planning and design decisions actually hit the ground, thereby improving the final implementation (Gehl, 2017). In the down-scaling from macro to micro, the regional-scale strategies have been tested in more detailed projects that, once developed and shared with the community, have been scaled-up in their strategic assumptions to inform again the final river basin vision.

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3 RESULTS

For the reasons described above, the scenarios construction has been chosen as a consistent methodology to organize the various points of view and the interests that animate the river and its management. First, an analysis of general and sectoral spatial planning instruments at Regional and Provincial level has let to provide for a scenario integrating different ways to conceive the basin area and its future. These projects, together with the results of the workshops with citizens and school children held in the first participatory phase, provided for defining three main issues (Tab. 1), at least partly divergent: risk and infrastructure; environmental and eco-systemic quality; accessibility and local development.

AUTOHORITY - Planning instrument	VISION 1 Risk and infrastructure	VISION 2 Environmental and eco-systemic quality	VISION 3 Accessibility and local development
TUSCANY REGION - Regional Spatial Framework and Landscape Plan (Piano di indirizzo territoriale con valenza di piano paesaggistico)	L	M	H
TUSCANY REGION - Regional Mobility Plan (Piano Regionale Integrato Infrastrutture e Mobilità (Priim))	H	M	M
TUSCANY REGION – Regional Plan for Mining Activities (Piano Regionale delle Attività Estrattive (PRAE))	M	M	L
TUSCANY REGION - Rural Development Program (Programma di Sviluppo Rurale)	L	M	H
DISTRICT BASIN AUTHORITY OF THE NORTHERN APENNINES - Flood Risk Management Plan (Piano di Gestione del Rischio Alluvioni)	H	M	M
BASIN AUTHORITY - Basin Plan - Hydrogeological Plan (Piano di Bacino - Piano di Assetto Idrogeologico)	H	L	L
TUSCANY REGION – Multi-year intervention programs (Programmi di intervento pluriennali)	H	M	M
LAND RECLAMATION CONSORTIUM- Reclamation activities plan (Piano delle attività di Bonifica)	H	H	M
SIENA PROVINCE – Provincial Territorial Coordination Plan (Piano Territoriale di Coordinamento Provinciale)	L	M	H

Tab. 1 Correlation between planning instruments and visions (High-Medium-Low)

These three scenarios call for different ways of understanding the river and its future, conveyed by groups of technical stakeholders, differentiated local interests, often in conflict

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with each other and accustomed to different specific languages and terminologies. The three scenario maps elaborated for the Ombrone river favour a representation of information organized in systems, envisioning the result of an interpretive action. This interpretative action is intended to develop different representations of the same river basin, which construct a reading of the territory organized on issues consolidated in planning practices and in the local debate (Carta, 2009): the synthesis directed to highlight the system of large infrastructures and hydrogeological risk and the works aimed at mitigating it; the synthesis focused to underline the interaction between the environmental and ecological dimension of the territory; finally, the one aimed at organizing the anthropic dimension, sustainable mobility and local development (Fig. 2).

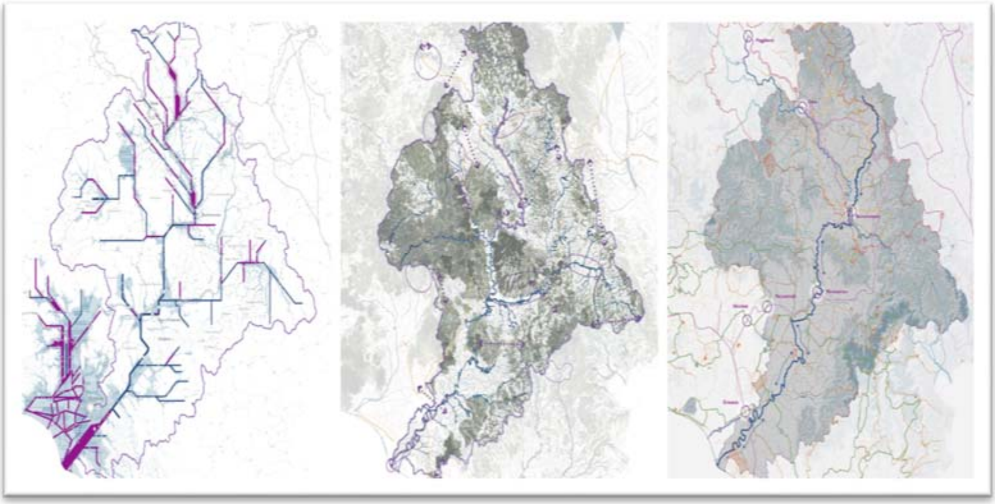

Fig. 2 Three scenarios for Ombrone river. From left: risk and infrastructure; environmental and eco-systemic quality; accessibility and local development

The different scenarios informed and were informed by the participatory process which was based on the two case studies of Buonconvento and Cinigiano municipalities, which have been chosen as representative of two very different realities of the river basin. Those two municipalities are, in fact, located in two territorial areas both along the river, but different from an ecological, political and topographical point of view (high and low Ombrone, province of Siena and Grosseto). Through a series of participatory planning workshops, a collective reflection on the impact of different scenarios in the local area and on possible intervention strategies was developed.

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The participatory design workshops have shown how the pilot project could be intended as a tool able to recompose the divergent large-scale scenarios in an integrated design perspective. Thus, the use of the fluvial territory can, for example, find a point of equilibrium with respect to the safeguard and enhancement of environmental and ecosystem quality; or the hydrogeological risk management and mitigation works can coexist with fruitive and productive activities.

In this way, the local scale becomes the key dimension for the definition of integrated policies able to guarantee the balanced management and development of the fluvial territories and its community.

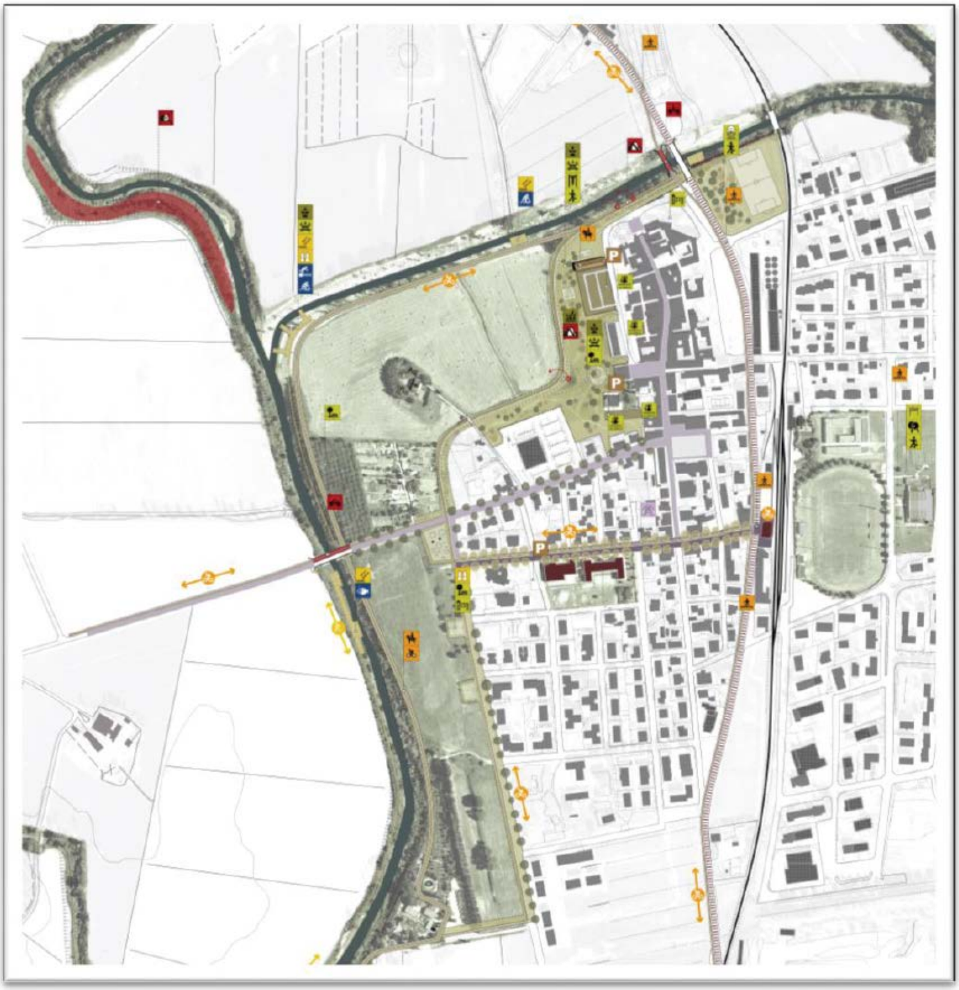

Fig. 3 Pilot project of Buonconvento (SI): the masterplan resulting from the participatory process

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4 CONCLUSION

The innovative character of the research-action path undertaken by the Regional Design Laboratory together with the Buonconvento Committee regards two elements: the structure of the bottom-up approach and the methodology used to define the vision of the riparian community.
Concerning the first point, the project seeks to find an integration between representative and participatory democracy starting from the bottom (bottom-up approach): the shared action of the local and the scientific community, which is also enriched by local researchers involved in the research-action process, outlines a concrete approach, based on a clear civic will that compares itself with the administrations to resolve the division of political competences. With respect to several examples of River Contracts both in Italy and abroad, generally promoted by supra-local institutions, in this case the proposal comes from a community that aims to involve a substantially wider territorial area and, starting from a traumatic event, to develop a collective reflection on the relationship with the river of the entire riparian community. This reflection, addressed with *Regional Design* methods and techniques, can give substance to a "regional project" that is as necessary as challenging, given the context of historical criticalities in which it is inserted.
In particular, the methodology consisted of a mutual contamination between scales (from micro to macro and vice versa) and between policies (from short to long term and vice versa), acting at the same time at the scale of the river basin – through the surveys subsumed in the three territorial scenarios – and at the local scale, through the two pilot projects. The results are then recomposed in a continuous process that binds the different scales of action and operating modes.
This process is therefore an attempt to overcome the hierarchical visionof the urbanistic and architectural design, placing in relation, from the first moment, structural and strategic choices with the design of the single nodes.
The current outcomes of this research-action path, as well as its future developments, through the definition of integrated pilot projects, shows that the use of *Regional Design* methods and techniques in the processes of activation of River Contracts opens wide research prospects and operational application, linked to the definition of indicative frameworks, images and visions of the territory and the interaction between the different institutions and projects, and between these and the stakeholders involved in the project of the future of the coastal territory.

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AUTHOR'S PROFILE

Carlo Pisano is assistant professor in Urbanismat the University of Florence, Department of Architecture, *Regional Design* Lab. He has been researcher, professor under contract and visiting critic in the field of urban design, urbanism and strategic planning. He has worked as designer and consultant in numerous international projects in Belgium, Russia, Austria and Italy.

Valeria Lingua is associate professor in Urban and Regional Planning at the University of Florence, Department of Architecture, *Regional Design* Lab. Her research interests are concerned with spatial planning and regional design, with a focus on cooperative governance in strategic planning practices at regional and local levels. Recent research activities concern the rescaling of planning systems and spatial planning across local boundaries, in the framework of a research project founded by the Italian Ministry of Education, Universities and Research within the prestigious SIR Programme (Scientific Independence of young Researchers) aimed to support young researchers at the start of their independent research activity.

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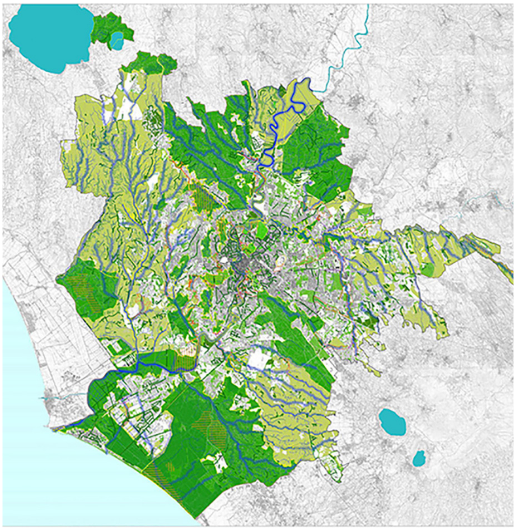

GREEN INFRASTRUCTURES IN THE MASTERPLAN OF ROME

STRATEGIC COMPONENTS FOR AN INTEGRATED URBAN STRATEGY

LAURA RICCI, CARMELA MARIANO
IRENE POLI

Department of Planning, Design, and Technology of Architecture
University of Rome - Sapienza, Italy
e-mail: laura.ricci@uniroma1.it
carmela.mariano@uniroma1.it
irene.poli@uniroma1.it

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ABSTRACT
As part of the research and experimentation activities by the Department of Planning, Design and Technology, Sapienza University of Rome, the contribution is set in the context of the Research project "Mediterranean Europe. Strategies of urban and metropolitan rebalancing", taking as its central theme the essential role of green infrastructures (GI) within planning processes aimed at urban and metropolitan rebalancing, and the implementation of urban and territorial regeneration strategies. The Research, in the conviction that urban regeneration is not feasible, in Italy, without a reform of the national urban planning legislative framework, adopts the need to start a process to renew of urban planning instruments involving the entire planning system. For these purposes, and starting from the awareness that significant disciplinary paradigms are already present in the experimentation of the plans and projects, as well as in regional legislative experiences, that have changed the strategies and competences of the urban plan by developing an effective model of a sustainable local plan, Research has investigated, with reference to some Italian cities comparing with European cases, the GI's potential to activate, as components of planning, ecological connection systems within large metropolitan areas. Among the cases investigated, the contribution focuses on the emblematic experience of the New Masterplan of the City of Rome (2008), and, in particular, on the decisive role played by the Environmental System and the Ecological Network for the purpose of implementation and managing the overall urban planning strategy of rebalancing and regeneration that inspired it.

KEYWORDS
Urban Regeneration; Ecological Network; Sustainable Planning; Green Infrastructure

1 INTRODUCTION

The contribution is set in the context of the Research project "*Europa Mediterranea. Strategie di riequilibrio urbano e metropolitano*", PDTA Department (2017), financed by Sapienza University of Rome, taking as its central theme the role of *green infrastructures* (GI) within planning processes aimed at urban and metropolitan rebalancing, and at putting into play strategies of urban regeneration characterized by a strong integration between interventions of morphological, cultural, and social requalification, and actions of an environmental nature (Oliva & Ricci, 2017).

Extended over the large-area—this strategy, in heralding a new decentralized urban organization that is polycentrically-structured, sustainable and accessible (Ricci, 2014), provides an integrated response to the demands of environmental regeneration, social revitalization, and cultural and economic valorization of the city, in accordance with principles of environmental and socioeconomic sustainability (Arcidiacono et al., 2016; Sbetti et al., 2016), calling into question certain structural limits of the current urban forms, and implying "an overcoming of the sectoral approach in favor of an integrated approach to urban complexity" (Maciocco, 2015).

In this setting, the Research deeply examined the issue of the GIs that appear as territorial components starting from which new strategies may be developed, aimed at reducing vulnerability and increasing the territory's resilience, while making the most of the specific ecosystem potentials (Mariano & Marino, 2018).

The European Union (EU, 2013) defines GI as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services". This definition includes three important aspects: the concept of ecological connectivity, as a network of territorial systems and areas, environments, and landscapes; the key role of planning; the concept of multifunctionality of ecosystems which, as the European Commission pointed out in 2012 (EC, 2012), refers to the range of functions that GIs can guarantee – including protecting ecosystems and biodiversity, improving the functionality of ecosystem services, promoting society's health and well-being, supporting the green economy – in order to ensure the essential conditions for the sustainability of the transformative processes. GIs, then, are a "cross-cutting network paradigm" (Gambino, 2010a) of the planning process, characterized by a multi-scalar and multi-sectoral approach, capable, within a broader regeneration strategy, of capitalizing on the interactions among the various connective and network systems, that traverse the territory (the hydrographic network, the ecological network, the cultural assets network, the agricultural fabric network, the soft mobility network).

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1.1 THE ROLE OF GREEN INFRASTRUCTURES IN URBAN PLANNING

The planning experiences being studied in the Research, with particular reference to French and Spanish cases, underscore the structural role played by GIs as full-blown invariables for the development and reconfiguration of the physical and socioeconomic aspects of the territories.

In these experiences, the networks represent the *structure* for urban and territorial regeneration, the framework for implementation and for the sustainable and *green* management of the public city, while also reducing costs by implementing systems for recycling and saving resources. They also contribute towards the change in citizens' values and lifestyles, towards a greater attention to and awareness of the environment and its preservation, and towards the development of new sustainable modes of use. This is also achieved by promoting new functions capable of restoring a sense and central importance to the territory's places of identity, in the context of processes of reclaiming and valorizing common goods (Ravagnan & Poli, 2017). The features of inter-scalarity and integration of GIs appeal to the need for a multi-level planning system, from the local one to the territorial, regional, or metropolitan one, supported by an inter-institutional and integrated governance.

1.2 RESEARCH METHODOLOGY

In particular, the main objective of the Research was to identify, starting from the debate and the examination of some European planning experiences, the methodological references and the tools for implementing interventions of urban regeneration. This is especially the case in the presence of risks and degenerative processes such as those connected with climate changes, and those of "dealing, using a systemic approach, with the complex roots of the environmental and territorial dynamics; of producing adequate knowledge and understanding of local realities and their development trends; of proposing holistic visions of the problems to be faced; and of advancing design possibilities capable of anticipating events and of giving a pro-active role to public leadership" (Gambino, 2010b).

Towards these purposes, the Research puts into play a multidisciplinary, integrated approach which, has as its central aim the creation of an open dialogue that joins together conceptual, cultural, and disciplinary paradigms that make reference to the notion of urban planning and territory on the one hand, and of environment and landscape on the other – notions traditionally considered in terms of opposition, and the prerogatives of separate and sectoral planning. In this framework, an emblematic role was place by the experience of the Masterplan (*Piano Regolatore Generale*) of the Municipality of Rome, approved in 2008 (PRG '08).

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2 INTEGRATING ECOLOGY AND URBAN PLANNING. THE ROLE OF EXPERIMENTATION

From the 1990s in Italy, the experimentation of *reformist local plans*, aims at an integration between ecology and urban planning, has profoundly changed content, strategies, and competences of the urban plan, developing a new sustainable model, centered upon the conservation of non-reproducible environmental resources, the regeneration of reproducible ones, and the objective that developing and transforming the city might not erode these resources.

The ecological regeneration strategy refers to the set of actions, activated directly by the plan, to improve the quality of the environmental resources, in support of the regeneration natural processes.

The strategy aims to:

- increased permeability of urban land, tree cover, and biomass;
- increased public and private greenery;
- reduced air pollution;
- preventive restoration of the lands to be reused.

Urban planning sustainability is operatively developed through:

- exclusion of new forms of urban expansion, orienting towards regenerating the existing city;
- environmental ecological compatibility of the mobility system and of the technological networks;
- application of principles and rules to increase the potentials of environmental regeneration and guarantee the compatibility of the plan's implementation, with reference to the existing city and to the settings of transformation (re-waterproofing of urban land; increase public or private greenery; creation of an ecological network providing connection between environmental, natural, and manmade components).

The PRG '08 of Rome refers to this cultural and disciplinary arrangement, making an important contribution towards developing a model for urban sustainability and, more generally, towards the process of innovating the planning system for the purposes of a reform of the national urban planning legislative framework.

3 THE MASTERPLAN OF ROME

The PRG '08 of Rome is to date an emblematic case of anticipation, confluence, and actualization of the most significant elements of output in the discipline over the past twenty

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years. Through a system of rules, tools, procedures, and implementation mechanisms, it has helped herald a new integrated, inter-scalar, and multidisciplinary approach to urban regeneration.

The Plan, approved in 2008 (City Council approval Decision no. 18/2008), was the result of a long planning process begun in 1994, which brought into focus and gradually implemented the overall urban planning strategy of regeneration and of urban and metropolitan rebalancing.

This strategy, inserted into a metropolitan horizon, heralding a new decentralized arrangement of a sustainable and accessible polycentric urban structure, within the residential fabrics and those for activities, such as diffuse settlements traversed and interrelated with the environmental System and the Ecological Network, are reorganized around the new urban and metropolitan Centralities.

The implementation of this strategy guides the urban transformations, as a priority, towards interventions to requalify and modernize the existing city, triggering virtuous processes of environmental regeneration. Concretely it thus pursues the containment of land consumption and guarantees environmental sustainability.

The Plan therefore puts into play a regeneration strategy based upon concepts of environmental compensation and of ecological/environmental potential, which, through specific rules, links every urban planning transformation to interventions to improve the quality of the air, water, and land resources. In essence, it guarantees that every urban transformation will not erode resources but will instead present a positive ecological balance.

3.1 PLAN’S STRUCTURAL COMPONENTS

To implementing and managing the urban planning strategy, the environmental System is referred to by the first of the three structuring choices constituting the Plan’s scaffolding.

The three choices are grounded in the components to which the Plan attributes a value of full-blown long-term invariables, which represent the “limits”, the “conditions”, and the “model” of urban and metropolitan transformation: the environmental System, the System of infrastructures for mobility, and the System of the urban and metropolitan Centralities.

The environmental System is the first choice adopted also in terms of timing within the Plan’s construction process. The System of urban and metropolitan Centralities configures a polycentric urban structure, based on 18 Centralities located in correspondence with intermodal exchange hubs, the points of maximum accessibility. This model pursuing the decongestion of the central area and responding to the demand for highly qualified spaces for innovative activities – is the bearing element of the processes of urban regeneration through the modernization and revitalization of the more peripheral areas.

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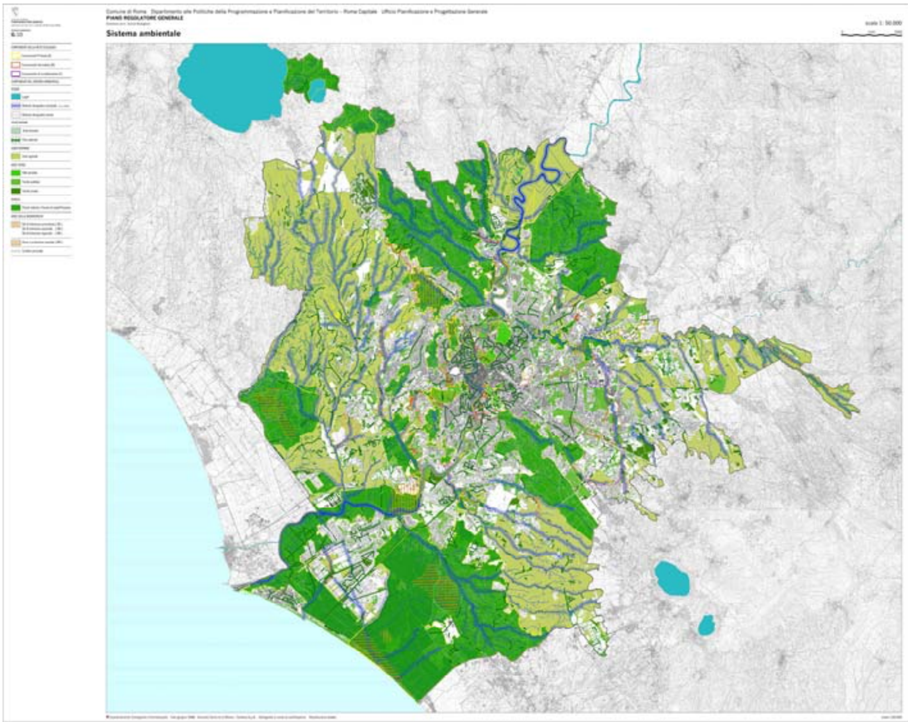

Fig. 1. PRG '08 of Rome. Document "Sistema ambientale (Environmental System)", 1:50.000

3.2 THE ENVIRONMENTAL SYSTEM

In addition to the extra-urban areas, the Plan completes the environmental System within the urban area (inside the Historic city, the Consolidated city, the City to be restructured), also traversing the new settlement forecasts (the City of transformation).

The components of the environmental System identifies in the prescriptive Document *"Sistemi e Regole (Systems and Rules)"* 1:10.000, are: *National and regional protected natural areas*; *The Water network*; *Agricultural areas*.

Agricultural parks, three large rural settings different from the protected natural areas, but ascribable to a unitary system of natural, landscape, and historical/archaeological interest to be protected and valorized, are identified in prescriptive Document *"Rete Ecologica (Ecological network)"*, 1:10.000. The design of the environmental System is supplemented with the environmental components making reference to the other Systems. PRG '08 identifies new components of the settlement System and new rules that respond to the need to confirm and increase the potential for environmental regeneration, in terms of permeability of urban land and of strengthening the biomass, precisely within the urban areas potentially subject to transformation.

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The components, which constitute ecological-environmental standards, are:

- Historic villas and open spaces of the Historic city;
- Private greenery of the Consolidated city;
- Public greenery and Equipped private greenery of the System of services and infrastructure;
- Road and railway environment belts of the System of services and infrastructure.

The new rules are:

- free transfer of areas for greenery and public services in a measure exceeding the minimum standard and as a percentage of the total territorial surface area for the intervention (from 30% to 40% of the surface area);
- insertion of a functional mix as quality indicator, with a minimum quantities, as a percentage of the total gross useful area quota of residential, non-residential, and flexible uses (to be attributed at the time of implementation);
- prescription of permeability coefficients, of tree and shrubbery densities in all the transformation settings;
- prescription of an area for *private greenery with ecological value* in all the transformation settings to guarantee the sustainability of the urban transformation.

3.3 THE ECOLOGICAL NETWORK

The Ecological Network (EN) restores a hierarchical reading of the different components' levels of naturalism, in which the concept of network underscores both the need to guarantee the areas' connectivity for the purpose of maximizing their environmental effects, and the *ecological* character, the concrete conditioning on the urban environment and on the city's livability. It represents the set of the principal ecosystems and the related connections. The measures and interventions are aimed at preserving, valorizing, and restoring the areas' values and levels of naturalism, as well as at ensuring their integration in accordance with criteria and objectives of geographic continuity and ecological functionality. The EN components are regulated by the combined graphic and text provisions of prescriptive Document *"Rete Ecologica (Ecological Network)"* on a scale of 1:10.000, which, in regulatory terms, is complementary to and at the same scale as the prescriptive Document *"Sistemi e Regole (Systems and Rules)"*, 1:10.000.

The EN components are:

- *primary components*: the ecosystems with stronger naturalism, including mainly *Protected natural areas, Agricultural parks, Water network*, less compromised and with greater connection, the *Agricultural Areas* of greater environmental and landscape value;

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- *secondary components*: the areas of average nature level of nature and a high level of integration among the primary components, including areas of the settlement System and of the System of services and infrastructure;
- *completion components*: elements that complete and further connect the EN, and this network to the other Systems with particular regard to flood risk areas.

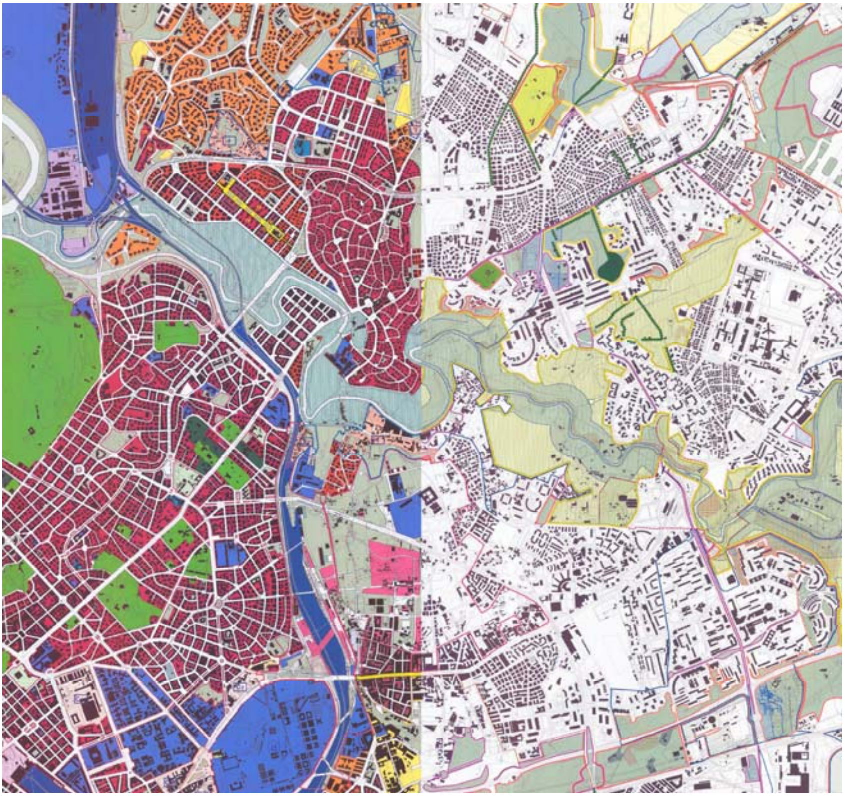

Fig. 2. PRG '08 of Rome. On the left: "Sistemi e Regole (Systems and Rules)", 1:10.000. On the right: "Rete Ecologica (Ecological Network)", 1:10.000

In order to preserve and strengthen the EN, the Municipality takes action with Programmes pursuing the following objectives:

- protect and expand the areas of natural vegetation;
- implement interventions for the maintenance or renaturation of water courses;
- promote interventions for the arrangement of the archaeological-historical heritage;
- protect scenic sights and the integrity of landscape;
- maintain existing cultivation activities, as part of the characteristics of the landscape;

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- limit/reduce land's waterproofing;
- limit the pollution of land, air, and water, as well as noise, visual, and light pollution, in accordance with sectoral Plans.

4 CONCLUSIONS

The complexity of the issues relating to the contemporary city requires putting into play a unitary, inter-scalar strategy of public governance, aimed at urban regeneration and at territorial rebalancing.

The new themes, as the urban impacts of ecological issues and the role of GIs within the strategies of urban regeneration, are founding objectives of the European urban Agenda, thereby underscoring the decisive role played by urban planning as a driver of development in making cities safe, sustainable, and resilient.

In keeping with these themes, and with the comprehensive characteristic of integration also appealed to by the European Community (2007), in order to implement green economy measures aimed at containing the consumption of natural resources, urban regeneration must be taken on as an integral part of an ordinary policy for the city, and therefore as a significant chapter in the national urban Agenda.

In Italy this brings up the need for a comprehensive reform of the national urban planning that systematize policies, procedures, tools and implementation mechanisms in order to turn the concept of urban regeneration and of *government of the territory* into concrete substance, and that can be a reference for a structural reordering involving the entire planning system.

The Research appropriates the need to a reform process, in the awareness that significant disciplinary paradigms and useful models are already present in the experimentation of the plans and in the regional legislative experiences that changed the strategies and competences of the urban plan by developing an effective model of a sustainable local plan.

This model requires a national-level regulatory framework that provides certainty of the law, while also synthesizing the innovations that have been introduced, which constitute a significant disciplinary patrimony to start from. At the same time it appeals to the need not only for technical competence, but for administrative and political competence to govern the territory.

As the case of PRG '08 shows, although the instrumentation and the procedures developed remain innovative and current, the political and cultural crisis and the substantial absence of technical and administrative skills following the change of administration to the City's government led in 2008 to the Plan's brusque removal and the suspension of its provisions, made it impossible the transition from the planning phase to that of full operation.

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AUTHOR'S PROFILE

Laura Ricci. Architect, PhD in Territorial and urban planning, Postgraduate Specialization Diploma in Methods and Tools of Urban Planning, Faculty of Architecture, Sapienza University of Rome. She is Full Professor of Urban Planning and Director of the Department of Planning, Design, Technology of Architecture (PDTA), Sapienza University of Rome. She is Director of the Postgraduate Specialization School in Natural and Territorial Heritage, Faculty of Architecture, and Director of the Postgraduate II Level Master Course Natural Capital and Protected Areas. Planning, Design and Management, Department PDTA. She is Member of the Academic Board of the PhD Course in Planning, Design and Technology of Architecture, Department PDTA. Since 1995 to 2012 she is General Scientific Advisor of

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the Municipality of Rome for the editing, approval and execution of the new Masterplan (PRG), approved in 2008.

Carmela Mariano. Architect, PhD in Urban requalification and Settlement recovery, Associate Professor of Urban Planning of the Department of Planning, Design, Technology of Architecture (PDTA), Sapienza University of Rome. She is President of the Master Degree Course in Architecture - Urban Regeneration, Member of the Academic Board of the PhD Course in Planning, Design and Technology of Architecture, Department PDTA, Member of the Academic Board of the Postgraduate Specialization School in Natural and Territorial Heritage, Faculty of Architecture, and Member of the Scientific Teaching Council of the Postgraduate II Level Master Course Natural Capital and Protected Areas. Planning, Design and Management, Department PDTA.

Irene Poli. Architect, PhD in Urban requalification and Settlement recovery, she is Fixed-Term Researcher of Urban Planning of the Department of Planning, Design, Technology of Architecture (PDTA), Sapienza University of Rome.

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SMART CITY GOVERNANCE FOR CHILD-FRIENDLY CITIES

IMPACTS OF GREEN AND BLUE INFRASTRUCTURES ON CHILDREN'S INDEPENDENT ACTIVITIES

ALFONSO ANNUNZIATA[a], CHIARA GARAU[b]

[a] Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: annunziata.alfonso@yahoo.it

[b] Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: cgarau@unica.it

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ABSTRACT

The research investigates the features of blue/green infrastructure integrated in the built environment that affect children's independent mobility and outdoor activities. Independent activities, including mobility, spatial appropriation, imaginative play and cooperative and social activities, are instrumental to children's physical, cognitive, emotional and social development. Building on previous research, the paper introduces the notion of meaningful usefulness to signify the potential of public open spaces to enable multiple purposeful, valued activities. The research aims to structure a synthetic index of usefulness and the Practices of children in open urban spaces (POCUS), an assessment tool which addresses the potential of public open spaces incorporating blue/green infrastructure to enable children's functional, recreational and social activities.

This research fills a void in the literature, by addressing two issues: i) the complex pattern of activities by means of which children engage with the material and social environment; ii) the social impact of affordances incorporated in blue/green infrastructure, in terms of children's well-being, agency and right to the city. The assessment tool and its embodied methodological framework support the design of trans-scalar mosaics of natural spaces, integrating hydrological function, biodiversity, and usable, safe, stimulating public spaces. Consequently, this research contributes to governance processes within the smart city paradigm, by supporting policies and urban planning practices which increase inclusivity and hyper-diversity within sustainable communities.

KEYWORDS
Usefulness; Blue/Green Infrastructure; Agency; Outdoor Independent Activities

1 INTRODUCTION

This paper analyzes how material, spatial, functional and social conditions of green and blue infrastructures integrated in the built environment affect children's propensity to engage in outdoor independent activities. The research aims to structure a synthetic index and the Practices Of Children in public Urban Spaces (POCUS), an audit tool which assesses the potential of public spaces incorporating Green and blue infrastructures to promote inclusion and healthy lifestyles by accommodating children's functional, optional/recreational and social activities. This potential is encompassed in the concept of meaningful usefulness, which is described in the subsequent sections.

This paper introduces the notion of children's independent activities (CIAs). Outdoor independent activities include independent mobility and the complex of practices producing the meaningful engagement with the material environment: exploration, occupation and transformation of spaces, intra-active play, structured group activities, imaginative and creative games (Annunziata & Garau, 2018; Garau et al., 2018). The planning and design of multifunctional trans-scalar networks, serving biodiversity, water safety and quality, landscape and heritage, biodiversity, local food production, while promoting inclusivity emerges as a crucial element in the construction of governance practices within the smart city paradigm (Chawla, 2015; Tjallingii, 2015). The latter implies in fact investments in human and social capital and traditional (transport) and modern (ICT) infrastructure that support sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement (Caragliu, 2009). This research focuses on the built environment and on urban blue/green infrastructure for two intertwined reasons: i) coherence with the authors' existing research on walkability, children's mobility, and child-friendly cities; ii) and the emergence of built environments as the main milieu of children's development. UNICEF (2012) observes that more than 1 billion children live in urban settings around the world and in the next future, following the global trends toward urbanization, the majority of world's children will grow-up in towns and cities. This research deals with a subject little discussed in the literature on the blue/green infrastructure and on walkability and livability of public spaces. In fact, the influence of BGI (Blue and Green Infrastructure) on children's spatial practices investigates in this research a specific aspect of social benefits provided by BGIs. These benefits are, for instance, the correlation of early nature experiences and the development of human nature connections, which in turn affect the possibility of the "trans-generational establishment of sustainable futures" (Giusti et al., 2018). Moreover, this research emphasizes the complex patterns of activities by focusing on outdoor independent activities instead of solely on physical activity or mobility

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The proposed POCUS audit tool incorporates qualitative street audit and quantitative GIS-based indicators for measuring microscale features specific to single spaces as well as indicators referred to meso- and macro-scale contextual factors. Moreover, the audit tool is integrated into an open and adaptable methodological framework which accounts for the dependence of perceptions and use patterns on socio-demographic individual factors and on contextual socio-economic and cultural factors. This methodology is applied to a central area in Cagliari, Italy.

Starting from these assumptions, this paper begins by defining the urban blue/green infrastructure and by analyzing the literature review on the availability of natural settings and public open spaces for children's independent mobility and physical activity. Then, a methodological framework for assessing the practicability of spaces incorporating the urban blue/green infrastructure, is presented. In the subsequent section a case study, a central area in Cagliari (Italy) is described. Finally, results of the study are exposed, by identifying the level of meaningful usefulness, of the selected public open spaces and individuating critical aspects to be confronted. The paper concludes by considering the validity of results of the case study analysis and exploring the limitation of the proposed model as well its relevance for other similar contexts.

2 LITERATURE REVIEW ON CHILDREN'S INDEPENDENT ACTIVITIES WITHIN THE URBAN BLUE/GREEN INFRASTRUCTURE

Urban blue and Green infrastructures (Urban BGI) are here defined as an interconnected network of natural areas and other open spaces that contributes to people's wellbeing and to the balance between city and nature by providing ecological, economic and social benefits, including water purification, retention and drainage, bio-diversity, local food production, recreation and identity building (Armour et al., 2014; Boyd & Banzhaf, 2007; Millennium Ecosystem Assessment - MEA, 2005).

This paper focuses on the social benefit dimension of urban green/blue infrastructure, in terms of its effect on children's well-being, agency and right to the city. This impact can be better understood by referring to the notions of affordance and capability. Affordances can be defined as the functional, emotional and social properties of a space incorporating opportunities and restrictions that affect users' active interaction with the environment. Affordances can be potential, perceived, utilized and shaped. A potential affordance can be actualized, thus utilized or shaped, only if it is available for children to use (Gibson, 1979, Jamme et al., 2018; Kyttä, 2003).

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The notion of affordance is instrumental to investigate the spatial, material, social and functional attributes of urban blue/green infrastructures that affect the use and the conceptional value of public open spaces and, thus, their potential to enable meaningful activities. According to Min and Lee (2006) spaces that enable meaningful psychological experiences are identified by children as places; a place is defined as a setting imbued with psychological, behavioral, and symbolic meanings.

The concept of capability is here introduced as a structural category for describing the ways in which the meaningful engagement with natural settings affects children's well-being and development. Capabilities refer to valuable states of being or conditions that a person can access (Sen, 1993). For children, the foundational capability is the "capability to develop". Chawla (2015) reconceptualizes positive effects of children's engagement with natural settings through the capability approach. Therefore, building on findings from research by Nussbaum (2011), Chawla identifies ten central capabilities associated with children's access to nature, including: life; bodily health; bodily integrity; affiliation; practical reason, play; senses, imagination, and thought; emotions; connection to nature and other species; control over one's environment. Building on these premises the notion of meaningful usefulness of a setting can be defined as the product of its spatial, material, functional and social properties incorporating opportunities for children's independent mobility and functional, recreational and social activities.

Furthermore, the existing literature on Children's experience of public spaces emphasizes the relevance of natural settings, including green areas, parks, nature/conservation areas, woods, wastelands, vacant lots, river banks, as destination spaces, threshold spaces, or transition spaces supporting children's independent activities socialization and community life, (Furneaux & Manaugh, 2018; Witten et al. 2017).

Availability, accessibility, proximity to other important places and sense of territoriality emerge as fundamental characters of these surfaces, for determining the conceptional and use value of a natural setting. In particular, the configuration of natural settings, as loose, available spaces is identified as a correlate of children's recreational and social practices by Garau et al., (2018); Jamme et al., (2018); Kyttä et al., (2018) and Min and Lee (2006), underline the relevance of size and morphological regularity as conditions that increase the openness of a loose space to diverse recreational and social practices.

Privacy and sense of territoriality are negatively associated to adults' control of the public space. Spatial control is exercised through authority constraints, interferences, and physical manicuring of the landscape: these practices communicate adults' ownership and result in a constraint on children's opportunities to dwell with open public spaces. Witten et al. (2017) underline that the identification of a setting as a place is profoundly conditioned by its affective

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atmosphere, which results from the combination of material, social and symbolic stimuli. The concepts of Eyes on the street and "broken window" refer to the nexus between built environment factors and social milieu attributes, which constitute the ecology of children's experience of the public space (Jamme et al., 2018). The former refers to the spontaneous surveillance of public spaces determined by the density of outdoor activities and the latter to the presence of signs of neglect and abandonment affecting the perception of social fragilities. Natural settings and elements are also related to improved conditions of comfort and well-being, resulting from the control of micro-climatic conditions and from the emotional affordances incorporated in natural elements and settings (Jamme et al., 2018; Min and Lee 2006). The minimal geometry designed by variations in the morphology of surfaces (Slopes, steps, terraces, level changes) incorporates potential functional affordances for different informal or structured recreational and social activities, according to Min and Lee (2006). Vegetation, grass, dirt surfaces, water features, loose elements, (earth, water, stones, grass, and branches) pieces of furniture incorporate affordances for creative and imaginative play, including exploration, manipulation and construction (Chawla, 2015; Pyyry, 2017) observes that the manipulation, experimentation and appropriation of spatial elements and loose objects, can result in intra-active play and can generate a meaningful, affectual engagement with a specific setting. The singular experience of enchantment can emerge from this profound involvement.

Finally, natural elements, affect the conspicuousness of the public space by reinforcing its complexity, human scale and imageability.

3 METHODOLOGY

The POCUS audit tool is based on a review of existing assessment procedures for the analysis of the quality of urban public spaces. In particular, the review of urban quality assessment tool is focused on audit tools, (Pedestrian Environment Data Scan [PEDS]; Environmental Assessment of Public Recreation Spaces [EAPRS], Public Open Space Desktop Auditing Tool [POSDAT], QUality INdex of Parks for Youth [QUINPY], (Mygind et al., 2016; Rigolon & Németh, 2018; Saelens et al. 2006); and questionnaires (Neighbourhood Environment Walkability Survey [NEWS]; Garau, 2013; Rosenberg et al., 2009;).

The POCUS tool is structured as an audit tool based on publicly available, secondary data, and including quantitative and qualitative indicators related to micro-scale site-specific variables and on macro-scale contextual factors. Indicators related to micro-scale features account for the functional, social and emotional affordances incorporated in the spatial organization of individual natural settings. Context-related Indicators assess land use patterns and density of the surrounding environment, as well as the spatial continuity of the blue/green

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networks and their connection with the networks of pedestrian paths and public transportation. The combination of site-specific and contextual factors reflects the fact that the meaningful usefulness of a place is determined both by its inherent attributes and by its endowed conditions (Blecic et al., 2015; Jabbari et al., 2018; Moura et al., 2017). The POCUS audit tool is incorporated into an adaptable methodological framework, structured as a 5 stages process. This includes: i) selection and characterization of the case studies; ii) selection of natural settings correlates of children's CIAs and definition of their relative importance through a comprehensive literature review and a session of stakeholders. The latter is based on the phenomenological approach and the saturation principle and is structured as a workshop of urban explorations involving 42 children – 18 girls and 24 boys – aged 5 to 13 years. A more detailed description is in Annunziata and Garau (2018); iii) selection of indicators and sub-indicators representative of natural environment correlates of children outdoor activities. Indicators are defined building on available audit tools (Mygind et al., 2016; Saelens et al., 2006; Rigolon & Németh, 2018) and respond to criteria of objectivity, relevance, measurability and reproducibility, validity, representativeness, comparability over time and understanding; iv) the definition of thresholds values and/or of value functions for the normalization of measurements for the selected qualitative and quantitative indicators; v) data collection, indicators evaluation and aggregation of results. The audit incorporates 19 indicators; six refer to accessibility related factors, twelve indicators refer to factors of the public space incorporating functional, social and contextual affordances and one refers to aspects related to children's participation in governance processes (tab.1). The range of values for each indicator is established according to the findings from the literature review and the session of stakeholders. It considers the relevance, quantity, variety, gradient and size of the affordances incorporated in the related environmental features.

The sum of the partial scores assigned for each indicator determines a global score, ranging from 0 to 100, which corresponds to the value of an Index of usefulness of specific public open spaces (I_{UIPOS}) defined by a score, ranging from 0 to 100. The subsequent stage is the determination of a continuity factor (f) of the blue/green network. The latter measures the level of connection of natural settings and is determined as the ratio of the aggregate size of the public open spaces contiguously connected in the largest continuous subnetwork and the total surface area of the public open spaces considered in the area of study. In the final stage the values of the I_{UIPOS} Indexes of specific public open spaces are weighted according to the surface area, aggregated and multiplied for the continuity factor (f).

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Categories	Indicators	Score
Factors related to functional affordances		0-33
Spatial	Variety of settings	0-10
Material	Enabling materials for imaginative play	0-15
	Presence of amenities/ equipment	0-8
Factors related to emotional/contextual affordances		0-45
Material	Water features	0-3
	Number of trees	0-3
	Bio-diversity	0-2
	Microclimatic conditions	0-6
	Imageability	0-7
	Location of lights	0-5
Social	Natural control of the POS	0-4
	Signs of neglect (broken window)	0-4
	Sense of privacy/territoriality	0-8
Commitment	Participation in planning/ design/ management	0-3
Accessibility		0-22
Spatial connection	Connection to mass transit	0-4
	Connection to pedestrian facilities	0-4
	Connection to bicycle facilities	0-2
	Barrier effect	0-4
Functional contextual	Availability of local destinations	0-4
	Residential density	0-4

Tab. 1 Indicators included in the POCUS tool

The result is a synthetic index of usefulness of urban blue/green infrastructures within a pre-determined area (I_{BGI}). The I_{BGI} index is thus representative of individual open spaces and of the connectivity of the blue/green networks. Data are retrieved from the Sardinia Regional Informative Territorial Service, the Municipal Cagliari informative territorial service, the Open Street Map platform, internet-based street level imagery services (Google Street View), and territorial imagery services (Google Maps, Google Earth, Bing Maps), and are validated through direct observations during on-site surveys. In the subsequent paragraphs, the authors illustrate the case study of Cagliari and the application of the POCUS tool.

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3.1 PRESENTATION OF THE CASE STUDY

Cagliari emerged as an optimal case study, because of its rich tradition of policies and projects developed to promote children's rights related to accessibility and participation (Annunziata & Garau, 2018). The study focused on a central urban area of Cagliari, that includes part of the historic and consolidated districts of Stampace, Castello, Sant'Alenixedda, Is Mirrionis (Fig. 1).

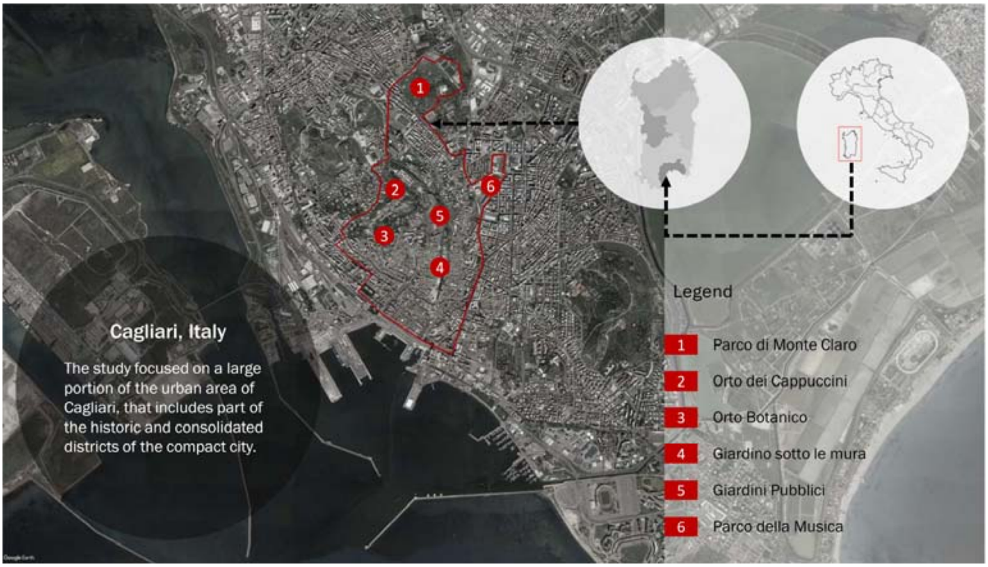

Fig.1. Representation of Public open spaces analyzed via the POCUS tool

The analysis focuses on a form of open space: the urban park. This refers to a man-made space, whose organization and management depends on a geometric rationality and on the use of "contrary energy" (Clement, 2005); yet, these spaces are considered as potential components of a trans-scalar, continuous mosaic of green spaces. The public open spaces individuated for the application of the POCUS tool are: Monte Claro, Giardino sotto le Mura, Giardini Pubblici, Orto dei Cappuccini, Orto Botanico, Parco della Musica. These spaces are selected according to 3 criteria: centrality within the public debate; significance as context of practices and activities of diverse groups of users; relevance as potential components of a continuous green/blue network across the compact city. The findings from the application of the Audit tool are discussed in the subsequent section.

4 FINDINGS AND DISCUSSIONS

The application of the proposed methodological framework demonstrates the potential of the POCUS audit tool for understanding and evaluating the opportunities for children's

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independent activities, incorporated in the spatial, material, social characters of public open spaces.

The results, described in Tab. 2 and in Fig. 2, show that the values of the Index of usefulness of individual spaces (I_{UIPOS}) ranging from 59 to 73, on a 100 units scale and a value of 38 (on 100 units scale) for the synthetic Index of the quality of urban blue/green infrastructure incorporating public open spaces (I_{BGI}).

PUBLIC OPEN SPACES	I_{UIPOS}	Surface (m^2)	Average ($\bar{I}_{UIPOS}$) (ΣI_{UIPOS}*A) / (Σ A)	f (Area_connected subnetwork/Σ A)	I_{BGI} ($\bar{I}_{UIPOS}$*f)
Parco di Monte Claro	73/100	224617	-	-	-
Orto dei Cappuccini	65/100	29673	-	-	-
Orto Botanico	62/100	65492	-	-	-
Giardino sotto le Mura	56/100	11337	-	-	-
Giardini Pubblici	69/100	32856	-	-	-
Parco della Musica	69/100	48376	-	-	-
Urban BGI (Area of study)	-	412351	69/100	0,54	38/100

Tab. 2 Values of the Indexes of usefulness for the selected POS

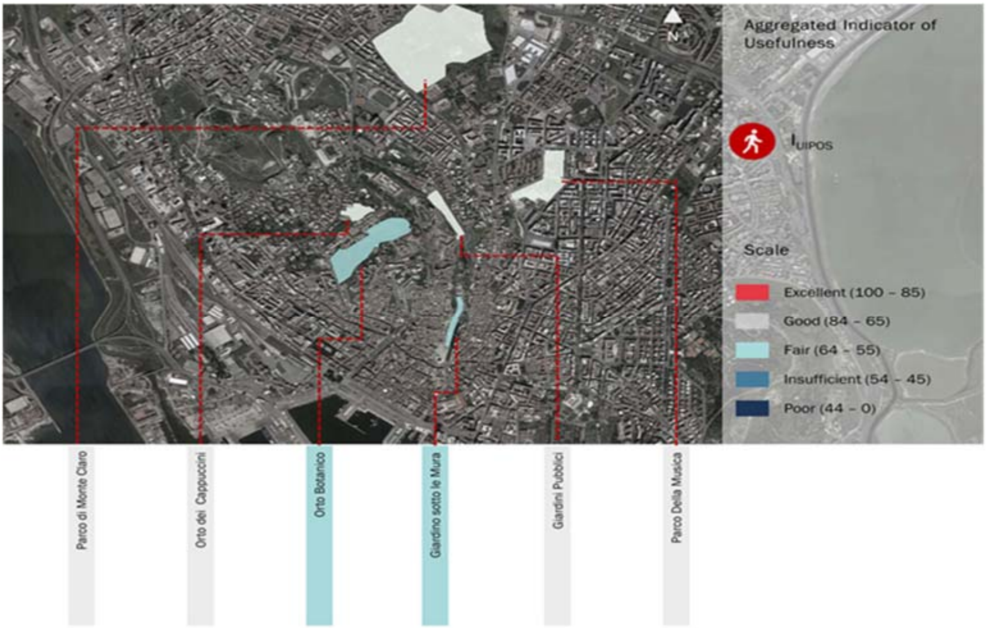

Fig.2. Representation of performance levels related to the indicator of usefulness I_{UIPOS}

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The results are determined by the divergence, in terms of utility among the material and spatial conditions of public open spaces related to the dimension of functional affordances, the social and environmental properties related to the dimension of contextual affordances, including the issues of safety, privacy and territoriality and the dimension of spatial properties related to the accessibility of public spaces.
Therefore, the biotic component of the selected public spaces and the morphology of surfaces determine a significant variety of spatial and microclimatic conditions and the availability of different settings and enabling materials (Witten et al., 2017). These spatial and material properties incorporate functional affordances for meaningful activities and experiences and are thus fundamental correlates of the meaningful usefulness of a space (tab. 3).

PUBLIC OPEN SPACES	Functional factors (Settings + enabling materials + equipment) - Imageability - Social factors (Constraints + broken window + eyes on the POS)	Spatial Connection (to pedestrian facilities + to Bicycle facilities + mass transport+ Barrier effect)	Available local destinations
Monte Claro	30/33 - 6/7 - 14/16	5/14	3/4
Orto dei Cappuccini	27/33 - 7/7 - 10/16	6/14	4/4
Orto Botanico	22/33 - 7/7 - 07/16	5/14	4/4
Giardino sotto le Mura	21/33 - 7/7 - 10/16	6/14	4/4
Giardini Pubblici	25/33 - 7/7 - 12/16	5/14	4/4
Parco della Musica	25/33 - 7/7 - 12/16	6/14	4/4

Tab. 3 Relevance, in terms of Usefulness of a set of material, functional, spatial and social features of the selected POS

As for the contextual affordances affecting the dimension of safety, comfort, privacy and territoriality, a fundamental issue is the conflict among children's need for spatial appropriation and adults' interferences and constraints. In particular, the analysis reveals different forms of adults' control on public open spaces: specialization, competition among adults' practices and children's activities, coupling constraints, and the manicuring of space. These constraints affect children's sense of privacy and territoriality by limiting their possibility to spontaneously engage with spaces, their access to natural settings and by communicating adults' ownership of the public space (Chawla, 2015; Min & Lee, 2006; Pyyry, 2017). A general positive situation is observed regarding the conditions related to concepts of "eyes on the street" and "the broken window".
These notions refer to the environmental stimuli determined by the built environment – social milieu nexus and associated with safety perceptions. The properties considered representative of the built-social nexus include condition of surfaces, furniture and vegetation, cleanliness,

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presence of services and of intergenerational activities. Conspicuousness, or the potential of a space to produce a structured, useful and meaningful image, is observed to be a distinctive positive condition of the selected POS: it results from the complexity and human scale incorporated in the vegetal structures as well as from the singularity of landscape elements, pieces of art, spatial elements, buildings and architectural follies. A positive element, in terms of usefulness, is represented by the variety of primary and secondary functions and services, located within a walking distance from the selected spaces. Nevertheless, the opportunities for meaningful purposive recreational and social activities are not supported by the conditions of inadequate spatial connection among public opens spaces and other meaningful places, thus resulting in lesser opportunities for children to frequently and independently access to and engage with the selected spaces. These conditions are determined by the discontinuity of the system of natural settings and public open spaces and by the configurational and compositional characters of the networks of pedestrian and bicycle facilities, including continuity, slope, inadequate dimension and conditions of separation/distinction of the pedestrian space, poor maintenance and barrier effect. Finally, it is observed the lack of participatory and co-creation process involving children and the wider community in the planning, project and management of public spaces. This results in a limitation of children's control on their environment (Chawla, 2015).

5 CONCLUSIONS

This paper describes an open, adaptable, methodological framework, for evaluating the potential of urban blue/green infrastructure to increase the meaningful usefulness, for children, of public spaces. Building on a comprehensive review of the literature on children's experience of natural settings, the POCUS audit tool fills a void in the research on the assessment of public open spaces and of urban blue green infrastructures. The proposed theoretical and methodological framework emphasize the meaningful usefulness of public open spaces as a central component of the social dimension of ecosystem services provided by the Urban Blue Green Infrastructure, underlining the relevance of childhood nature experiences, as an issue concerning both the integral development of children and the establishment of Human nature connections. Additionally, this research operationalizes the concept of affordance in terms of an auditing tool for investigating, evaluating and describing public spaces. The application to a case study reveals the potential of the POCUS audit tool to support timesaving and thorough analysis of the capacity of specific public open spaces and of the blue/green networks within a pre-specified area to enable children's independent activities. The limitations observed concern the validation of the results and the determination of the weight of each indicator, which is expressed in the scale, or potential score, associated

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to each of them, and which constitutes a fraction of the total score equal to the value of the I_{UIPOS} Index.

In fact, several inquiries including Garau et al. (2018), Moura et al. (2017), emphasize the correlation between children's propensity to engage in outdoor activities and cultural constructs, contextual socio-economic factors and individual socio-demographic characteristics. Consequently, future stages of the research will be aimed at addressing two fundamental aspects: i) establishing procedures for weighting natural environment attributes and the related indicators, according to children's individual purposes and cultural and socio-demographic characteristics ; ii) defining a validation procedure, based on direct observations or on home based and on site surveys, for comparing the outcomes of the analysis with actual levels of outdoor activities and with children's perceptions of spaces.

The POCUS tool contributes to the monitoring and assessment of the quality of the public space by supporting three actions: i) the comparison of the quality of individual public open spaces, in terms of their usefulness; ii) a synthetic description of the capacity of the urban blue/green networks to support inclusivity and social processes by enabling children's practices; iii) the understanding of criticalities to be addressed in order to increase the meaningful usefulness of public open spaces integrating urban blue/green infrastructures.

Consequently, the POCUS tool relevantly contributes to the implementation of governance processes within the smart city paradigm by supporting planning actions which promote children's access natural spaces and consolidate inclusion and equality within sustainable communities.

AUTHOR CONTRIBUTIONS

This paper is the result of the joint work of the authors. 'Methodology', and 'Findings and discussions' were written jointly by the authors. Chiara Garau wrote the 'Introduction', and 'Conclusions'. Alfonso Annunziata wrote the 'Literature review on children's independent activities within the urban blue/green infrastructure'.

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recommendations expressed in this material are those of the authors, and do not necessarily reflect the views of the MIUR. This study was also supported by the project "Healthy Cities and Smart Territories," founded by the Foundation of Sardinia and Autonomous Region of Sardinia (Fondazione di Sardegna—Convenzione triennale tra la Fondazione di Sardegna e gli Atenei Sardi Regione Sardegna 2016).

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AUTHOR'S PROFILE

Alfonso Annunziata (1984) is a post-doc researcher at the DICAAR (Department of Civil and Environmental Engineering and Architecture) of the University of Cagliari, Italy. His research investigates the issues of landscape infrastructure, landscape urbanism, configurational properties of networks and child-friendly cities. He is author of over 30 scientific publications, including conference proceedings, articles in national and international journals, chapters of books.

Chiara Garau (1979) is an assistant professor of Urban and Regional Planning at the DICAAR (Department of Civil and Environmental Engineering and Architecture) of the University of Cagliari, Italy. She was a member of the scientific and organizing committee of the YA AESOP (Young Academics—Association of European Schools of Planning, 2011–2013). She was a scientific and technical adviser for the Smart Cities Observatory of Rome (2013–2014), and in June 2015, she received the Best Paper award at ICCSA 2015 with a paper entitled Benchmarking Smart Urban Mobility: A Study on Italian Cities. In 2015, She won a national research competition (the SIR call proposal—Scientific independence of young researchers, Domain SH—of the Italian Ministry of Education, University and Research) with the GHOST project ("Governing the smart city: a governance-centred approach to smart urbanism"). She is author of over 70 scientific publications, including monographs, conference proceedings, and articles in books and national and international journals.

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RESILIENCE, SMARTNESS AND SUSTAINABILITY. TOWARDS A NEW PARADIGM?

SABRINA AUCI[a], LUIGI MUNDULA[b]

[a] Department of Political Science and International Relations
University of Palermo, Italy
e-mail: sabrina.auci@unipa.it
URL: https://www.unipa.it/persone/docenti/a/sabrina.auci

[b] Department of Civil, Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: luigimundula@unica.it
URL:https://www.unica.it/unica/it/ateneo_s07_ss01.page?contentId=SHD30530

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ABSTRACT

The urbanization and the vulnerability of a city make challenging the ability of remaining along a sustainable development path. From a sustainability point of view, the smartness concept has been enlarged up to incorporate the definition of sustainable development with the so-called smart and sustainable cities. Another aspect is gaining importance in this debate: the growing challenges posed by climate change and by environmental issue at large. This issue has forced governments and in particular cities, which represent the main place for the prevention and the implementation of initiatives against negative environmental events, to develop flexible and resilient actions, initiatives and plans. In the near future, the majority of the population will be establishing in cities or urban context, so that the active actions will be based on the need to adopt solutions that address the principle of resilience. Since policies, plans and projects should succeed in considering together these three principles – sustainability, smartness and resilience – the aim of this paper consists in analyzing the common features of these concepts which may be at the basis of an integrated approach. Adapting the definition already accepted for buildings in terms of bright buildings, the relevance of brightness issue consists in developing a new paradigm of reference for a city.

KEYWORDS
Smart City; Resilient City; Sustainable City; Bright City

1 INTRODUCTION

Cities are the world's engines for economic growth, generating more than 80 percent of global GDP. The rapid urbanization as well as the increasing vulnerability to climate change events rise the risk for a city to maintain itself along a sustainable development path. Cities, therefore, represents "*the cornerstone of a battle to defend the planet*" (Bhatia et al., 2019, p. 1).

A city should reinvent itself following a new design of sustainable development. This improvement, by more efficiency and an advanced technology use, is now a reality in many medium to large urban centers. The need for cities to evolve themselves alongside this direction is the consequence of the growing urbanization of the world population, the increasing demand for energy-efficiency and more in general the management of non-renewable natural resources that tend to be more and more scarce (Addanki &Venkataraman, 2017).

The analysis of urban development based on the relationship among citizens, environment and new technology has yielded a bundle of several concepts about city's goals. These different issues are related to different stakeholders spanning across different sectors in pursuing the future development of a city. Many of these concepts are not mutually exclusive but complementary if not overlapping. Recently, the political debate has expanded considering a plethora of new city definitions such as: sustainable cities, green cities, livable cities, digital cities, intelligent cities, knowledge cities, resilient cities (Arafah et al., 2018; Bibri & Krogstie, 2017; de Jong et al., 2015).

These terms are used in an interchangeably way by policy makers, planners and developers, even though they capture different aspects of a city development. The sustainable city concept results the most frequent occurring category and the most interconnected node, related closely to the eco city and green city concepts. The smart city concept represents the second interconnected node in the academic debate. Finally, resilient city is considered as a distinct concept with low frequency and an isolate node. Hence, the main issue becomes whether these city categories are interchangeable due to similar principles and characteristics or not because of distinct features with limited overlapping (de Jong et al., 2015).

A sustainable city, whose original definition comes from sustainable development of the Brundtland Commission (WCED, 1987), is such "if its conditions of production do not destroy over time the conditions of its reproduction" (Castells, 2000). Sustainability is based on human activities and human ability in using resources and reducing pollution to reach a balanced socio-ecological system in the long-run (Bibri & Krogstie, 2017). The smartness concept, firstly related to energy saving and efficiency use issues, it has been developed to include quality of life, environment, transport net, telecommunication facilities etc. (Auci & Mundula, 2017). A

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benchmark research by Giffinger et al. (2007) has defined smart city on the base of several intangible indicators as smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. The resilience concept consists in creating a better quality of life, sustainable urban development, and improving environmental condition (Arafah et al., 2018). Developed by Holling (1973), resilience is based on the ability of a system to recover from disturbances and disruptions. Thus, urban resilience concept describes a city that (CEN-CENELEC, 2018): is prepared to resist, absorb, adapt and recover from any shocks; involves stakeholders and citizens in disaster risk reduction processes; reduces vulnerability and exposure to natural and man-made disasters; and finally increases its capacity to respond to climate change challenges and other unforeseen stresses.
Starting from the two by two analysis of smart, sustainable and resilient city, the study develops a new paradigm for a sustainable, digital, and less vulnerable city which may be defined as Bright City, where combined actions are implemented in order to maximize city's efficiency and management efficacy. This concept is traced back from the definition of bright buildings and is adapted to cities to develop a new paradigm of reference (Auci et al., 2019).

2 THE CROSSING PARADIGMS IN THE URBAN AGENDAS

In these recent years many cities have stepped up and started setting their own sustainability, resilience or smartness agendas where actual actions are implemented to solve some main problems related to urban environments.
To face these challenges some crossing paradigms have been developed in literature. Some recent researches have focused on how to incorporate sustainability in smart city approaches for developing a more complex smart sustainable urban model. The increasing awareness about environmental and sustainability issues related to urban growth and technological transformation is at the basis of the Smart Sustainable Cities concept (Höjer & Wangel, 2015). This kind of city which has to face climate change as well as other challenges as concentration of population within an urban area, has become a concept widely used since mid-2010s (Al-Nasrawi et al., 2015; Bibri & Krogstie 2017). With smart sustainable city, it is described a city "*that is supported by a pervasive presence and massive use of advanced ICT, which, in connection with various urban domains and systems and how these intricately interrelate, enables cities to become more sustainable and to provide citizens with a better quality of life*" (Bibri & Krogstie, 2017). The new technology, based on the Internet of Things (IoT) (ITU, 2016), allows citizens to be always connected through several devices. The real-time data may provide the opportunity of real-time feedback which may support real-time citizens' decisions in light of sustainable choices. The smart sustainable city allows decoupling high

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quality of life and economic growth from resource consumption and environmental impact (Addanki & Venkataraman, 2017).

Moreover, sustainability has been closely associated with the concept of resilience (Folke et al., 2002), since this last term "*is often used to describe characteristic features of a system that are related to sustainability*" (Carpenter et al., 2001).

Verma and Raghubanshi (2018) distinguishing among three aspects, economic, social and environmental, underline how these have resulted in the development of Sustainable Development Goals (United Nations, 2015). These goals allow both developing and developed Nations to reach sustainable development through a holistic approach. In particular, Sustainable Development Goal 11 vows to "*Make cities and human settlements inclusive, safe, resilient and sustainable*".

However, there are some authors (Timon, 2014) which disapprove this connection considering resilience as just a label. To be sustainable, cities and urban areas must be ready to face shocks and stresses which undoubtedly sooner or later will occur and will modify the state and the operating ways. In other words, they must be resilient (Pierce et al., 2011).

Coherently with this approach, Beatley and Newmann (2013) propose the term of Biophilic City. The idea is that to make cities greener, more natural or, in their words, more biophilic, it is important to make them more resilient. This target can be reached in a direct way when investments in green infrastructure – i.e. a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services' in both rural and urban settings (EC, 2013) – achieve resilience outcomes; or in an indirect way when actions or projects stimulate green and healthy behaviors that in turn serves to enhance the resilience of a city and of individuals.

Over the past decade and from a political point of view, urban resilience concept has emerged as one of the core principles of sustainable urban development widely acknowledged among various agreements such as the 2030 Agenda for Sustainable Development with its dedicated goal on cities—SDG 11, the Paris Agreement on climate change and the Sendai Framework for Disaster Risk Reduction.

It is worth to note that the urban resilience issue has also been associated with the smart city concept (Arafah et al., 2018). In fact, both concepts "*are operationalized on the basis of similar or even the same systems, having similar trajectories of development and similar dilemmas to be solved*" (Baron, 2012). Moreover, these notions aim at improving sustainability and increase the quality of life, although follow different paths. Even if some international organizations or networks as well as a wide number of cities are fostering integrated projects and strategies for building up smarter and more resilient cities, a theoretical framework is still missing. An attempt in this direction is the one of Papa et al. (2015) that develop a conceptual

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hybrid model which combines a solid theoretical background with some operational elements. The authors begin with the identification of the common characteristics of smart and resilient urban systems to define a model structured as a cyclical process, based on the learning capacity of urban systems, and characterized by the dynamic interplay of persistence, adaptability and transformability.

3 A BRIGHT CITY: A PARADIGM SHIFT

In line with Papa et al. (2015) view, our analysis aims at developing a systematic and a holistic approach combining fragmented knowledge, strategies and objects. This view allows facing the climate change issue as well as other interconnected challenges within complex urban systems through the definition and the development of a new paradigm based on cross-sectoral strategies and multi-objective actions. Smart city, resilient city and urban sustainability are three concepts which follow different paths and use different instruments to reach similar and close benchmarks such as the increase of the quality of life and the economic sustainable development. Since these three concepts complement one another, altogether they completely define the main problems of a community of citizens and suggest the more appropriate and mutual solutions to be applied within an urban context. For this reason, smart city, resilient city and urban sustainability delineate a new paradigm for a city. In line with Kuhn (1970), the definition of a paradigm is based on how some scientific achievements are universally recognized and shared among scientists and on how successful is in solving problems of a group of practitioners who has come to recognize as acute.

Following Buzási & Csete (2017), the interrelation among smart city, resilient city and urban sustainability may be summarized in Fig. 1, where urban sustainability represents the main aim of a city planner. The smart city pursues urban sustainability through creating a digitally-enabled environment which promotes a more efficient use of energy consumptions and a more effective management of networks. The more a city is innovative, the more information and communication technologies is used improving the quality of life and the sustainable development. Uncertain events such as weather and climate negative events at urban level, together with a growing population which increases the urban sprawl phenomenon, feature the need of creating and maintaining prosperous social, economic and ecological systems through sustainable urban systems (Papa et al., 2015). Moreover, the capability of a city planner to develop a strategic approach that adopts a wide and long-term vision may contribute to make a city more resilient and less vulnerable. Climate resilience as well as a digital environment may contribute to support strategies for reducing vulnerability and achieving sustainability. In fact, the more information and data are available from multiple sources in a smart city context the more it may facilitate the knowledge of potential climate-

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related risks and damages. This may increase urban resilience due to a more conscious planning and decision-making process in reducing urban vulnerability. Technology may contribute to better planning and managing a resilient city through the improvement of city's adaptive capacity and the implement of city's mitigation strategies (Buzási & Csete, 2017).

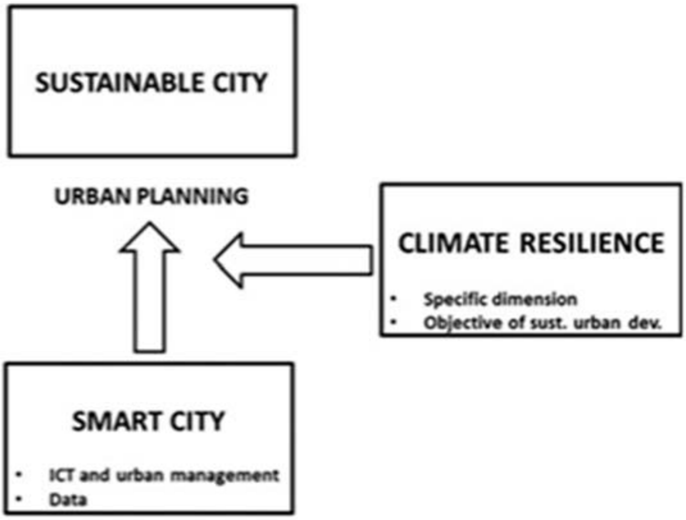

Fig. 1: Interconnections between climate resilience, smart and sustainable city

As a consequence, these three definitions provide a common paradigm of future urban development and structure. The city's evolution aims at increasing the quality of life and reducing vulnerability following a sustainable path of development in the near future as well as guaranteeing further progress in the future. This new paradigm for a sustainable, digital, and less vulnerable city may be defined as "bright city", where combined actions are implemented in order to maximize city's efficiency and management efficacy. In Fig. 2, all the intersections are reported. The three concepts are represented by three circles. Their intersections delineate three areas in which the two by two concepts are analyzed and a central area in which all the circles overlaps. While in literature the two by two intersections are considered and well analyzed, the central area represents a new perspective. In this case, a city is bright if the main object consists in combining aspects of sustainability, resilience and smartness. Following Papa et al. (2015), the characteristics of bright cities, as common features of smart, resilient and sustainable cities, can be delineated as: adaptability, awareness, collaboration, creativity, diversity, efficiency, flexibility, innovation, learning, networking and participation. Thus, a bright city means a city which is based on knowledge and performance-oriented approaches to urban design and planning. This means that

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stakeholders from different backgrounds and domains of expertise are involved bringing and sharing multiple levels of information, at multiple scales of analysis and intervention. In this way the bright city is a reaction to the growing challenges that urban centers are facing and could represents a new urban design and policy paradigm. Environmental degradation, increasing economic inequalities, as well as growing populations may exhaust social and physical infrastructure and increase the need of improving the operational, service and energy efficiency of cities, rendering them better places to live for all (Auci et al., 2019).

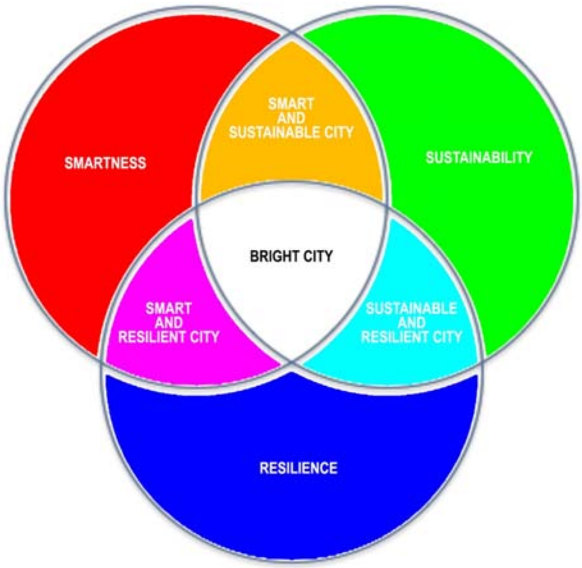

Fig. 2 Bright city as integration of sustainability, smartness and resilience

According to the evolutionary approach of the resilient city (Drobniak, 2012), the bright city is assumed to be a complex adaptive system which is dynamic, connected and open with the ability of evolving in many and varied ways. Thus, there is no a unique equilibrium and growth path to be reached but several possibilities. A bright city's economy would be a city that adapts successfully returning to or improving its long run equilibrium path.

4 CONCLUSIONS

Cities, facing new environmental challenges and social dynamics, are asked to answer with the adoption of new approaches. To find effective solutions, the actual academic debate focuses mainly on some concepts such as resilience, smartness, and sustainability. Consistently with these concepts are not mutually exclusive but complementary if not

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overlapping, the more recent literature combines them two by two, exploring new ways and strategies. However, these proposed solutions - aiming for example to a more efficient use of resources and a greater ability to respond to stresses and shocks - achieve a sub-optimal result because they are not framed in a broader strategic framework which permits managing these concepts in an integrated way. From this point of view, solutions are optimal when are framed in a coherent framework with the aim of achieving consistent targets and assessing reasonable choices. The concept of the bright city, proposed in this paper, although at an embryonic stage and therefore to be deepened, can represent the answer to these challenges. Adopting this concept, a city should be considered as a complex adaptive system, i.e. a dynamic, connected and open city with the ability of evolving in many and varied ways. Moreover, bright cities are not obliged to reach a unique equilibrium or to follow the same growth path but several possibilities are allowable and feasible. Finally, a city may be considered “bright” whether it is able to adapt itself successfully to the challenges and the opportunities with the aim of returning to or improving its long run equilibrium path. As a next step for further researches, the characteristics of bright cities through a set of indicators, weights and relationships criteria should be defined.

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AUTHOR'S PROFILE

Sabrina Auci, is an Adjunct Professor of Economics at the University of Palermo and a temporary professor at the University of Cassino and Southern Lazio. Her actual research interests are related to innovation economics, environmental economics, urban economics with a particular interest in the impact of climate change on human activities.

Luigi Mundula, is an Adjunct Professor of Economic and Political Geography at the University of Cagliari and Research Fellow at the Tor Vergata Economic Foundation. His research interests are related to economic and territorial development policies, urban geography with particular reference to the role of ICT and innovation.

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ENERGY AUTONOMY IN SYMBIOSIS WITH THE AESTHETICS OF FORMS IN ARCHITECTURE

PIETRO CURRÒ

Department of Planning, Design, and Technology of Architecture
University of Rome - Sapienza
e-mail: architettopietro@libero.it

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ABSTRACT

The project contains use, application and development of the results of some structured research, and it aims to build a methodology for the definition of programs, plans and projects able of set up an energy paradigm for regeneration into an urban system, in line with the demands of protection of urban landscapes too.This project, related to the research, becomes more and more a system of demonstrative, informative and aesthetic experimentation of innovative solutions and technologies; it settles: re-use, energy saving and the use of renewable energy sources through the circular economy. The worth of quality must regain its role and provide new forms of regeneration and redevelopment in the systemic design. The transformations must be designed strongly interconnected with their complexity and no longer divided into different parts, conceiving the entire system as a whole. It is not a matter of seeing quantities in numbers as a reference, but it is a matter of doing something in order to live better, to create works that pollute not much, because they are responsible for the emissions they produce and for the quality of the environment in the product chain. The themes are always ecology and circular economy, in the holistic way of conceiving interventions, related to terrestrial and marine ecosystems. Therefore a creative and scientific path, suitable for the enhancement of places through the achievement of systemic and consistent interventions that settle a unitary vision aimed at restoring formal, energetic and environmental characteristics.The target of the project is also to suggest the implementation of a data collection and processing platform coming from institutional sources and not with participated acquisition methods, in fact there are already two Research Poles. The planning and full management of the project proposal consists of a set of dynamic interfaces, designed to meet the needs of the types of players involved in the transformation and regeneration processes of the town, promoting conscious styles of energy consumption (energy efficiency on an urban scale). The application of these concepts has found the proper definition in the planning of "Area Tempietto", where the physical and incorporeal connections with the places recover both the ethical and aesthetic question of responsibility and belonging, disclosing the landscape values in an open dialogue with architectural and environmental elements

KEYWORDS
Energy; Aesthetic; Architecture; Sustainability

1 INTRODUCTION

For a long time now, the new challenges of architecture have been related to the types of energy used and to the sustainable economy, with the awareness that the so-called linear economy: "producing, consuming, wasting" is no longer sustainable and must be replaced with the circular economy: "producing, consuming, recovering". The approach is to define a "smart project", which integrates the efficiency of new scientific paradigms in urban transformation and regeneration, with energy systems integrated into the existing urban fabric and tools for the representation and the spread of information about energy saving and community participation issues. The energy requalification is not only a standard-technical activity which aims at maximizing energy efficiency, but also a involving decision-making concept; with experts and citizenship together in a structured development aimed at sustainable redevelopment of the existing eco-system of the whole city.
The increase in consumption and the current limit in the utilization of natural energy resources and the related partition of these resources on the territory, affect in a negative way some key areas of development. However, new technologies available allow to develop and increase a new output of clean energy, both with direct use, and with indirect use. Using energy from renewable sources (clean and inexhaustible) remains the only opportunity to improve the environmental conditions of the Earth. Considerations must be made in relation to the selected criteria to be implemented, to the players involved, to the definition of design solutions and finally to their implementation through territorial programs and policies.
Renewable energy sources (wind, sun, subsoil heat, biomass from woods and agricultural crops, underwater currents, high altitude winds, sea waves), with low environmental impact implants, represent a critical point for our future and for planet’s health. Renewable energy sources are inexhaustible and produce minimal CO2 emissions. The symbiosis, the close relationship among different elements, that creates bond, interdependence, interconnection, coexistence, is really important. Research and a culture of sensitive knowledge (aesthetics and harmonic structure; search for form and configuration; typology of the elements and unity of the whole set; physiognomy of concreteness and exteriority of appearance; physical condition and morphological qualification), express the necessity and the complexity, of being unquestionably contemporary in the use of materials and technological innovation, connected to the concept of flow and movement, typical of the progress of human life. European tools highlight the need to establish a participatory process of knowledge building that involves decision makers, experts and communities. For the definition and evaluation of urban regeneration actions and for defining the characteristics of the project system, local

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administrations play the crucial role of promoter and manager of the processes, despite the keystone is represented by the community.

A good smart planning and architecture project are often the result of ethical values and anthropological knowledge. Designing and creating a work means bringing the aesthetic/ecological scheme and the economic scheme to the same level, in order to exchange and estimate natural resources and production factors, economic goods and services, waste and refuses. This is the complex system that must respect: sustainability and physical, biological and climatic boundaries.

The majority of the world's population lives in cities. These ones progressively moved from a closed form to a development for directional geometries. After the abandonment of "forma urbis" (urbis shape), it becomes necessary to identify a "form" that has environmental and energy sustainability as a new firmitas, which addresses the actuality of urban redevelopment and regeneration process.

The values of quality must regain their role and ensure a development that requalifies what has been built, from the city to rural disintegration, proposing a new path on the road to environmental reconversion and landscape regeneration, focusing on the design of ecosystem services. This refers to the large green and blue infrastructures, to the critical metropolitan and rural areas.

Energy efficiency on an urban scale is the result of various physical factors, such as the geometry of buildings, materials and installations, and of a random nature factors such as human behavior, but also climatic considerations.

New and multiple skills and abilities are needed; we need to be a little architect, a little bit of an engineer and a little something else, we need to know the materials and the various forms of energy. Humanity needs new professionals to talk to. It is necessary to call on to the instruments that nature gives us (natural air conditioners such as water and green spaces, surfaces that reflect and absorb solar radiations) and to relocate to a planning scientifically oriented by a knowledge process that unifies. When natural resources were plentiful and the ability to soak up changes was in the nature of things, science could specialize in separate forms of knowledge, it could lose that holistic relationship with an understanding of the world that previously connected it to epistemology and to philosophy of science, losing sight of the unitary vision of natural phenomena. The unity (unitarity) of science, in a holistic dialectic, is an incontrovertible fact.

Lingering on the value of sustainability, does not decrease the poetic potential of a work, but, in reverse, it increases it through the strengthening of aspects such as nimbleness, lightness and relations with the landscape. The project must contain great delicacy and technical knowledge, it must be informed about developments in each field, so that its aesthetic-

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architectural scaffolding will be able to absorb them without showing them. Sustainable architecture is the one able to find the right balance. There is no doubt that the alliance with the environment and the smart use of our technologies can preserve physical and mental resources, regenerate the environment and the human psyche. This represents: savings, measure, elegance, sustainability. The design attitude to sustainability means awareness of responsibility. A thorough update of the aesthetic, technological and construction components of the architecture itself is required. This is the general assumption that activates all the disciplinary interrelations that can give an innovative character to each specific activity in the scientific project, characterized by multidisciplinary in synergy with the current interdisciplinary relationships.

Quality values must resume their role and guarantee a new regeneration and redevelopment plan in the systemic design. The set of values is part of the way of thinking about architecture and its contemporary vision.

Every work must answer important questions and not for their own sake such as emissions and energy savings. Here it’s not about finding quantity in numbers, but doing something in order to live better, to build works that produce less pollution because, in the production chain, each element is responsible for the emissions it produces and therefore for the quality of the environment that he himself has transformed. For this reason, it becomes essential to introduce the value of energy as a new fixed point of territorial transformations, facing up to the issues of ecology and the circular economy in the right dimension. In history, architecture has always tried to be sustainable, setting up a deep connection with the environment. Today a connection that combines technical imprint and aesthetic vision is necessary. The beauty of a work also lies in its unique quality, in the materials used for energy and sustainable values. Sustainable design is based on the aesthetic ideal, in a dialectical relationship. The architectural project gets inspired by the natural, social and cultural characteristics of places in a "human-scale" design able to satisfy the social, economic and cultural needs of individuals, thus allowing the refoundation of comfortable and stimulating environments. Aesthetics and beauty also lie in what is unseen as in CO2 emission savings. This is why we are often enraptured by works that have an ethical content and a worth, like any product that carries a production chain that cares about to the good and the beauty and therefore it owns an aesthetic quality within,that originates from its ethical content.

2 METHODOLOGY

In latest years, research has increasingly focused on eco-systemic services, from green and blue infrastructures to the governance and management of natural sites (including sea and coastal areas), addressing, in particular, urban and environmental problems, and activating a

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continuous exchange of knowledge, which obliges the promoters of the "project" to a concept of the study area as an experimental, informative and aesthetic space with innovative and ecological solutions and technologies, with the application of the circular economy that redefines reuse, energy saving and use of energy from renewable sources. A creative path, suitable for the enhancement of places through the realization of systemic, consistent and coherent interventions that represent a unitary vision of the image of the city and of its relationship with the ecosystems of reference, both green and blue, aimed at restoring formal and environmental characteristics of the city itself.

Fig. 1 Concept

1. Permanent and temporary exhibition area 2. Thematic botanical gardens 3. Gym and outdoor sports area 4. Playground area 5. Dog agility area 6. Public parking area, car sharing, electric shuttles and social charging shelters and Wi-Fi 7. New fluorescent bicycle lane section 8. Floating pier 9. Refrigerium route 10. Ancient Port of Calamizzi Archaeological Area 11. Pedestrian subway connecting to Lungomare Falcomatà and Villa Comunale 12. Lift and pedestrian subway connection with Central Station and archaeological area of Piazza Garibaldi

The structuring criteria of the project proposal (of the case study: "Area Tempietto". Project drawn up by the associated firm: arch. Sebastiano Altomonte, arch. Pietro Currò, arch. Maurizio Giovanni Imperio, arch. Giuseppe Penna, ing. Pietro Alessandro Polimeni and arch. Alfonso Sorrento) were: the park equipped for the city between two research poles; technological innovations in multiple fields with recycling and reuse; architectural quality and environmental sustainability; the satisfaction of needs of the community and the health protection; saving and energy efficiency; the materials used and the life cycle with the maintainability of the works; the gym and outdoor sports; the multifunctional social shelters and the phyto-purification tank; the enhancement of bergamot and native plants; thematic botanical gardens and biodiversity; the pedestrian paths and the "Refrigerium" multi-sensory walk; the bicycle lane and the fluorescent lighting; new technologies and interventions on existing structures.

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Fig. 2 Area tempietto entrance
The new cycle-pedestrian path runs along the sea and is made up of draining recycled materials, fluorescent paint and, at times, punctuated by piezoelectric tiles for the production of electricity when passing bicycles and people.

Performance requirements and design coherence, tell of a range of ideas and design hypotheses on which to base work in order to respect of the following values: historical-cultural and landscape-environmental, from urban regeneration to urban landscape, identity of places and sustainability. The "smart project" represents the opportunity to organize the social function of the area, to experiment the use of innovative and ecological products and technologies, such as shelters also designed to play an educational role of information and services. New functions are integrated, and they are able to provide the experimental implementation of sustainable mobility systems, through software applications for “infomobility” and remote management of lighting and irrigation systems, and for the calculation of emissions and CO_2 compensation, partly with the increase and development, with trees and urban green facilities.

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Fig. 3 The refrigerium route

It is marked by vertical elements which diffuse perfumed nebulized water, in addition to guaranteeing the lighting of the area a sensory journey that recalls the Roman thermae of the Via Marina.

The intervention on the weaving of the built territory and of the open spaces, has led to combine the urban with the insertion of new elements in new aesthetic forms. Here, the "permanences" and those values of the qualities that constitute the structure of the narration and the signs of the local identity have taken on an important role. The resilience of the city, the ability to react to external shocks, leads to a new and more pragmatic sense of sustainability.

It is through the tool of quality in urban planning that cities are protected from external pressures of climate change and anthropic risks. The Laboratory Park is one of the places of experimentation of sustainable solutions that can contribute to the promotion of saving limited resources, such as water and raw materials, and the reduction of energy consumption. The paved areas, from an all-round experimental space point of view, are used to install piezoelectric machines and gym equipment, which transform the kinetic energy of the movement into electrical energy, fostering the organization of collective sports and health sessions that at the same time promote and practice new and innovative ways of energy production and consumption.

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Fig. 4 The parking and the social shelters

It represents the southern access to the area, in addition to the private cars, it hosts the stalls for electric shuttles and car sharing; the shelters allow parking and recharging of electric bicycles and wheelchairs for the disabled people.

In this idea, the history of the city, which represents an extraordinary set of myths, emblematic architectures, functions and unique cultures with a strong symbolic value, is not neglected.

Fig. 5 The open-air garden and sports area

Absorbed in the green of the botanical gardens, it is organized with piezoelectric exercise equipment that transforms kinetic energy into electricity (sustainable and educational leisure and sport).

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Fig. 6 The raso water tank and the "onda" bench

Recessed LED nozzles and projectors allow water and light to play, enhancing the monument to Rhegion. The "wave" seat, with variable shape in plan and in elevation, recalls the sea waves and is made of concrete covered with colored grit that recalls the design of the historic “graniglia” benches of the marine street.

The historical connotations find their original element in the myth and in the Tempietto revisited in a modern key with respect to the correct East-West orientation according to the canons of Greek culture, claiming a renewed sensitivity towards the landscape and the ecologies of the city.

The aesthetic structure and the design consistency are realized through the principle that unites Euclidean geometries and curved and flexible spaces and find the vitality in Kandisky's formal citation with: point, line, surface.

Both the equipped spaces, the thematic gardens and the walks, and the relationship between the whole and its parts have been configured by using this elements; the places have been designed as adaptable spaces, orderers of surfaces and routes and ready to welcome any additional services for events. Functional and flexible areas, with a space covered by a tetrahedron-shaped tensile structure: an element of compositional aggregation.

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Fig. 7 The exhibitive agora and the materials recycling
The structure for permanent and temporary exhibitions is realized through the reuse of containers. Functional and flexibles areas divide a space covered by tensile structure, in order to configure a sort of Agora, with the shape of a tetrahedron: an element of compositional aggregation.

The different processing of surfaces and paving offers moments of delay and observation of the urban landscape in relation to the sea. So we find the straight lines of the internal paths, which semantically show harshness and power, in contrast with the curvilinear paths of the bicycle lane and the wave bench which instead express harmony and fluidity.

Fig. 8 Urban Ecosystem and intervention

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The vivacity of the design system is strenghtened by the use of different ranges of colors in harmony with those already present in the thematic gardens and in the multiple equipped spaces.
The relationships of the urban ecosystem with the sea, sometimes calm and flowing, sometimes changing and overwhelming, are also qualifying elements of narration and history.
The third research laboratory, open-air, represents the themes of sustainable and available technologies, where citizens and visitors, in addition to expanding the direct knowledge on the fundamental topics of these days, can also verify the functioning and touch the various forms that can take on creativity, scientific research and innovation, from a perspective of Smart Communities, as an aesthetic-experimental space.
Water recovery and the phytodepuration plant guarantee the elimination of effluent spills to the sea, and the creation of a gravity net that conveys the water into an underground tank in order to reuse it.
The relationships of the "green and blue" eco-system and the biodiversity of the “Mediterranean Scrub” become a condition for sustainability. Limiting the depletion of resources and considering all actions based on resilience, lead to the view of the territory as a capital to be preserved and regenerated.

Fig. 9 Green and blue” ecosystem

The floating pier It allows the docking of electric shuttles for sightseeing of the city from the sea.

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3 CONCLUSIONS

The project contribution defines a good practice for the management of sustainable urban regeneration and redevelopment of the existing heritage and the landscape, proposing an idea of smart planning based on the use of technological innovation and participatory governance. The first condition is constituted by a system of contamination of information, knowledge and technologies applied in urban space; the second consists of a network of strategies and actions aimed at development and management with the direct involvement of citizens and municipality, in the presence of three Research Laboratories, one of which is open-air. These actively involve citizens in achieving the objectives of a "smart plan" that is realized through the sharing of the *knowledge process*, a fundamental vehicle thanks to which a citizen can modify his behavior, and with the creation of co-management systems in which the citizen-user is not limited to the use of a service, but becomes an important node within the economic processes and management of energy resources. The layout of the proposed idea has the prerequisites and characteristics necessary to redevelop and give functionality to an area interposed between two terminals: a linear park to the south and a green system, of the most important infrastructure of the city. An urban hole that demands to be filled in a smart way, especially in view of the new eco-systemic and aesthetic challenges. In conclusion, not a simple redevelopment of an urban area but an action of rebirth, a pole of attraction, and a center of experimentation of new sustainable technologies at the service of the urban ecosystem and the entire community.

The first results of the research can come from the realization of the intervention, open different application perspectives in order to test and validate the real effectiveness of the platform, with the construction of sustainable requalification processes. The study was directed to the design of the communication and development interface, through smart networks of energy services. These are the founding elements, which by integrating with the energy infrastructures, will be able to generate systems of knowledge and interaction in the production of smart processes of regeneration of the city. The materials used, the life cycle and the maintainability of the works were evaluated, paying particular attention to the possible accounting of polluting emissions both during the design phase and during the construction phase. In this regard, the calculation of the ecological footprint as a compensatory measure (through the planting of tree species capable of adequately balancing the polluting flows) of the equivalent CO_2 emissions produced was also suggested as a tool.

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AUTHOR'S PROFILE

Pietro Currò, has taught several courses at Università Mediterranea of Reggio Calabria, La Sapienza University of Rome and other several Universities; he deals with urban and landscape design, energy and aesthetics as an ecologically sustainable process and transdisciplinary languages for systemic analysis. He has carried out and he performs theoretical-experimental research on these themes at some universities and he has produced several publications. In addition to teaching, he promotes and participates in conference activities.

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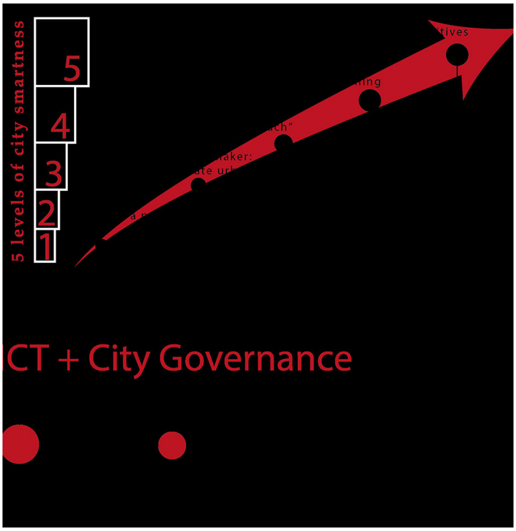

SHARING GOVERNANCE AND NEW TECHNOLOGIES IN SMART CITY PLANNING

***PAOLO DE PASCALI**
SAVERIO SANTANGELO
ANNAMARIA BAGAINI

Department of Planning, Design, and Technology of Architecture
Sapienza University of Rome, Italy
e-mail: paolo.depascali@uniroma1.it
saverio.santangelo@uniroma1.it
annamaria.bagaini@uniroma1.it
clara.musacchio@uniroma1.it
francesca.perrone@uniroma1.it

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ABSTRACT

The paper aims to analyse the impact of new technologies in developing urban sharing governance, and the consequences on urban planning. New Technologies, smart computing, and monitoring are at the base of the smart city. Socio-economic warns emerge about the dangers coming from technological dominance in relation to the political mission and driven by big companies. The work moves in the opposite direction. The approach focuses on the potential of social inclusiveness in urban planning and urban management, using new technologies. Many authors and local authorities are studying the different paths to better integrate new technologies and increase the "smartness" of cities. Many times, efforts are focused on explaining the opportunities coming from ICT in raising the quality and efficiency of city services. Still now few studies focus on the impact of new technologies in terms of increasing urban sharing governance and how they can review the way in which urban plans are made, for instance, the implications of energy decentralisation. The paper wants to understand the effects of new technologies in opening a new era for urban planning and urban policy-making with a higher impact on citizens' inclusion. We pointed out four grades of improving the Urban Planning quality using new technologies: increase the awareness of urban living impact; increase the monitoring process; increase the urban security and the urban health; increase the sustainable local development. In conclusion, the paper shows opportunities in terms of reducing the risk of technological dominance in urban planning transformation, aspiring to improve the strategic aim of urban planning with a social impact in terms of inclusiveness.

KEYWORDS
Smart City; Smart governance; Sharing governance; Sustainability; Urban Planning

* The other authors are: Clara Musacchio, Francesca Perrone.

1 INTRODUCTION

There isn't a shared definition of Smart city, and what would be the impacts on the Urban Planning. The smart city is based on the increasing awareness about city performance and quality, which depend on physical infrastructures and the availability of data and information. Those are related to the increasing of using information technologies in daily life. Authors define Smart City as "a city well-performing, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens" (Giffinger & Gudrun, 2010); as "a city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city" (Hartley, 2005); as "a city combining ICT with other organizational, design and planning efforts to de-materialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability" (Toppeta, 2010). Those definitions explain how ICT assumes in the Smart city a crucial role. Therefore, a major element is the change in city managing, which is about governance improvement (Batty et al., 2012; Nam & Pardo, 2011).
The citizens' role tends to change. They are more than urban end-user with a passive role. Citizens would be key-actors in the urban governance and managing process. They can be considered as urban sensors (Goodchild, 2007), and system managers. Citizens can deliver urban services, inform about the quality of services, attend to decision-making, increase the collective business capacity thanks to new technologies. The ongoing transition to a smart society can deliver also to some problematic issues, privacy security in one side and social iniquity in the other. New technologies open a path of inclusion and sharing responsibilities, but the role of controlling and promoting it is in the local authorities' hands. The paper aims to understand the impact of technologies on new forms of policy, planning, and governance. It is part of ongoing research and it wants to display the different implications of ICT use in Urban planning performance and processes, but also the presence of unexpected problems.

2 FROM SMART CITY TO SHARING GOVERNANCE: IMPLEMENTING URBAN PLANNINGTHROUGH NEW TECHNOLOGIES

The evolution of Smart City aims to overcome the centrality of technology. The technology hegemony encourages a development process towards unpredictable "dehumanized and alienated horizons" (Demichelis, 2018; Fumagalli, 2017). Techno-euphoria strengthens the domain of techno-capitalism in the form of what has been called "surveillance capitalism" (Marconi, 2019). In the current phase, social components emerged claiming more sharing

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governance, but difficulties and criticisms in meeting such instances were immediately evident, especially at municipal level: local authorities tried to optimize their own internal administrative system rather than open to the relationship with citizens (Bolivar, 2018). So, new technologies tend to replay a centralistic social model with the support of new tools but without any form of civic and "bottom-up" pervasiveness.

The convergence between the smart city, smart community and sustainability practices of sharing governance would open new perspectives in the use of technology and influence planning processes, but they request new forms of engagement. To permit citizens being engaged in public action, they must be directly involved in technology governance and networks control. Managing networks becomes a democratic process for building inclusive communities. Social governance connected to the technological dimension emerges, and the "Smart" issue transits from big players to local communities. In this way, "city smartness" results articulated in three levels of public actions for sharing governance (Meeus et al., 2011):

- leading by example;
- governing the private urban operators;
- implementing an integrated approach at the local level. It is characterized by the presence of decentralized functions and inclusive processes.

In the last years, two other levels of inclusiveness emerged. A fourth level can be recognized in promoting local networks and sharing management of big data for planning actions. A fifth level concerns bottom-up and voluntary initiatives that involve citizens, landowners, real estate operators and final users (Header Fig., inspired by Meeus et al., 2011).

Thus, the urban plan is no more a stable product: it becomes a dynamic action, and, in some way, it identifies itself in the participatory process, as a communicative, relational and informational product.

All these planning attributes are supported by ICT, where it supports city managing and the planning process itself.

Urban plans, with technological support, become tools of inclusion, networking, and communication between the social, the public and the private sector. Two applications emerge:

- the plan tends to become a sort of behavioural plan,
- new governance bodies emerge, more contaminated by civic activism, and new forms of citizenship. Digital networks and relations generate new forms of bottom-up initiatives. Technology helps to enlarge the range of actors engaged in urban transformation.

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3 NEW TECHNOLOGIES FOR SMART GOVERNANCE IN THE URBAN PLANNING PROCESS

The Smart city concept does not find practical implementation yet. The opportunities opened have often a marketing aim, and it is difficult to understand the real impact on the urban framework. The research ongoing point out four application fields in which new technologies can increase shared governance within the urban planning process. The four levels of interaction between technologies and urban planning highlighted are not complete, but they represent the most interesting links, at this time. In the four levels of interaction, new technologies play a crucial role for the urban planning development.

3.1 NEW TECHNOLOGIES FOR SMART GOVERNANCE IN THE URBAN PLANNING PROCESS

End-users as sensors of urban quality (local services and environment) have a key role in increasing the shared awareness of urban daily life impacts linked to each citizen behaviours. The opportunity to understand the impact of one's behaviour using new technologies, which provide constant information about the consequence of actions, give the power to self-evaluate personal interaction with the city and environment. It increases the capability of self-changing behaviours throw better performance. For the urban planning process, based on shared goals and commitments, the understanding of self-impacts on urban development and managing is crucial for increasing the inclusion and make it more efficient. At the same time, continuous bottom-up monitoring can be an effective evaluation system for urban plans. It can show the urban planning unexpected impacts and opportunities for improvement. This is evident for the CO2 emission. People who understand the different impacts in terms of greenhouse emission, depending on their choices, can change their action. The cost of avoided CO2 emission is strongly related to the type of technologies used (McKinsey et al., 2010).

Having access to updated information provided by end-users is interesting also for understanding the emotional relationship between citizens and places. This relationship is the base of the place identity concept, which means the value assigned by citizens to places. Bio-mapping1 experiences work on it and aim to draw up emotional mapping, recording and showing people's feelings connected to urban places. They can be created by using data

[1] Emotional Maps by Christian Nold (http://biomapping.net/new.htm).

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coming from mobile devices and social networks. Those mappings can now take advantages from the new developing of Augmented Reality[2] (AR).

3.2 NEW TECHNOLOGIES FOR INCREASING THE MONITORING OF URBAN FACTORS

The shared use of sensors and monitoring systems to control the performance of a settlement or an urban district (Borga, 2013) can inform the local authorities and the urban planning about critical and unexpected elements happened within the city. All information and data provided by sensors (quality of air, traffic problems, lack of public services, etc.) are important to improve the public action. Monitoring the urban quality trend and having access to spread and upgraded data can reduce the cost of data acquisition for Urban Plans elaboration. This configuration changes also the way in which the urban planning is made and its nature, moving toward the "planning by doing" approach instead of a "command and control" one, thanks to the possibility to evaluate continuously the previsions and the real evolution.

3.3 NEW TECHNOLOGIES FOR INCREASING URBAN SECURITY, EMERGENCIES, AND URBAN HEALTH

Emergency and security issues linked to urban areas are now supported by new technologies, monitoring critical situations, problems and dangers. The information provided aim to prevent emergencies, risks and solve them when necessary, but also to inform urban planning and decision-makers for avoiding problems. The information can be used also to improve and boost more secure and informed behaviours, and even healthier. The healthy city concept can take advantages from new technologies application. Health protection under an urban planning view refers to air/land/water pollution reduction and mitigation, risk reduction, unhealthy behaviours reduction. Many of those dangerous behaviours (psychological and physical) are linked to the urban form[3], for example the relationship between urban sprawl, car use and obesity. The urban planning can assume the correlation between settlements and human diseases fostering health prevention through new technologies.

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[2] http://www.planningtoplan.net/session-5-back-to-augmented-reality-part-
http://www.isprs.org/proceedings/XXXVIII/part1/10/10_01_Paper_106.pdf;
http://www.inria.fr/en/innovation/industrial-sectors/energy-transport-sustainable-development/demos/artefacto-augmented-reality-and-urban-planning;
http://nguyendangbinh.org/Proceedings/ISMAR/2002/papers/ismar_ishii.pdf

[3] Imperfect Health. The Medicalization of Architecture, of the Canadian Centre for Architecture, Montreal (http://www.cca.qc.ca/en/exhibitions/1538-imperfect-health).

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Emergency refers to natural disaster but also to the lack of needed urban services or infrastructures, the later more recurring. Security refers both to personal security and collective security. Related to urban security is the concept of dependability. It aims to create urban systems, services and infrastructures not only secure but also comfortable to boost and optimise the use. The dependability becomes a synthesis of different characteristics such as reliability, maintainability, availability, performability, safety, security (Avižienis et al., 200).

The massive use of new technologies linked with the security issue shows some criticism and problems, as seen before. Graham (2011)[4] shows how it can bring to social exclusion phenomenon, segregation, racism, discrimination between social classes. Those criticisms can emerge, but the potential of social inclusiveness by using these technologies in urban planning is evident. There is a good chance that this will happen, the same Graham is optimistic in the enlargement of the social context, regarding access to these technologies by social movements and communities.

3.4 NEW TECHNOLOGIES FOR INCREASING THE SUSTAINABLE LOCAL DEVELOPMENT AND THE ENERGY TURN

The energy liberalization process, in relation to the distributed and decentralised energy production, opened new paths for increasing sharing sustainability, sharing governance and boost the local energy turn. It finds opportunities in the changing of the end-user profile, that becomes a prosumer (energy producer, supplier, and user). The renewable resources show interesting potential for local development when connected with bottom-up initiatives: when local communities or citizens enter in the energy chain by becoming social enterprises, community cooperatives, etc. This innovation path is particularly interesting in terms of high impact on people inclusion, and urban governance. Citizens become owners of energy plants, producer of energy services, manager of the business itself. In Europe some experiences exist. In Denmark[5], the energy system is built on many citizens cooperatives supported by national policies. In Europe, Local energy communities (communities which produce, manage, use and sell to third energy) are recognised and supported by EU directives[6] (Hancher & Winters, 2017).

[4] Urban militarism: excluding the 'disordered', Graham 2011 in:
http://www.opendemocracy.net/5050/vijay-nagaraj/urban-militarism-excluding-disordered

[5] http://dbdh.dk/images/uploads/pdf-key-articles/best-practice-in-danish-district-heating.pdf

[6] Article 16 of the E-Directive requires that Member States adopt a legal framework that ensures the possibility for local energy communities to own, establish or lease community networks and to autonomously manage them.

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The ICT applied to the local energy production and supply can facilitate this democratization process, especially in managing energy local grid (heating/cooling and electricity) and balancing the fluctuation between RES production and energy demand. The goal is being able to control and manage the local energy-mix and the energy network made up by multi-energy generation systems. The Goteborg[7] experience is one of the most recent and interesting. It is based on a novel district energy system, having as the main focus the balancing of the demand. The Energy District is based on the mutual exchange of energy coming from different productions and from different storage sets between different stakeholders, in relation to the variations in the energy demand. A sort of Energy Exchange Community is formed, also with effects on urban planning and participatory processes.

4 CONCLUSION

From the study emerge some final considerations, related to Urban Planning. They represent the base for future research in the field of Urban Planning development and transformation.

- The massive use of big data and ICT systems characterizes the future of the city, linked to sustainability. They would act on the physical-functional organization of the city, and they would become an important factor in the evolution of urban planning with a sharing democracy impact.
- Some criticism and alarms emerge, related to privacy issue and social discrimination phenomenon. The new ICT age pushes towards new forms of alienation, surveillance domination, urban militarization, and social inequality. In this critical process, the big companies, which manage ICT systems and data are playing a big role. The ICT urban applications, particularly those for security, can bring to segregation, and discrimination phenomena, which find evidence in the city physical organization.
- Those criticisms can be overcoming with the enhancement of the role of local governance, which can control and protect final users, or being the provider of ICT services and the manager of big data provided. The new information technologies and networks can support the development of democracy in planning processes, but they need an institutional framework to support the development and local governance.
- New forms of advanced governance regarding decentralization of functions and the extended participatory processes can find support in new technologies. They can inform and influence urban planning and urban decision. For instance, the effects of Energy

[7] https://www.uia-initiative.eu/en/uia-cities/gothenburg

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decentralization process can open some novelties in urban design and governance in terms of Energy Districts and Local Energy Communities development.

- ICT can support the physical and functional organization of the city to encourage virtuous behaviours (behavioural planning). The planning can generate virtuous behaviours, instead of being shaped by.
- The Smart city concept changes the urban players. There are citizens and the local associations, cooperatives, consortia, committees, etc., on one hand, the producers of advanced technologies and services, on the other hand. The smart city opens the possibility that the traditional urban plans interlocutors are partly replaced in the role of driving urban transformations.
- Specific fields of technological applications can open interesting possibilities for the development of planning processes in terms of raising direct and inclusive participation in planning and urban management. Technology application seeks to go beyond the simple role of support to become an integral part of the planning methodology. Advanced technologies, properly implemented, enhance the dynamic and evolutionary value of the plan; the direction is towards the "planning process" and "planning by doing". The dynamic characterization of the plan is likely to drive the dialectic of city–behaviours and to respond appropriately to the information obtained in real time. The research in moving in this direction. The next steps look to understand in concrete the consequences of using ICT and city-user big data on the Urban Planning development path: how they can transform the Urban Planning practices, the Urban policy-making and governance, focusing on studying and comparing best practices and examples increasingly influential worldwide.

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AUTHOR'S PROFILE

Paolo De Pascali, Full Professor in Urban Planning (ICAR 21), PDTA Department, Sapienza University of Rome. Chair of Urban Regeneration and Urban Planning Fundamentals. Director of the II level University Master Course URBAM (Urban planning in public administration). Since 1983 he is the Director of research institutes, responsible for research & innovation projects in national and European programs in the fields of energy and settlements. Currently, his studies mainly focus on the relevance of energy-environmental factors in Urban plans to foster urban regeneration and local development.

Saverio Santangelo, Associate professor in Urban Planning, PDTA Department, Sapienza University of Rome. He carries out research on public action issues in urban planning, and on topics of strategic

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planning, social housing, local sustainable development. Member of PhD Department board in Planning, Design, Technology of Architecture. Scientific coordinator on behalf Sapienza, PDTA Department, in the European funded project Interreg MED Coasting.

Annamaria Bagaini, Urban and Environmental Planner, PhD in Planning, Design and Technology of Architecture. She works on increasing awareness related to the relationship between Urban Planning and energy turn, by a better integration between them, also provided by using new technologies and smart tools, able to inform the decision-making process and enhance social inclusion in the energy chain.

Clara Musacchio, Architect, PhD in urban and landscape planning. She usually works as development planning and policy consultant for public administration and private players. She participated in national and international research groups on planning itineraries for weak social categories. She currently deals with large area planning, metropolitan cities and instruments for controlling and rebalancing settlement expansion.

Francesca Perrone, Landscape planner. She received her Ph.D. in Planning, Design and Technology of Architecture, Sapienza University of Rome. She got her post graduate degree in GEOinformation and Geographic Information Systems, for systemic analysis of territory and geographic data. She obtains the international certificate of Esri ArcGIS User. She has engaged in issues ranging from land take control to soil ecosystem services. Her research interests focus on sustainable landscape planning, territory management and soil ecosystem services.

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SMART MAPPING TOOLS FOR THE BALANCED PLANNING OF OPEN PUBLIC SPACES IN THE TOURIST TOWN OF GOLUBAC, SERBIA

***GALEKSANDRA DJUKIĆ[a]**
BRANISLAV ANTONIĆ[a]
JUGOSLAV JOKOVIĆ[b]

[a] Department of Urbanism
University of Belgrade, Serbia
e-mail: adjukic@afrodita.rcub.bg.ac.rs
antonic83@gmail.com

[b] Department of telecommunications
University of Niš, Serbia
e-mail: jugoslav.jokovic@elfak.ni.ac.rs
nikoladinkic@elfak.rs

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ABSTRACT

Cultural tourism is becoming an important factor for local socio-economic perspective today. This is especially visible in smaller remote locations with rich cultural and natural heritage, where the other economic drivers are usually limited due to this remoteness. The proper example for this is the Iron Gates, where local heritage has been isolated by this longest gorge of the Danube. Nevertheless, the boom of cultural tourism has been noticed last years. The problem is that it is very concentrated in the main heritage sites, leaving the other parts without observable socio-economic benefits. Golubac Town at the western entrance of the gorge is such example. This is the only town in the Iron Gates with a historic urban core and the variety of open public space. Although magnificent Golubac Fortress is close and the Danube is the widest in its flow in the front of Golubac, local tourism is still underperforming.
This paper aspires to examine the prospects of Golubac Town to become a proper destination of cultural tourism by the comparison of two methods, both based on spatial networking through mapping. The first one is customised space syntax, oriented to the use of open public space by different users as a prerequisite to support the deconcentrated use of wider urban environment. The second method is newer and "smart" – it the mapping of the use of open public space extracted from social media (Tweeter, Instagram, and Flick) and it is more attached to visitors. Using these two methods on the case of Golubac the paper results in the recommendations how to improve traditional urban planning and design for the potential tourist destinations that face the high spatial imbalance of tourist visitors between their parts.

KEYWORDS
Smart city; tourism mapping; cultural tourism; space syntax; social networks

* The other author is: Nikola Dinkić.

1 CULTURAL TOURISM, PLANNING, AND SMART DEVELOPMENT

Tourism is one of the most promising sectors in global economy. By the recent estimations, tourism and travel account more than 10% of global GDP (WWTC, 2018). However, more significant is that tourism is developing fast – it is predicted that tourism will grow by 3.8% annually in the next decade, far more than general economy. Therefore, it will play more important role in the socioeconomic prospects in the world (Lyon & Wells, 2012).

Some subsets of tourism are anticipated to have even faster development, becoming megatrends (OECD, 2018). A right example is a cultural tourism, which refers to traveller's aspiration to meet with and experience of the culture of a certain tourist destination, including many local cultural factors, such as heritage, lifestyle, manifestations, tradition or customs (ICOMOS, 1997). It is regarded to be a key element of a "quality tourism" (Richards, 2007, p. 1) The rise of the cultural tourism has been evident in the last decades. It has a constant increase in tourism share, making almost 40% of tourism arrivals globally (UNWTO, n.d.). Therefore, this tourism subset is becoming the important generator of the local economy (Frey, 2019). Finally, the cultural tourism also generates new trends in tourism sector, such as its geographical expansion and interest on indigenous cultures and traditions (Richards, 2018) or the engagement of the visitors in the local cultural practice, to experience direct cultural contacts (Chen & Rahman, 2018).

With its rise, the planning of the cultural tourism emerges as a paramount element of its sustainable development. Knowing that all socioeconomic practices inevitably reflect in a space (Lefebvre, 1974), the territorial planning imposes its importance in the formation of the competitive tourist destinations (Risteski et al., 2012). This is noticeable at different spatial levels. In a regional planning, the concept of the cultural landscapes and their viable use especially refers to the proper planning of cultural tourism (Şimşek, 2017). Then, it is also related to all levels of the urban planning and all segments of settlement areas (Barrera et al., 2016).

Nevertheless, the proper planning of the cultural tourism and, even more, the implementation of these planning actions are an immense task. This is particularly true in the case of small and underdeveloped towns and communities, which, as it was aforementioned, arising as new-trend destinations in this sector. The economic, organisational, and human resources of these communities are usually limited (Jamieson, 1993). Taking into account possible pressure from mass-tourism, these towns and communities face many spatial problems in their destination-tourism development. A common consequence is a poor spatial balance in this development that further implies social and economic polarisation in the destination and its overall underperformance (Paskaleva et al., 2006).

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A good example is the small town of Golubac in the Iron Gates Region along the Danube, Eastern Serbia. The Iron Gates are unique by the fact that this is the longest gorge of the Danube, the second longest European river and its first-tier inland waterway. The recent boom of the mainly cultural tourists, driven by promoting heritage destinations along the Danube, has had a limited impact on local communities in the gorge due its traditional remoteness and inherited socioeconomic obstacles. This is also visible in Golubac Town, where the new tourist flow has not been appropriately utilised for the local prospects, at least partly due to imbalance in the spatial development of the tourist destination.

The explained gap between tourist potential and limited local resources conditions an adequate research and assessment of their current state as a prerequisite for a qualitative planning (Paskaleva et al., 2006). In this situation, the innovative and out-of-the-box approaches can be especially useful for the efficient planning of the small-format tourist destinations, such as Golubac. The aim of this research is to present them by the comparison of two network-based methods: customised space syntax and the mapping of the sentimental paths from social media. Using these two methods on the case of Golubac the paper results in the recommendations how to improve traditional urban planning and design for the prospective destinations of cultural tourism that face the high spatial imbalance of tourist visitors between their parts.

2 METHODOLOGY

This paper is shaped as a case-study research. Before the presentation of the case study, relevant theoretical fundamentals are scrutinised. The case study – Golubac Town – is analysed by two quantitative methods:

- Customised space syntax method, oriented to the use of open public space by different users during a day; and
- Creating the sentimental path of users - mapping of the use of open public space extracted from social media (Tweeter, Instagram, and Flick), more related to visitors' experience.

The both methods are innovative for the urban planning because they are based on the networks through the concepts of sentimental paths and place attachment. The network planning has long been neglected instead of the zoning spatial planning; however, the network-led spatial planning is more adaptive, effective and dynamic (Dupuy, 2008). The correlation between the methods refers to the postulates of the concept of the place attachment that explore emotional interaction between a person and an environment (his or her place). The both methods indirectly identify the complexity of this interaction. Rapoport

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(1990) concludes that environment acquires its meaning through the way people react on it. In the case of the mapping of the social media, the new sentimental paths are formed by the experience of the tourists transferred through their use of the social media; in the space syntax, the trajectories of users in a certain place refer about their habits and the ways of life, i.e. their feelings, memories and interpretations evoked by space.
Their comparison in the final part of the paper is a guideline to create the recommendations for a sustainable and innovative urban planning of the small-format tourist destinations.

3 CASE STUDY: GOLUBAC TOWN, THE IRON GATES GORGE

3.1 GOLUBAC TOWN – CURRENT ASSESSMENT

The location of Golubac in the Iron Gates Gorge gives this town uniqueness as itself (Fig. 1). The Iron Gates (Serb. *Đerdap*) reach many records at European and broader regional level. With the length of more than 130 km, it is not only the longest gorge of the Danube River, but also at the entire continent. The narrowest part of the gorge is also the narrowest point of the Danube in 2/3 of its lower length, downstream from Germany. This 180 m-wide part is Veliki Kazan (Eng. *Great Cauldron*) inner narrow (Fig. 2), but it is also the deepest point (82 m) of any European river (Stanković, 2006).

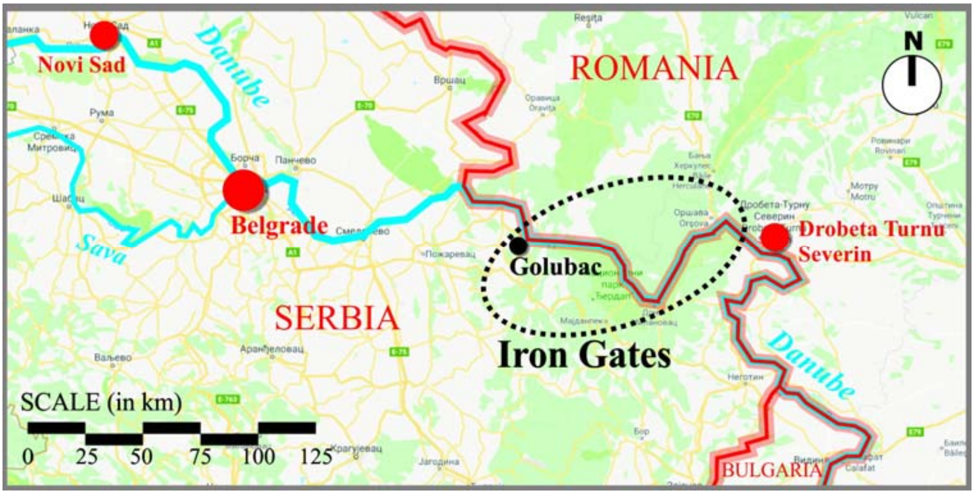

Fig.1 The location of The Iron Gates/Đerdap Region and Golubac Town (Author: B. Antonić; Supplementary maps: Google Maps).

These remarkable dimensions of the Iron Gates have influences on the other specific aspects of their nature. First, the geomorphologic features of the gorge are extraordinary, with the

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variety of the tectonic structures. The gorge isolation further causes microclimate conditions, which eventually enable unique flora and fauna, rich biodiversity and many endemic species (Maran Stevanović, 2017).The natural protection of the gorge was also a crucial to one of first permanent human settlements in Europe is situated here. The famous Lepenski Vir Archaeological site from Mesolithic was nicknamed as "the first city in Europe" (Pavlović, 2017). Human activities have been noticeable since that, but by far the major intervention by man, was the construction of the "Iron Gates (Đerdap) Dam 1" with hydroelectric power station and the formation of 130-km long artificial lake in the gorge. Iron Gate I power station is the largest in Europe without Russia by electric power generation capacity.


Fig. 2 The narrowest part of the Iron Gates Gorge (Author: B. Antonić)
Fig. 3 Golubac Fortress at the upper entrance of the gorge (Author: B. Antonić)

The name of the gorge – Iron Gates – comes from two Ottoman fortresses that controlled its upper and lower entrances by iron chains across the river for toll. One of them is Golubac Fortress at the upper entrance (Fig. 3). The fortress is monumental, with a strategic position at the entrance of the Iron Gates (Cunjak & Jordović, 2002). It was built in the medieval centuries, but was more important in the later centuries, when the Danube divided Hapsburg and Ottoman empires and, even more, the two civilisations and cultures (Tracy, 2015). The borderland character of the Iron Gates has continued until today. Since the World War I, the Danube in the gorge is also an international border between Serbia and Romania.
This political division has just emphasised the natural isolation of the Iron Gates and its communities. The right example is Golubac Town, the seat of one of three municipalities in Serbian side of the gorge. The town is the only settlement in the Iron Gates that was not resettled by the formation of the Iron Gates Lake, preserving a historic urban core and the variety of open public space. Its current position on the Danube where it is the widest in its entire flow is also a great advantage.

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The economic, social, and demographic profile of Golubac in the last 50 years pretty much demonstrates the challenging situation of all settlements in the gorge. The town is one of the smallest in Serbia, with less than 2,000 inhabitants. Golubac has been losing population since the start of post-socialist transition of the country in 1991. The demographic situation at municipal level is even more severe; Golubac Municipality, as well as the other two gorge municipalities, has rapidly shrinking (Tab.1).

COMMUNITY	Census 1948	Census 1991	Census 2002	Census 2011	Difference 2011/1948	Difference 2011/1991
Golubac Town	1,373	1,995	1,896	1,653	145.3%	-17.1%
Golubac Municipality	14,844	12,513	9,913	8,331	-43.9%	-33.4%
Majdanpek Municipality	19,610	27,378	23,703	18,686	-4.7%	-31.7%
Kladovo Municipality	26,161	31,881	23,613	20,635	-21.2%	-35.3%

Tab. 1 Demographic indicators of Golubac Town and the gorge municipalities in last national population censuses (Source: SORS, 2014)

This is the clear reflection of the economic downturn and the overall isolation of Serbia in the last decades; three Gorge municipalities are among the last ones by the economic performance in Serbia (MRDRS, 2009-15).

However, the recent rise of the cultural tourism in the gorge has positively shaken somnolent settlements in the Iron Gates. National level has invested in heritage protection and presentation, such as the revitalisation of Golubac Fortress, to present local cultural and natural treasure to visitors. The problem is that this, new vigour has been oriented to a few main heritage sites, where the state is in charge, leaving the local level stretched between them. Consequently, the impact of the tourism has limitedly reached declining local population, which supposedly should be the main target of such projects. Golubac is a showcase for this gap; although the local community has invested a lot in the reconstruction of the open public spaces (the Danube quay in the town, the main square, town park) in the town in last years, local tourism is still underperforming.

The on-site research and discussion with local experts in Golubac confirmed that the main problem is the weak and unprepared municipal governance, which is not able to back and guide the development of supplementary tourist services and infrastructure. Moreover, the local strategic plans are controversial; some important planning actions are internally in collision and many of the proposed key projects are located without a real connection to the local community. Their spatial location in a narrow strip along the Danube is also doubtful, leaving to connections with the mountainous hinterland of the gorge with preserved intangible heritage and the vernacular villages (Antonić & Djukić, 2018). The local strategies and plans

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are also very conservative in essence; they do not support the innovative and alternative ways of a tourism development such as creativity and creative industries (Djukić, & Antonić, 2018). For example, the huge inflow of the tourists in Golubac Fortress in the last couple of years has not properly reflected in the general development of nearby Golubac Town, which has played more a "transit zone" towards the fortress than a real attraction.

3.2 ANALYSIS 1: SPACE SYNTAX

The space syntax is a relatively new method in spatial research, developed in the early 1980s, with the rise of computer modelling (Hillier, 2002). Nevertheless, it is among the rare methods in urban practice that have gained an international attention from early beginnings (Jiang & Claramunt, 1999). The method concerns pedestrian flow in the urban nodes (crossroads in streets and squares) per an hour during the characteristic daytimes and days in a week. The difference in obtained results during a day or week and their spatial configuration can be good indicator of the broader spatial and socioeconomic circumstances of the investigated urban area (Sayed et al., 2013). In the case of the development of cultural tourism, this is related to the aforementioned newest trends that the cultural tourists want a new experience of the cultural space, including a "real" interaction with local population. Thus, streets and squares, as the main urban places for socialisation, are a good showcase to explore the local pattern that can facilitate and/or enhance the cultural tourism.

The customised space syntax investigation that included the measurement of the pedestrians flows, cyclists, cars, and heavy vehicles (buses and lorries), was conducted in Golubac in the Thursday, March 2, 2017 (Fig. 4). This day is intentionally chosen because Thursdays are market days in Golubac and the weather was sunny and between 15-20°C. In contrast, March is a month outside of tourism season. Hence, this day was perfect to measure the maximal exploitation of the open urban space by the local users and ordinary passers-by, e.g. without disruption by tourists. This stance was important for the research – Richards (2007) points that local lifestyle is becoming increasingly important for the contemporary consumers of the cultural tourism. Tourists will follow local people in their lifestyle and "consume" the same places in the urban structure.

The obtained results in Golubac are very indicative for this matter. Generally, cars and pedestrians dominate in the open public spaces in central Golubac; on the other side, the cyclists are quite scarce. If this issue is analysed from node to node, it is obvious that there is a huge gap between the pedestrians and the other users. The cyclists and all types of the vehicles tended to use the main west-east transport corridor through the town (Đerdap/Iron Gates State Road), which is also the widest street in the town. At contrary, pedestrian movement has a less dispersed network. The numbers of pedestrians and other observed

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users are both similar and highest along the main street and around the main square, with the highest concentration of the central facilities. However, this is a sharp contrast with the main tourist attractions, such as the Danube Quay and the nearby city park with the view on the fortress. These spaces are not appropriately used by local pedestrians to eventually become magnets for the external visitors.

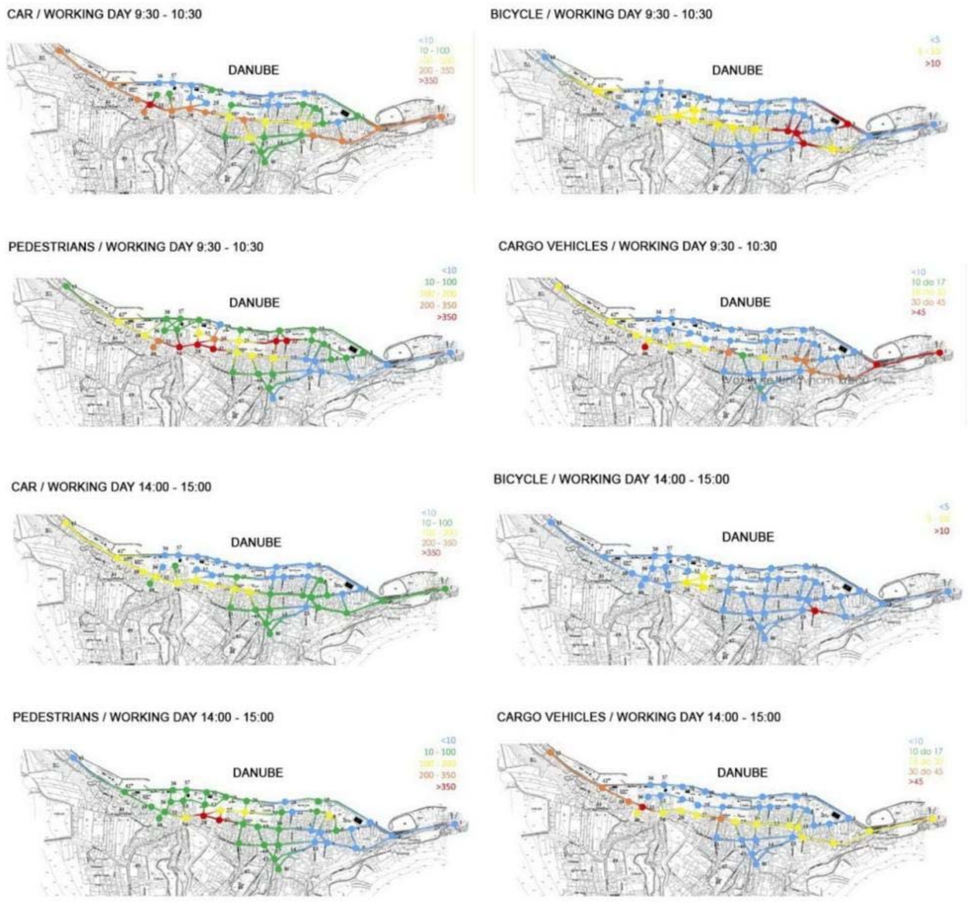

Fig. 4 The flows of the different users of open public space in central Golubac in two characteristic daytime period (Authors: M. Zukanović, J. Milovanović & T. Radić).

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3.3 ANALYSIS 2: SOCIAL MEDIA MAPPING

The global development of social media (Facebook, Twitter, Instagram, Pinterest, ect) in two recent decades concurs with the acceleration of the cultural tourism. These two sectors have become dependent recently. Muscat Declaration (WTO, 2017) highlights the computer-based activities to post and share or, indirectly, to promote the cultural tourism by distributing related big data. The social media arises as important segment of this big-data exchange (Demunter, 2017).

The analysis of posted geocoded data in Golubac were conducted for two social media networks (Instagram and Twitter) in the period 2011-2017, done by Jugoslav Joković and Nikola Dinkić.

Instagram: The analysis of location tags (hashtags) by Instagram in Golubac area demonstrates the general interest on the fortress instead on the town; the tags that include the words fortress, castle and their Serbian match-words are the most frequent. The only other Golubac location mentioned in Instagram is the town quay (Fig. 5):

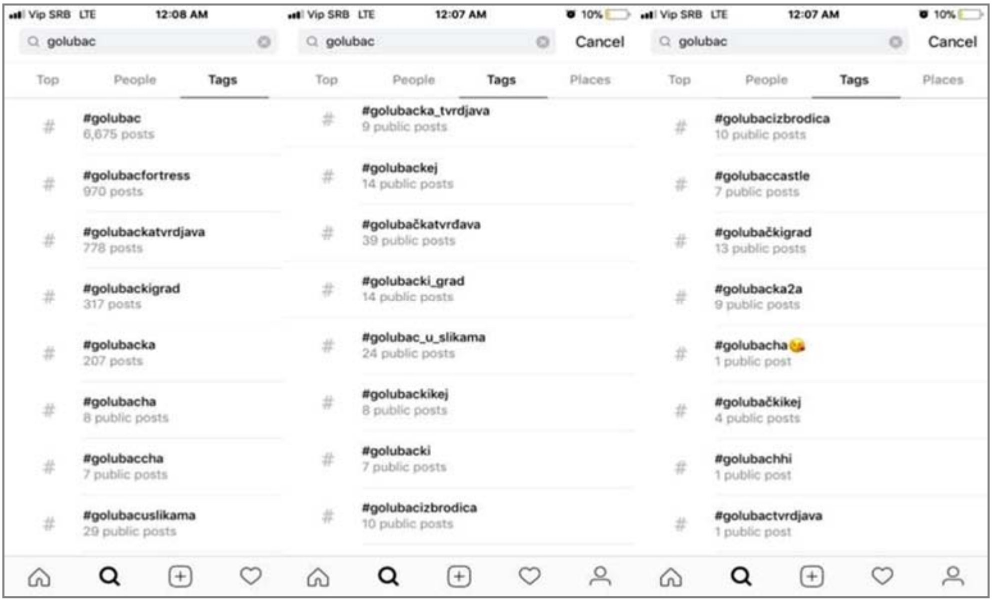

Fig. 5 Golubac hashtags by Instagram (Source: J. Joković & N. Dinkić).

The same analysis of Instagram data done by also showed several key hashtags related to Golubac, with the total number of 8,740 these tags. The non-denominational hashtag *#golubac* dominates with 76% share. The second ones are the hashtags related to the fortress

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(*#golubacfortress* and *#golubackatvrdjava*) – 20%. The last ones are the hashtags that refer to the town (*#golubactown*and *#golubackigrad*) with just 3.7% share.
Twitter: At the first glance, Tweets analysis showed that the interest of users existed just for Golubac Fortress. Thus, the Tweets analysis is narrowed to the fortress, where an explored location is defined by the fortress coordinates (44.660241 N, 21.679019 E), with 300-metres radius. The results of Tweets analysis (Tab. 2 and 3) profoundly show that Golubac Fortress is becoming an international tourist attraction; eight used languages and the variety of the applications used for Tweets distribution confirm this statement.

Analysis type	Number
Total number of Tweets	61
Number of users	44
Number of applications	5
Number of languages	8
Number of likes	36
Number of re-Tweets	2
Number of followers	85,253
Number of friends	50,872

Application	Share (%)
Instagram	56.3
Foursquare	20.8
Twitter for Android	18.3
Twitter for iPhone	3.2
WorldPress	1.1
ekskursja.pl	0.4

Tab. 2 and 3 Tweeting on Golubac Fortress2011-2017: general figures (left) and the distribution of Tweets by applications (right) (Authors: J. Joković & N. Dinkić)

4 CONCLUSIONS

The main findings from two analyses in Golubac Town are given in the following highlights:
The sharp division between western and eastern half of Golubac centre due to their different character; the western part is more related to retail and transport and the eastern part is more with public institutions (school, kindergarten, etc.).
The results of space syntax clearly show that the "ordinary" actions of the modern planning in tourism cannot be predicted in a traditional way. For example, the local government has invested a lot in the open public space along the Danube Riverfront (town quay or town park), these space is underused most of the year. Space syntax results reveal that these places are not on daily routine for the majority of local population. At contrary, the main street, the part of the Iron Gates Main Road, is not adequately recognised as an important public space even though its transitive character, also identified by space syntax, means that it is the "gate" of Golubac Town to the-first time passers-by. Therefore, it can be crucial for the first-time individual cultural tourists to notice the potential of the town and the nearby Danube riverside and spend some time in Golubac.

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Interestingly, some places important for local communities are totally unnoticed by local government and local plans.

For example, the town open market ("bazaar") is very important for local community by space syntax research, but cultural tourists do not know about it. However, it can be easily promoted as an integral part of Serbian life and culture, which is in line with the recent trends in cultural tourism (traditional culture). Similarly, the tourists are not informed about the upper part of central Golubac with excellent viewpoints to the lower historic part, Golubac Fortress, Romania and the 6-kilometre wide Danube. The market, located in this part of town can be included in this town tour.

The previous findings are further support by the results from social-media analysis. There is a noticeable gap between the attractiveness of Golubac Fortress, which has already known internationally, and Golubac Town, which is far behind. This indirectly points out that the broad surrounding of the fortress, including the town and its open space, cannot currently enable the same tourist interest as the fortress, which size is negligible comparing with the town.

For the future planning and design, the following recommendations are crucial:

- Physical improvements of the main street and the open public space around bus station are the most desirable, with preserving its vibrant life;
- The "softening" of its image of a 'mental boundary' between the lower and upper parts of the town;
- Open public spaces in the eastern part of Golubac deserve a profound regeneration, which should be based on multi-aspect approach – to include physical, functional improvements, as well as social and cultural interventions; and
- The better visual and symbolical link with the fortress as an already established major attraction should be embedded in the future interventions in the town. The new planning and design projects had to include the view on Golubac fortress and the Danube. Furthermore, it is necessary to explore the meaning and importance of the fortress by promoting the design that symbolically resembled the fortress and related matters (middle ages, knights, etc.). However, it is important to use ICT-driven tools to link tourism and culture through public space(digitised heritage, augmented reality, etc.).

The future research regarding cultural tourism should be more focused on how to use the social media and geo-located data derivedfrom user movement in urban planning. Finding the sentimental paths of the users and missing links between the nodes within open public spaces is crucial for the successful functioning of the city regarding the cultural tourism. It is also important to recognise all key tourist spots, to strengthen the links between them and eventually to form the network based on them. This is the only way to be in touch with the

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already mentioned new trend; to wide tourist offer from the main tourist sites to their surroundings, including local tradition and customs and involving tourists to participate in them.

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AUTHOR'S PROFILE

Aleksandra Djukić, is an associate professor at the Department of Urbanism, University of Belgrade – Faculty of Architecture, Serbia. Her scientific and pedagogical interests are urban planning and design, with a special respect on urban morphology and urban renewal and regeneration. She is an active participant in scientific conferences and exhibitions. She is also a licensed urbanist, planner and architectural designer – she was the leader of member of working team in numerous documents in urban planning and design, as well as in architectural design and spatial planning.

Branislav Antonić, is a teaching assistant at the Department of Urbanism, University of Belgrade – Faculty of Architecture, Serbia. His scientific and pedagogical interests are urban and spatial planning, with a special focus on the planning of medium-size and small communities, as well as the spatial aspect of housing and tourism. He is an active participant in scientific conferences and exhibitions. He is also a licensed urban and spatial planner with professional involvement in more than 30 spatial and urban plans and urban design projects.

Jugoslav Joković, is a research associate and teaching assistant, received from the Faculty of Electronic Engineering, University of Niš, the Dipl.-Eng, M.Sc. and Ph.D. degrees, in 2000, 2004, and 2007, respectively. He participated in scientific national projects – in the programme of technological development, energy efficiency and interdisciplinary research, and also within programme of bilateral cooperation with Germany, as well as Actions in European COST program. He is author or co-author of more than 100 scientific papers in the field of communication and signal processing, of which seven papers in journals with impact factor. He is a reviewer of international journals and conferences and the member of IEEE (MTT, CAS, GRS).

Nikola Dinkić, is a research assistant with Dipl.Eng. Degree from the Faculty of Electronic Engineering – University of Niš. He is a research assistant with Dipl. Eng. Degree from the Faculty of Electronic Engineering – University of Niš. He joined Department of Computer science in 2014 as a PhD student and researcher, participating in scientific projects financed by Serbian Ministry of Science. His research interests include artificial intelligence, geographic information systems and internet applications. He is co-author of 12 scientific papers in international and national conference papers.

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TOWARDS A MODEL FOR URBAN PLANNING CONTROL OF THE SETTLEMENT EFFICIENCY

ISIDORO FASOLINO, FRANCESCA COPPOLA
MICHELE GRIMALDI

Department of Civil Engineering
University of Salerno, Italy
e-mail: i.fasolino@unisa.it, fracoppola@unisa.it
migrimaldi@unisa.it
URL: http://docenti.unisa.it/isidoro.fasolino
URL: http://docenti.unisa.it/michele.grimaldi

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ABSTRACT
The urban model of cities of the future is closely linked to the concept of sustainability. The current research on the subject does not provide a particularly rich picture of studies carried out in terms of a quantitative engineering approach and has a poor and incoherent national regulatory framework. There is no attempt to evaluate the overall performance level offered by the system elements which make up the settlement. The international relevance of sustainability issues, when applied to the governance of the territory, is what leads to the need for integrated innovative strategies in the planning process aimed at reconstructing a balance with the natural environment. This need is addressed by constructing a model aimed at verifying and planning the most efficient urban planning of the settlements, by taking into account the environmental, economic and social contexts and through the definition of a specific index of settlement efficiency. Constructing a model requires the identification of indicators, which can be controlled on an urban level and are associated with elements and relevant performance in terms of resilience, energy efficiency and innovative urban facilities. The subsequent development of these indicators derives defining appropriate benchmarks and the implementation of multi-criteria analysis. The model is configured as a tool to support the strategic environmental assessment of the municipal urban plan and controlling tool, in quantitative terms, of the impacts on the environment caused by town planning choices while allowing for changes aimed at raising the quality level of the solutions identified. The general objective is to equip the planning process with tools for the design and construction of inclusive settlements, which are self-sufficient from an energy point of view and capable of coping with climate change.

KEYWORDS
Efficiency; Settlement; Urban planning

1 THE URBAN PROBLEM

The urban model of cities of the future is closely linked to the concept of sustainability which implies the capacity of the system to achieve the balance between consuming and regenerating resources connected to the growth of cities but also the capacity to pursue social and economic equity, while taking into account that citizens are active elements in the management and protection processes of their living environment.

The growing interest in the construction of new cities or the transformation of existing ones in a smart perspective and the international relevance of these problems, applied to the governance of the territory, determines the need to integrate innovative strategies into the planning process that aim at sustainability and the resilience of urban settlements and, therefore, the recreation of a balance with the natural environment.

The relevance of the themes are highlighted in the 17 Sustainable Development Goals (SDG) designed and promoted by the UN (The United Nations). In particular, reference is made to SDG 11 – Make cities and human settlements inclusive, safe, resilient and sustainable (UN, 2015).

Today's challenges facing urban areas, such as land use and climate change, make it necessary to define a methodology for assessing the sustainability of urban planning that will allow for the creation and validation of a protocol on an urban scale. The city is, in fact, the place where the majority of economic and residential activities are concentrated and, therefore, has the highest rate of energy consumption whereby wasted and irrational uses of resources are common place along with the production of the greatest quantity of waste, not to mention, the environmental impact which is generated by mobility and social exclusion caused mainly by economic mechanisms. Although cities occupy only 3% of the Earth's surface, they are responsible for 60-80% of energy consumption and 75% of carbon emissions. These aspects are becoming increasingly widespread when placed within the global trend of urbanization. In fact, nowadays, approximately 3.5 billion people live in the city and by 2030 the world population will live in urban areas will reach 5 billion[1], with the consequent increase in consumption, demand for resources and environmental impact.

However, the urban realities are able to more effectively counter the negative effects caused by development processes as well as being able to offer an institutional framework which is more suited to the drafting and operational implementation of tailor-made policies.

[1] https://www.un.org/sustainabledevelopment/cities/

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A sustainable city cannot and must not be thought of only in relation to environmental protection as well as the protection and restoration of its integrity, but also as a place in which to extend wellbeing to the whole community.

2 PLANNING PARADIGMS

Settlement efficiency is understood as an urbanistically controllable subset of the more general concept of sustainability associated with a «a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development; and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations» (WCED, 1987). In an approach that goes from the holistic to the reductionistic, the assessment of the efficiency degree of a settlement cannot be carried out without considering the different factors that determine its performance: *resilience*, *energy efficiency*, *innovative urban facilities*.

Resilience, regarded as a resource which should be preserved and increased, is closely connected to the built environment, in its most general sense, and correlated to the delicate relationship between the anthropized and natural environment. In relation to urban systems, *resilience* can be defined as the capacity to «resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner» (UNISDR, 2009).

«A resilient city assesses, plans and acts to prepare for and respond to all hazards – sudden and slow-onset, expected and unexpected»[2] associated, nowadays, mainly with climate change, classified among the main risks on a global level (WEF, 2014). In addition, in order to achieve settlement efficiency, the need for a more rational use of *energy* must be considered through actions and measures aimed at saving energy and using renewable sources, and *innovative urban facilities*, aimed at improving the quality of community life.

The problems related to the most elementary methods of fruition of a territory have been dealt with up to now through the creation of gray infrastructures such as roads, sewage systems, railways, etc. In order to complement these, within the framework of a global project aimed at defining a strategy for the sustainability and resilience of human settlements, a decisive role is played by *green and blue infrastructures*, as a planning paradigm to articulate and detail in a system of choices of an eminently urbanistic nature. In fact, the latter are able to: reduce the fragmentation of natural habitats; restore the conditions for carrying out natural processes in the city; increase the degree of biological diversity and self-regenerative skills; construct corridors connecting with external habitats, through favoring the necessary

[2] http://urbanresiliencehub.org/what-is-urban-resilience/

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biological exchanges; reduce the ecological footprint of cities on the territory and increase the degree of resilience of the urban ecosystem, by increasing the load capacity and performance of the constructed environment; improve urban metabolism and the eco-efficiency of its various components; mitigate the effects of climate change. In this sense, an efficient settlement can be considered as an urban segment of green and blue infrastructure.

The current research on the subject, from an urban point of view, does not provide a particularly rich picture of studies carried out in terms of a quantitative engineering approach, which analyzes the urban settlement fabric and the territory as a whole, with reference to all the elements that constitute it, in an organic and unitary way.

In particular, the European strategy for sustainable urban planning outlines the prospect of high density and mixed-use settlements, with the reuse of abandoned soils, and a planned expansion of urban areas that replaces isolated processes (CCE, 2004), while the Italian, national and local regulatory framework appears to be lacking in the analysis of social and environmental aspects, limiting itself, for the most part, to quantitative requirements (standardization of building, urban planning, environmental standards, etc.) which are not included in a clear and defined strategy. Any attempt to evaluate the overall performance level offered by the system of the elements constituting the settlement is lacking.

3 RESEARCH OBJECTIVE

The objective of this research is to define a model aimed at planning and verifying the most efficient urban planning of settlements, with particular reference to environmental, economic and social contexts, through the construction of a specific *index of settlement efficiency*. The most general purpose is to provide the urban planning process with tools for the design and construction of inclusive settlements, which are self-sufficient from an energy point of view and capable of coping with climate change.

4 METHODOLOGY

The scope of the methodology is evaluating the settlement efficiency through the prediction and combination of the factors that determine it. Constructing the model (Fig. 1) requires, therefore, the identification of a series of indicators that are associated with elements, which can be controlled on an urban level, and related performances considered relevant in terms of *resilience*, *energy efficiency* and *innovative urban facilities*. This is based on the analysis of scientific and technical literature, including sustainability protocols on an urban scale, and best practices. The subsequent development of these indicators derives from the definition and

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quantification of appropriate benchmarks and the attribution of weights and scores through the use of multi-criteria analysis techniques.

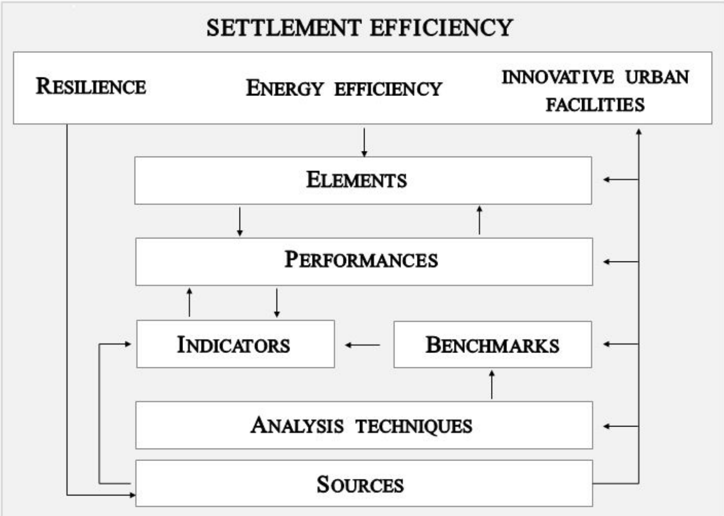

Fig. 1 Conceptual scheme of research.

4.1 ELEMENTS AND PERFORMANCES

In order to achieve the objective established, the model provides for the identification of a series of elements in the urban planning of a settlement that contribute to its efficiency. A large part of these elements is part of green infrastructures, on an urban scale, in other words, they are tools for the valorization of natural environments which are modified or disfigured by the development of human activities. However, from the point of view of *multi-functionality*, *adaptation* and *flexibility*, each element can guarantee one or more performances, namely oriented towards sustainability, resilience, energy efficiency. According to these considerations, the interesting elements for the model are to be found in these macro-categories:

- *Resilience devices*: elements especially designed and managed to increase the resilience of the settlement such as: green spaces and parks, cistern squares, green retention, watersquares, forestation, permeable pavements, urban meadows, etc.
- *Nature based solutions* (*Nbs*): solutions designed, managed and enhanced to perform certain services which are economically advantageous and at the same time able to provide benefits for the environment in terms of the quality of life of citizens and the

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economy. These include: waste water recycling, rainwater harvesting, green walls and roof, raingarden, wetland, etc.

- *Energy efficiency*: roofs, canopies and photovoltaic facades, district heating, etc.
- *Innovative urban facilities*: social housing, cycle paths, urban gardens, natural habitats, ecological microrets, etc.
- *Urban systems*: ecological islands, emergency management spaces, etc.

These elements can be considered as the main dowels of an urban segment of green and blue infrastructure.

4.2 INDICATORS AND BENCHMARKS

The construction of an efficiency evaluation system for a settlement which is able to converge and integrate environmental, economic and social aspects towards forms of effective relationships in a synergistic way, is able to identify a concrete solution in the correct application of suitable indicators through which the performance of the elements defined above can be measured.

The choice of indicators to be used in the evaluation is a complex and delicate operation which imposes a series of requirements such as: *precision* (guaranteed by technical and scientific substantiation), *measurability* (accessible and available indicators, statistically documented, regularly updated, transparent and sensitive to changes in the phenomena monitored), *relevance* and *potential use* (representative of the scope to be analyzed, which are easily understandable and interpretable, with the possibility of describing temporal trends, communicative immediacy and comparable with a reference value that testifies its relevance). The latter are indispensable in order for the selected indicators to perform the task for which they were designed[3], namely «to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems» (UNSD, 1992).

In particular, they must be representative of the conditions of the system; the relationships between human activities, the pressures and the components of the urban structure and they must be capable of orienting the definition of environmental quality targets and the objectives of environmental strategies. Furthermore, they can be used to stimulate participation as an indispensable element to support decision-making processes in the allocation of priorities and in the selection of possible alternatives.

[3] The Indicators were officially introduced at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992.

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The choice of indicators is carried out through a critical analysis of scientific and technical literature and the most widespread urban sustainability protocols, both nationally and internationally, as well as other available sources. This operation highlights some interpretative, conceptual and applicative problems that make it necessary to select and reduce them to a set of controllable and significant indicators from an urban point of view and to which a quantitative or qualitative evaluation can be associated. The choice falls on a limited number of indicators that makes it possible to define the form and functions of specific portions of the settlement, in line with the objectives of the model.

In relation to the different measurable elements, we identify three homogeneous areas in which to group the selected indicators: *natural capital*, *artificial capital* and *social capital*.

The valorization of the selected indicators, which are essential for the formulation of a synthetic judgment on the global performance of an urban settlement, derives from the definition and quantification of suitable benchmarks and the subsequent attribution of weights and scores through multi-criteria analysis. Choosing the latter is necessary due to the complexity of the issue and the presence of numerous aspects of an environmental, economic and social nature that are sometimes conflicting. The difficulties encountered at that point in defining the methodology are linked to the significant lack in both the literature and in the national and international case studies of threshold values through which a score can be assigned to the indicators. Furthermore, in the use of these techniques, the estimate of the efficiency of the settlement will not be univocally defined as it is conditioned by discretionary hypotheses and value judgments necessary in the definition of the weights and scores.

5 RESEARCH PERSPECTIVES

The research development perspectives are embedded in the potential of the methodology and in the way it is structured. In fact, the hypothesized model is configured as a controlling tool, in quantitative terms, of the impacts induced by town planning choices, on the degree of settlement efficiency, making it possible to make the necessary changes in order to increase the quality of the solutions identified in the municipal urban plan and to support its strategic environmental assessment.

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AUTHOR'S PROFILES

Isidoro Fasolino, Engineer. He has a PhD in Urban Planning Techniques, in an associate professor in Urban Planning Techniques and teaches Urban Planning and the Fundamentals of Urban Engineering at the University of Salerno. He is the author of articles, essays and books in these subjects. He is an effective member of the Board of Directors, both in Campania and in Italy, of the National Institute of Urban Planning (INU).

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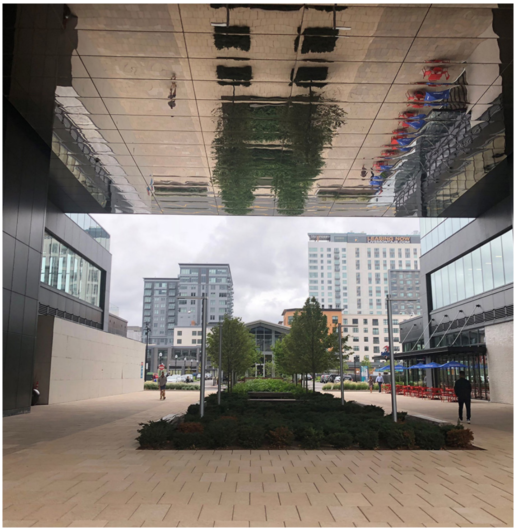

SOMERVILLE: INNOVATION CITY

LUNA KAPPLER

Department of Civil, Building and
Environmental Engineering
"Sapienza" University of Rome, Italy
e-mail: luna.kappler@uniroma1.it
URL: www.dicea.uniroma1.it/en/users/

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ABSTRACT
The city of Somerville has answered in the last ten years to the rise of Innovation Districts, especially in Boston and in Cambridge and its outcomes, complaining that the term "innovation district" has almost become a slogan, instead that focusing on creative forms of strategic policies. That is why it has decided not to create a specific district related to innovation but to build its own economy around innovation, including the use of new economic tools and development processes to build a solid ecosystem within the whole city. The article aims to present a focus on the territorial and economic transformation that has affected Somerville, especially in the areas of Assembly Square, Union Square and Boynton Yards. Those have been considered the proper field to test new economic tools for a development based on innovation. Still today, the definition of a community vision is giving the possibility to innovative businesses and start-up to locate in a friendly and inclusive live/work environment. The main consequence today is that the city is becoming compact and benefits from the creation of a dynamic physical realm which strengthens the proximity and the impact of knowledge. The research is the result of on-the-spot analysis and interviews with the protagonists in the phases of the process, selected among promoters, entrepreneurs, citizens and professors.

KEYWORDS
Innovation Districts; Innovation Economy, Vision, Proximity

1 THE EVOLUTION OF THE CITY OF SOMERVILLE DURING THE YEARS

Somerville was first settled in 1630 as a part of Charlestown, and was established as a town in 1842, after being separated from the urbanizing Charlestown because it was still largely rural. It was incorporated as a city in 1872, due to its growing population and increasing industrialization.

As a part of Charlestown, areas existing in modern-day Somerville such as Union Square were critical military positions in the American Revolution.

In 1803, the Middlesex Canal connected Lowell with Charlestown, spurring development of a textile industry along the Merrimack River. The Assembly Square area's proximity to, first the canal terminus, and after 1842, the Boston and Maine Railroad, made it a center for industry and commerce. Tidelands were filled and factories were built. The Olmstead firm, designers of Boston's Emerald Necklace, planned a tree-lined boulevard connecting Broadway (now Foss) Park to the Mystic River that became the Northwest border of Assembly Square when built in 1897. The rail station built at the Southwest tip of the site in 1901 served streetcars and an elevated line. Streets lined with homes and businesses integrated Assembly Square with East Somerville[1]. By the early 1900s, Somerville itself had become a densely packed urban area, featuring immigrants from across Europe. Public transit made Assembly Square's thousands of jobs easily accessible. In 1926, Ford built an assembly plant, from which the square took its name, while one year later First National Stores built a warehouse complex running from what is now Circuit City to Lowes Theater.

2 THE STARTING CONDITIONS OF THE AREA

Two events changed the city. First, deindustrialization hit Somerville early: Ford closed its plant in 1958, followed by First National in 1976, each laying off more than a thousand workers. Most of Somerville's factories closed between those two dates. Developers converted abandoned factories to residential uses, which produced only 60% of the tax revenues, but twice the costs of commercial uses. Secondly, the Commonwealth drew up plans for Interstate 93 (I-93) that would rip out the heart of East Somerville and isolate Assembly Square (Shelton, 2006). Neighbors formed "Somerville Citizens for Adequate Transportation" to fight them, while the city administration opposed.

[1] "About Somerville", https://www.somervillema.gov, accessed October 2018.

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By 1976, Assembly Square was becoming a ghost town. In 1978, city officials began preparing a redevelopment plan. They declined to develop a master plan, but embraced a developer's initiative and presented it as the city's redevelopment plan.
Then, as now, the site for a new mall was the old Ford plant. FBI agents caught them in a securities-fraud and tax-evasion scheme, so a decade after it opened, the business began a decline that would end with its closing.

3 THE CHALLENGE: DEVELOP AN INNOVATION ECOSYSTEM

Somerville has always been suffering of the competition with its most fortunate and globally known neighbor; Boston.
It had to face and answer to these Boston's effective policies that were creating incredibly various scenarios, such as Seaport by the ocean, with its high-rise development and Roxbury, with its attention to social inclusiveness. So it decided not to create a specific district related to innovation but to build its own economy around innovation, including the use of new economic tools and development processes to have a solid ecosystem within the whole city. For this purpose places of concentration of interests were identified among those that where in the program of Main Streets: Union Square and Boynton Yards together with Assembly Square.
The term "innovation district" has almost become a slogan in Greater Boston, referring to areas in which large scale mixed-use development is centered on major anchor institutions and related firms, entrepreneurs and companies (Katz, 2014). Anchor institutions typically come from the education or healthcare fields, but can also be non-profit cultural institutions, locally-focused philanthropies, libraries, or even large for-profit corporations. Large companies, universities help spread the fixed costs of research and development and help support a fledgling innovation ecosystem, which is created when a synergistic relationship rises between people, firms, and places that facilitate idea generation and accelerate commercialization. Providing a physical environment where this can take place, requires a continuum of spaces for companies. Instead of creating isolated scientific parks, the "Innovation Districts" focus largely on the creation of a dynamic physical realm that strengthens the proximity and the impact of knowledge. They represent the effort to create new products, technologies and market solutions, through the convergence of disparate sectors and specializations. To find an example of an innovative economy twenty years ago, one was forced to drive to a lost research center, work alone and keep one's ideas secret (Katz, 2014). Proximity is everything today (Bradley, 2013). People want to be in dynamic urban places, which can be reached on foot or by bicycle, where they can meet other workers, share their ideas and appreciate varieties. Companies appreciate the proximity to other

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companies, research laboratories and universities, in collaborative spaces, to make it easy to transform brilliant ideas into attractive products.

3.1 A NEW VISION FOR SOMERVILLE AND ASSEMBLY SQUARE

In the fields of education, social services, health, recreation and open space, Somerville's needs were disproportionately large. Nevertheless, the city had an extraordinary potential as a community, home and workplace.

In April, 1998, residents were invited to discuss this potential at "SomerVision", a citywide event with attendees from economic development, real estate, business management, and environmental backgrounds. First, the best way to meet many of Somerville's needs was full employment. Second, regional grants could only meet a fraction of the city's needs. Third, the only land left that could accommodate development adequate to produce needed jobs and tax revenues was Assembly Square and the Inner Belt. The benefits and burdens associated with different development patterns were investigated and their economic requirements, market potential, and environmental impacts were analyzed. Degradation changed Assembly positive features deriving from its close position to the city center into negative ones, but it emerged that Assembly Square was the best development site left in Greater Boston for high-density development. Its $6 billion in infrastructure investment, second only to Boston's financial district, includes the Orange Line, three commuter rails, Routes 28 and 38, the Mystic River, and I-93. It's less than 15 minutes from downtown, the airport, financial centers, Harvard and MIT. If developed only as parkland, Assembly Square would be a permanent fiscal and physical burden, instead, housing development would create a greater burden, offering more than new tax revenues, together with large retail stores. It has been considered that developed as an office-based urban district with supporting housing, retail, a hotel, and cultural facilities, Assembly Square could produce $30 million in net taxes and 30,000 new jobs and 30 acres of new open space. Another point was that developers won't undertake projects unless they have assurance that surrounding properties will be well designed, supported by sufficient transportation infrastructure, and not include uses that would undermine their investment; so they required a master plan. The citizen activists chose for themselves the name "Mystic View Task Force" and began to formulate a vision. Candidates Dorothy Kelly Gay and Joe Curtatone both endorsed it, during the election to replace Mayor Capuano (Dorothy Kelly Gay became Mayor).

IKEA bought 17 acres of waterfront property in 1999 for $19.5 million. Mayor Gay rejected its plans because, "it did not include sufficient mixed use on their vital waterfront acreage". For the activists like the Mystic View Task Force the store's traffic impacts were fundamentally incompatible with Somerville's interests. In 2000, the Somerville Redevelopment Authority

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(SRA) acquired title to a 9.3-acre former railroad parcel and issued a RFP for developers. The City initiated an extensive public planning process, producing the "2000 Planning Study" which set out a new vision for Assembly Square as a 24-hour mixed use district. In 2004 investors voted to sell the areas to Federal Realty Investment Trust for $64 million.

Fig. 1 Mystic View Task Force main focus area, photo taken in September 2018

4 THE CHALLENGE: DEVELOP AN INNOVATION ECOSYSTEM

Aim of the city was to reconnect and revitalize marginalized areas, with a special focus on Assembly Square for its need of being redefined in terms of urban space and uses.
For this purpose in 2009 there was a call to residents: "Help create Somerville's long-range plan", that driven by a sixty person steering committee and hundreds of participants at public meetings led to "SomerVision 2010-2030"[2], the City's first comprehensive plan. Shared values and long-term goals have been vital steps for the next 20 years development.
Each neighborhood answered to the plan's indications. In 2015, the residents of Union Square wanted the same process to inform their future. The resulting document is the Union Square Neighborhood Plan; the first neighborhood plan in Somerville to put policy before physical development. Union Square residents cared deeply about their community and wanted to make sure that over time, no matter what type of growth happens, that Union Square would have been a place for everyone. The "Vision for the Future" chapter details the programs that would have helped the community to reach goals for equity, public realm, housing, economy and mobility.
"SomerVision" came from shared learning between residents, the business community, nonprofit groups and public officials. It was based on a series of research reports prepared by the Mayor's Office of Strategic Planning & Community Development (OSPCD) in which information available on demographics, economics, housing, transportation and land use was

[2] In 2009, the city's community started a three-year process of discussions that culminated in SomerVision 2030; now, after 10 years into the plan's scope, Somerville has decided to revisit it and extend its vision to 2040.

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assembled to help the citizens to understand and participate in the Comprehensive Planning process. After these Trends Reports were completed, ten open community workshops were held to discuss the implications. The Comprehensive Plan is an easy-to-use guide for future growth and development in the City. The choice was to include both neighborhood and capital plans with a broader view on diversity, community, economy, accessibility, sustainability and innovation. The horizon considered was 2030, to guide decisions though a 20 years process. The plan is the first to have a participatory, long-range and inter-disciplinary view about Somerville's future with a specific focus about five themes such as neighborhoods, commercial corridors, squares and growth districts, resources, transportation and infrastructure, housing. The "Small Business & Entrepreneurship" policy has connected the five themes to protect and promote a diverse and interesting mix of small-scale businesses, establishing policies, regulations and fees for selected activities.

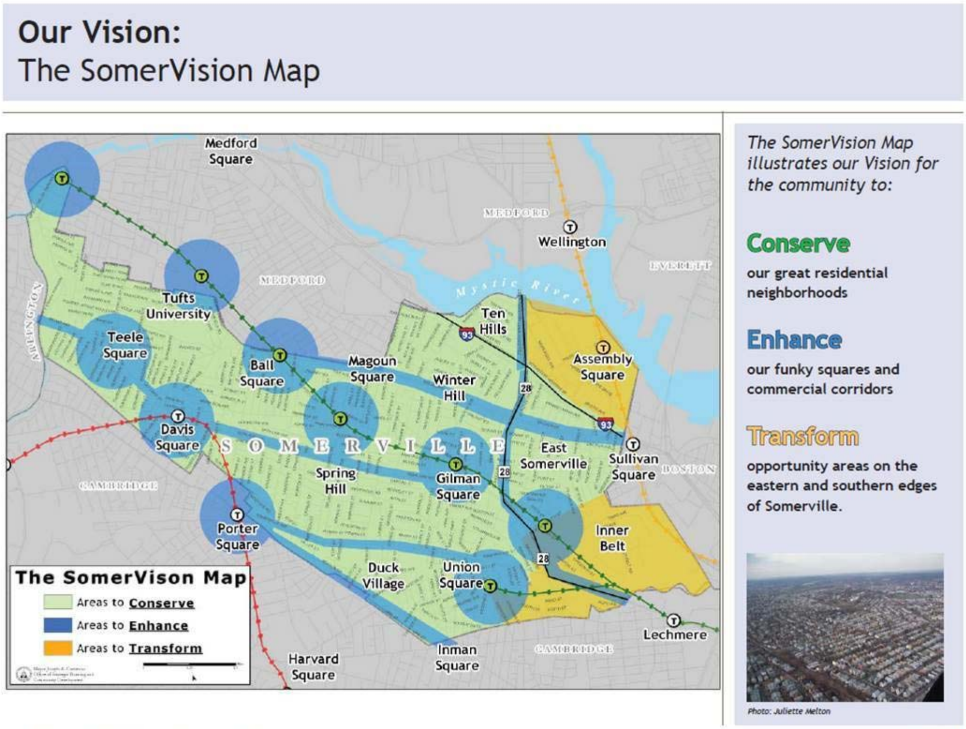

Fig. 2 The "SomerVision Map" of the "SomerVision Comprehensive Plan", April 2012, p. 17

The main aim was to allow these changings ensuring that appropriate businesses could be easily permitted in designated areas, such as close to transit stations. As a consequence, the review of zoning regulation has been a priority. To drive a smart growth process the city had

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to identify a community vision and give the possibility to innovative businesses and start-up to locate in a friendly and inclusive live/work environment.

4.1 GOVERNANCE ARCHITECTURE AND PARTICIPATION PROCEDURES

A leading role has been played by the economic development office, a division of the office of strategical planning and community development with a special interest in the fields of housing, planning, transportation and economic development. The team is still today made of six full time people who work on real estate with developers, on urban renewal plans and project management to make sure that the processes driven even by other forces are focused on administration aims. It has worked with other divisions on innovative economic tools such as District Improvement Financing (DIF) or I-cubed and community grant contributions. Other than real estate, it is focused on attracting new companies to Somerville. The third component of the office is workforce development to prepare residents to work in the companies that the city is trying to attract (Ben Sommer[3], 2018).

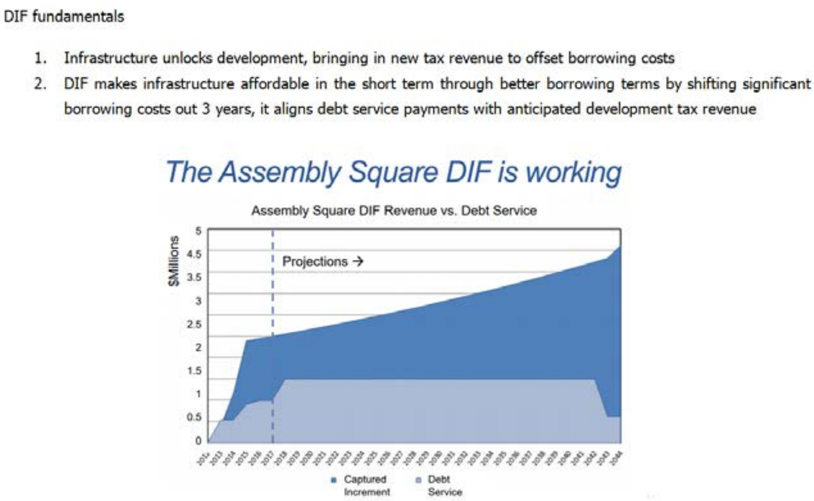

Fig. 3 Introduction to DIF, City Staff & RKG Associates, October 11, 2017

The framework of the development was made of new strategic policies from the government of the city and of new tools to drive the changings. First of all, the "Innovation Fund" or "I-Fund", a $1 million loan fund for Somerville businesses with innovative products or business models, has been used to help promising businesses move to or stay in Somerville.

[3] Economic Development Specialist, interviewed at Somerville city hall in September 2018.

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In 2017, the City of Somerville, Greentown Labs, and the Northeast Advanced Manufacturing Consortium launched Form to Factory, a cross-sector partnership to support the Commonwealth of Massachusetts' advanced manufacturing industry. It is meant to create new workforce pipelines and connect local manufacturers with innovative hardware startups. The support given ranges from ideation through prototyping, to training new young specialists to be in manufacturing. The state's Economic Development Administration's Regional Innovation Strategies grant program is funding it for a $1-million three-year initiative for companies in Middlesex, Suffolk or Essex Counties.

Moreover, a new concept of building has been experimented with the name of FabVille, a public fabrication space within Somerville High School that complements the collection of professional, semi-professional, and artist-focused spaces already available in the city.

Always in 2017 the Innovation and Opportunity Lab has been established to complete the innovation scenery and to give to it solidity. It is a Mayoral advisory committee composed of technologists, community leaders, and Somerville residents with the mission of building the innovation ecosystem of Somerville through creative policies, partnerships, programs and connecting this wave of innovation within the neighborhoods[4].

These new solutions enhanced the rise of an innovator spirit around residents and entrepreneurs which led to animate the interest towards the redefinition of the city.

5 ASSEMBLY: START-UP OF THE INITIATIVE AND ITS FOLLOWING MODIFICATIONS

From 2010, the 45 acres designed with the name of "Assembly Square" went through a difficult process to find who could be interested in developing them through a Urban Renewal Process[5] that was driven by the Somerville Redevelopment Authority (SRA) in charge of creating reports and documents to let the city be able to take the grants and to acquire private land (Sunayana Thomas[6], 2018).

Between 2011 and 2012 a request for proposal was held for 9,3 acres which correspond to the development now visible in Assembly Square. Federal Realty still owns from Kmart place to Partners Healthcare (where it was supposed to be IKEA). The presence of Partners

[4] Innovation economy in Somerville, https://www.somervillema.gov, accessed October 2018.

[5] The urban renewal is a state process, in which the state overseas through DIF and TIF, accompanied by state policy and investments.

[6] Senior Economic Development Planner, interviewed at Somerville city hall in September 2018.

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HealthCare's in Assembly is ushering in a new wave of development on Somerville's east side[7] and it was made possible thank to the Orange Line, which came there in 2012 through I-cubed, the Infrastructure Investment Incentive. The city has assembled the site paying the market value for those properties from different owners and the developer had to pay all the other costs associated with the project. The city of Somerville and the private developer asked to have the extension and the new stop of the Orange Line, the first new MBTA station in 27 years. Federal Realty said "if we don't get it there is no project to the scale that we want" (Ben Sommer, 2018). A public-private partnership was created before asking for proposals and there were contractual agreements with Federal Realty to give directions on the project in order to achieve all the city requirements, represented by SRA along the whole process.
In Assembly Square Community Advocacy Groups played a fundamental role of supervisors, ensuring that the best intentions of the residents and users of the area were captured, as job count, open space and facilities. The "Massachusetts Department of Environmental Protection" followed the preliminary exploration of the conditions of the area and the remediation process paid by the developer.

5.1 ASSEMBLY: THE URBAN CONTEXT TODAY AND IN PROGRESS

Federal Realty decided to build a neighborhood with the challenge of creating something out of nothing. Assembly will comprise 1,800 apartments, 635,000 square feet of retail space and 2.8 million square feet of office space (today according to Ben Sommer we are at 40% of the process). The project had to answer to the South Boston Innovation District in which it was recognized a sense of desolation and alienation. The Federal Realty team has paid attention to pedestrian space, especially the sidewalks. A majority of the neighborhood's retail stores are intentionally outlets, to respect people's needs after the recession (Shelton, 2006).
Assembly Square has attracted people who want the convenience of city living along with easy access to public transit and the highway. Though it's pricey, rents range from $1,900 a month for a studio, to $4,200 a month for a three-bedroom, it's less costly than downtown Boston. The more than 1,600 residents comprise approximately 2 percent of Somerville's population of just over 81,000.

[7] Partners selected the Assembly site from 55 contenders because of its size, cost, and proximity to public transportation.

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6 UNION SQUARE AND BOYNTON YARDS: RELATED AND FUTURE INITIATIVES

The city is now looking for new proposals to improve the underused potential of other neighborhoods, focusing on innovation in arts and creativity.
Union Square, thanks to a planned new stop of the green line, is going to benefit of a new transit oriented development comparable to Assembly Square's one. The plan wanted to boost the commercial corridors in the area, but they are mostly still to be built. Meanwhile, industrial agglomerations with plenty of empty space as Inner Belt and Boynton Yards in Ward Two could benefit from DIF unlocking development through infrastructure, bringing in new tax revenue to offset borrowing costs.
Union Square's arts and creative economy is a diverse collection of sole-proprietors, small firms, and larger corporations integrated throughout the neighborhood. By 2011, Somerville Open Studios became the largest one-weekend open studios in the entire country with over 390 participants. Companies like Greentown Labs and Artisans Asylum along with hundreds of individuals and small start-ups have clustered together to form a community of innovation. As Union Square and Boynton Yards evolve into an urban employment center, many of the existing buildings that creative enterprises call home today will feel market pressures to meet the demand for housing or even office space. New development so should support an expanded presence of the arts and creative economy by including space for these uses in new construction. With the help of Responsible Real Estate Developers and Investors, the City and community currently have a better understanding of the priorities for community benefits and each large-scale developer will contribute to community benefits as a part of their permitting process. The Economic Development office continues working with landowners and developers in Union Square and Boynton Yards to increase efforts marketing the Square as a viable alternative for anchor institutions to Kendall Square and the Innovation District.
Open space is created by zoning requirements and through zoning and city acquisition, renovation and reuse. The neighborhood plan identifies 13.5 new acres of open space through private funds and reclaiming wasted space, while the other 1.5 acres needed to reach the SomerVision target goal will be created by the city.
Greentown Labs, an innovative idea incubator for industries of clean energy has moved from Boston's innovation district to the Somerville Innovation City. It has brought 24 start-ups to Union Square in 33,000 square feet and was facilitated through a working capital loan that utilizes Community Development Block Grant Funds, agreeing to hire Somerville residents in all available job opportunities. "People are figuring out that this isn't the innovation district or the innovation center—Somerville is the Innovation City. We are a city that prides itself on

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innovation, creativity and originality," Mayor Joseph A. Curtatone said in 2013. "We have made it a priority as part of our SomerVision plan to bring in companies like this".

7 RELEVANCE OF THE EXPERIENCE

The focus on innovation economy seems to be the proper answer to years of abandonment and lack of an urban planning strategy. Within the whole city creative enterprises and individuals from the creative workforce are a defining characteristic of the local economy and culture. Policies should be established to both preserve existing buildings with the characteristics creative industries need to function and create new floor space that remains accessible and affordable to artists and other creative individuals. The concept that the Office of Strategic Planning and Community Development has embraced is that Space means Work. This has driven the most recent policy decisions surrounding the Arts and Creative Economy in Somerville which will lead the near future of the city.

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www.somervillema.gov

AUTHOR PROFILE

Luna Kappler, awarded in 2011 by the President of the Italian Republic of the title "Alfiere del Lavoro". Engineer and PhD student at "Sapienza" University of Rome in "Infrastructures and Transport", with curriculum "Planning of Transport and the Territory". Researcher in mobility at "Northeastern University" of Boston for the "Sapienza" FOCUS unit on the topic of "Innovation Districts", as part of the "MAPS-LED" research, "Marie Sklodowska-Curie RISE", funded by the EU program "Horizon 2020".

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URBAN REGENERATION FOR SMART COMMUNITIES

CATERINA PIETRA
ELISABETTA MARIA VENCO

Department of Civil Engineering and Architecture
University of Pavia, Italy
e-mail: caterina.pietra@unipv.it
elisabettamaria.venco@unipv.it
URL: http://uplab.unipv.it

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ABSTRACT

Urban regeneration refers to a process from a functional, economic, social and environmental point of view. In this study, it is linked in particular to the topic of smart communities defined as the entity able to promote communication with the individual inhabitants of a neighborhood and to share contents, knowledge, planning, forms and ways of social action of the new millennium. The authors studied these concepts referring specifically to China: in this reality, planning is more oriented towards short-term vision of the buildings (about 40% of housing realized before 2000 will be replaced during the next 10-15 years). Therefore, urban regeneration arises in order to establish new ways of designing that can ensure longer life to architectures and meet the real needs of population.

To get interesting results, it has been studied a methodology which works for big industrial areas regeneration. In fact future structures of the cities are conditioned by the evolution of the industrial areas; in China, in particular, analyzes on the potential of industrial heritage have been developed only recently. Authors propose a methodology defined by five main elements (general strategy) that constitute the starting point for the development of the single projects and their planning choices (specific tactics and actions) that enhance the smartness of each community. By analyzing one case located in Shanghai (megalopolis) and another in Lianshi, Zhejiang province (town), authors demonstrate how the proposed method and its tools can perfectly work even applied to complete different urban contexts and, therefore, can be defined as a multi-scale approach.

KEYWORDS
Smart Environment; Multiscale Approach; Communities; Urban Function Program; Chinese context

1 INTRODUCTION

When approaching an urban regeneration process closer to communities, a bottom-up process begins. In fact, the community furnishes indications to planners, designers and politicians to develop solutions that, generally, respond to what are the real needs. The community can be described as a group of people and stakeholders who live or routinely work in a given portion of the city, and they share a certain urban space, history, interests, goals, culture, economic and social fabric. Starting from the literature, Smart community could be defined as: "A community in which government, business, and residents understand the potential of information technology, and make a conscious decision to use that technology to transform life and work in their region in significant and positive ways" (Lindskog 2004). Therefore, smart community is recognized as an active partner, and it represents the entity through which it is possible to communicate with the individual inhabitants of a neighborhood, in order to face common problems and to promote participation to decision sharing contents, knowledge, planning, forms and ways of social action of the new millennium (Sassen 2011).
Beside this, the intervention of regeneration arises to establish a long-term vision of the urban functions as opposed to the short-term that it is found in many Chinese realities (MOHURD 2010). Indeed, focus on short-term operations leads to solutions that in an urban area are inefficient, expensive and especially harmful to human relationships of the communities themselves.
The sense of personal belonging and social cohesiveness comes from a well-defined neighborhood and by a coherent structure of volumes and voids, buildings and streets, built and open space functions. All great cities share a specific character, which, in a globalized world, can only be created within a community that is open to social changes and diversity and able to respond to the needs of their citizens by discovering new ways of using information and communication technologies for economic, social and cultural development (AAVV 2013).
Authors intend to define a specific method of multi scale urban regeneration that takes into account the smart community elements and develop them through different planning instruments: the general strategy with five main pillars and the related specific tactics and actions constitute the common basis of the method. Moreover, these actions are applied to the case studies and further detailed to elaborate the unique New Urban Function Program that fully meet the necessities of each site and community and, finally, to define the optimal renewal project.

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2 METHODOLOGY

In this study, urban regeneration takes place through specific projects of industrial areas regeneration: industrial areas play a strategic role in defining the future structures of cities and defining them as urban voids has often allowed transformation actions up to demolition, even when the prerequisites were not recognized (Liu et al., 2014, Nijkamp at al., 2002).

The urban voids determined by the industrial abandoning, inside or at the edge of the urban fabric, characterize the structure of urbanized areas in territory that have been hit by de-industrialization phenomena. In most cases, these areas have high volumetric concentrations: the vacuum is determined by the absence of a precise urban role in the complex urban system and by the urban blight that compromise the level of environmental quality and living conditions of citizens.

However, it is also true that the same problematic areas can become, and in many cases have already been, a valid resource for the regeneration of whole parts of the city since they are related to not only identity, memory or traditions, they belong also to the city, to its sites, and its transformations (Cossons et al., 2015).

To achieve successful results the research has defined a specific methodology (Fig. 1) that can be applied to contexts characterized by different urban scales: megalopolis and towns in China.

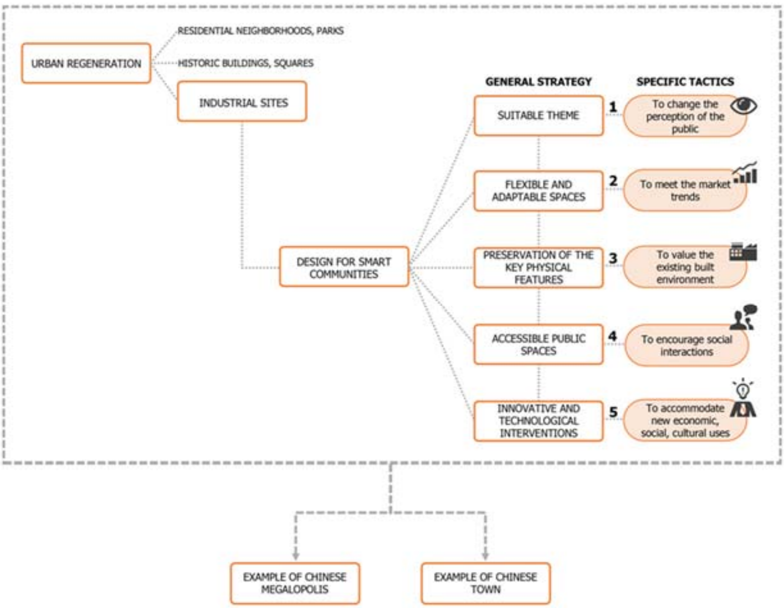

Fig. 1 Main methodology

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The regeneration project is studied for communities aiming to enhance their smartness in relation to environment, health, social capital, commerce, work, technologies, education, cultural issues and so on (AAVV 2013). This assumption generates some tools to take into account during the design process. In particular:

- To change the perception of the public. One of the first priorities is to identify the suitable vision or theme for the new urban space. This will determine the main broad functions, and make it easier to market or promote it. The innovative urban functions are essential in order to change the perception of the public towards its industrial nature: visitors have to see it as a new kind of experience (Yifei, 2016).
- To meet the market trends. It is fundamental designing flexible and adaptable spaces that meet the demand of current market trends and have the ability to transform in a fast-changing economy context.
- To value the existing built environment. Maintaining the whole composition trying to give a new characterization without destroying the crucial elements and preserving the key physical and perceptual features it is essential in order to search for elements of connection between old and new and to guarantee social acceptance (Rossi, 1978).
- To encourage social interactions. It is necessary to provide and curate accessible, and livable public spaces designed and programmed to reflect the needs of the population, the site, and the surrounding neighborhood that can stimulate social interactions and exchange of ideas.
- To accommodate new economic, social, cultural uses. Innovation and technology offers new kinds of production that can enhance other activities in the site (Ratti, 2013).

The directly use of community identity in the design process put the architecture within an extra dimension, due to its intertwined relation with its history, context and culture. It involves also the need to achieve a balance in the new buildings, that is the balance and harmony between the uses and the synergy with the building itself.

The non-compatible uses usually drive out the better ones, and uses that might appear to bring secure money can often undermine the long–term credibility of the project. In general, the most popular uses include housing, offices, workshops, manufacturing spaces, storage space, art galleries, restaurants, bars, performance space, shopping facilities, community facilities, and leisure facilities (Stratton, 2000). All these different uses are able to enhance the smartness of the community that considers the refurbished building as essential element to its needs and promoting local interests.

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3 APPLICATION OF THE METHODOLOGY TO DIFFERENT URBAN SCALE

The proposed methodology is applied through two examples taken from the Chinese reality. The multi-scale component of this specific industrial area regeneration study is what authors want to highlight. They have common characteristics:

- Industrial site with historical and cultural value, part of the local industrial heritage.
- Presence of water as a reference point.
- Community able to interact with the site directly.

The geographical aspect clearly identifies the reference to the megalopolis and the town: the first case considers the city of Shanghai, which has about 24 million inhabitants and a territorial extension of 6.340 sq. km, while the second refers to Lianshi Town, which is part of Nanxun district, in the prefecture level-city of Huzhou, in Zhejiang province, populated instead by only 51,000 inhabitants and with an area of 71 sq. km.

The aim is to demonstrate how similar strategy and tactics, applied to contexts that vary for an urban scale factor (with also all the differentiations regarding the urban, economic, administrative, infrastructure system, and even social relations) lead to the same valid solutions regarding industrial area regeneration and enhanced communities' smartness.

3.1 CASE A

The area is in the East Bund, also known as the Yangshupu Industrial area that develops, for a length of 15 km, along the north bank of the Huangpu River (the most important symbol of Shanghai that runs for 114 km). Ideally, it is the third vertices of the triangle of interaction between Pudong, the south Huangpu Area River (i.e. the Expo area built in 2010), and the northern area of the river (Fig. 2).

This is the largest riverfront of the city and it has witnessed the history of the modern industrial development in Shanghai, and the deep historical and cultural accumulation of this place represents a precious heritage of the city. In China, the conservation and reuse of industrial heritage have attracted unprecedented attention in recent years and Shanghai has undoubtedly proved to be the most extraordinary protagonist (Yu, 2012). Therefore, the research has found a meeting point between the context characterized by the presence of industries with a defined cultural value, and the community developed around them. Specifically, the analysis concerns some buildings belonging to the Shanghai Power Station Auxiliary Equipment (west), at 1900 Yangshupu Road, which is recommended by the regulation to be kept (Dong 2004) (Fig. 3).

The site is huge extending for about 126.000 sq. m.

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The intervention scale has mostly affected the surrounding area and the outdoor areas and, finally, the entire city without dwelling on the details of the architectural composition of the individual spaces of the buildings, but trying to generate harmony and coherence between the industrial complex, the surrounding living area and the riverfront.

Fig. 2 Location of Yangshupu industrial zone and of the infrastructure and green spaces network

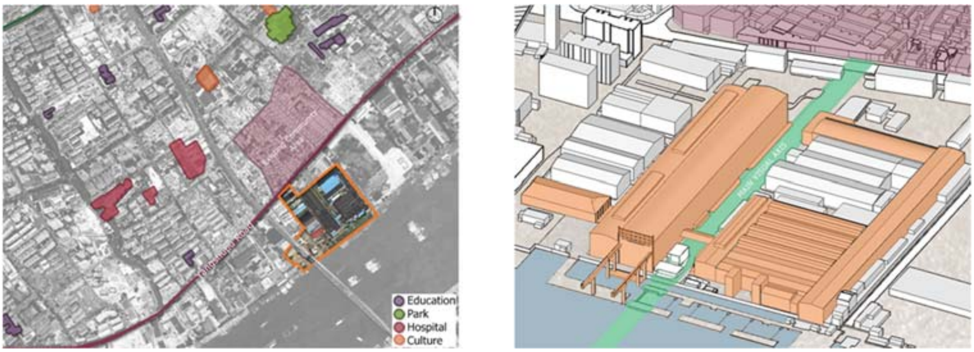

Fig. 3 Context analysis of the factory

As shown in the diagram (Fig. 4), the specific tactics, previously identified, define the New Urban Functions Program. Here, Cultural and Aggregation, Research and Innovation, Experience and Consumption become the starting point to develop the renewal of the entire industrial site and the smartness of the community (the new one in the area and existing one in the surrounding area, in this case it is possible to refer also to the entire city).

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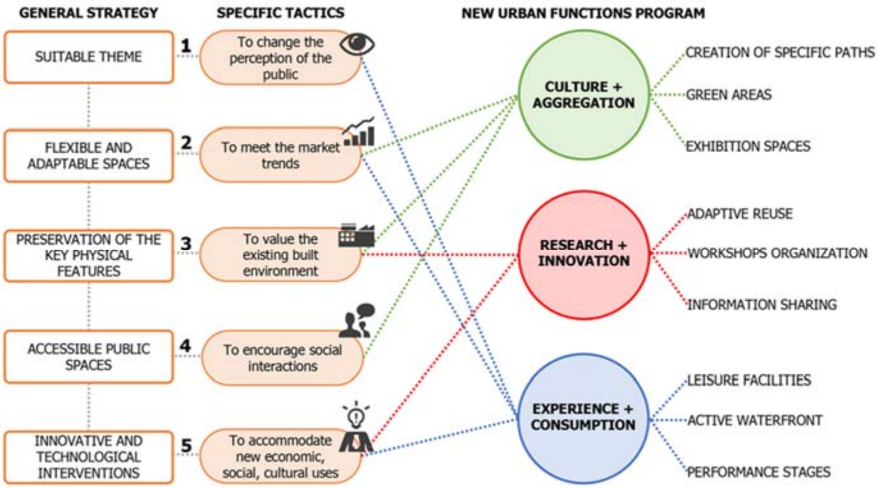

Fig. 4 Definition of the new Urban Functions Program

The couple of functions Culture + Aggregation is also identified as the first type of experience that future visitors will be able to test, and includes:

- Generating a new system of connection between the urban functions in order to have relations on different levels.
- Designing open spaces and green areas where people can easily interact with each other by creating social mixes.
- Providing exhibition spaces that can involve visitors and make them aware of the history and evolution of the site and of the entire industrial area of Yangshupu.

Research + Innovation represent another winning couple as they keep the connection with the other functions alive and it aims to:

- Using principles of adaptive reuse to exploit industrial heritage resources according to existing needs.
- Programming activities studied for different types of users to generate exchanges of information and to improve the overall structure of the program.

Experience + Consumption, then, increase the development and maintenance of the project over time, it refers to:

- Enhancing the attractive aspect of the project that can affect more types of people and therefore more consumers, establishing a leisure center.
- Transforming the waterfront along Huangpu River into an active area of the site by installing walkways over the water that extend the public space in a smart way.

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- Organizing specific parts of the plant that can be used by the community to make special events or any form of aggregation.

The project idea is to create a new system that can integrate with the existing one, overlapping and generating further characterization. The existing and not-demolished three buildings can be compared to three big blocks: they create spaces themselves but also around themselves. The aim is to obtain a composition that looks unique to the view, filling the empty spaces between the buildings: in particular, the empty space is a green area that differs every time depending on the kind of activity (spontaneous or well organized) carried out in the building to which it belongs. The different spaces then will be connected through the realization of paths, footbridges and walkways, in order to create a new connection system to add to the existing system (Fig. 5).

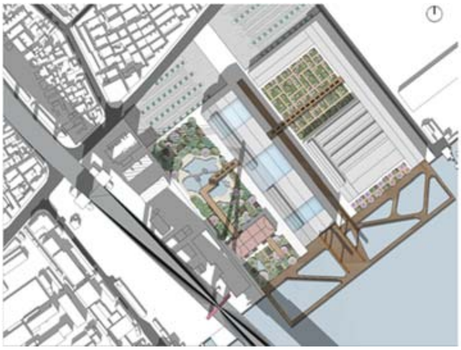

Fig. 5 Masterplan and localization of the new urban functions

3.2 CASE B

The second case study is located in Lianshi Town. Lianshi is in the south part of Lake Tai, China's third largest freshwater lake, in the central area of the Yangtze River Delta, about 3 hours away from Shanghai. Inserted in a traditional water town environment and a rich naturalistic context, this area is one of the most developed referring to the entire Chinese history. In particular, the town is divided in two zones: Zaixing Community and Wanxing Community (Fig. 6).

The site, which covers an area of 15.000 sq. m, constitutes part of the built heritage: it was born around the 1950s as a granary for the collection and trade of rice and, to facilitate these activities, the complex was built along one of the canals that branch off from the main river that runs through the town.

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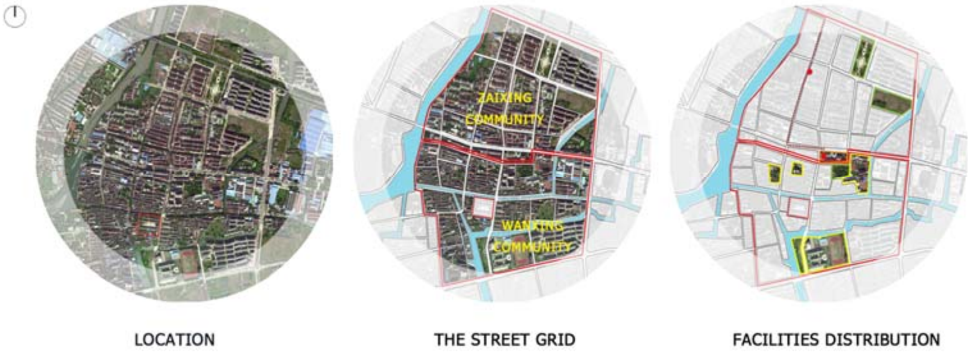

Fig. 6 Context analysis of the area

Its evolution then depended on the various historical events that characterized China's history (following the foundation of the PR of China). Here the granaries represent the most characteristic and expressive architectural element of the cultural heritage of that period (Fig. 7). Thus, working in a neighborhood scale, the aim for this project is to demonstrate how the heritage can be revived in current cities developing the main characteristic of the communities in order to obtain a living and smart one.

Fig. 7 Views of the site and the granaries

In this specific application, the idea was further supported by the results collected after doing a direct survey among locals. They remember the site not only linked to industry but also as a place of meeting and fun, since they were used to meet friends and play chasing each other running around the granaries. In fact, many of them would like to see the area transformed and enhanced as a new public space where people of all ages, and also from other neighborhoods, can interact and engage in diversified activities satisfying more needs.

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To achieve this, the main methodology is supported by an urban study considering three elements: Preservation, Connectivity and Activation that together become the New Urban Functions Program and define the final definition of the industrial site renewal including this particular project in a wider plan that acts on, and connect several parts of the city (Fig. 8).

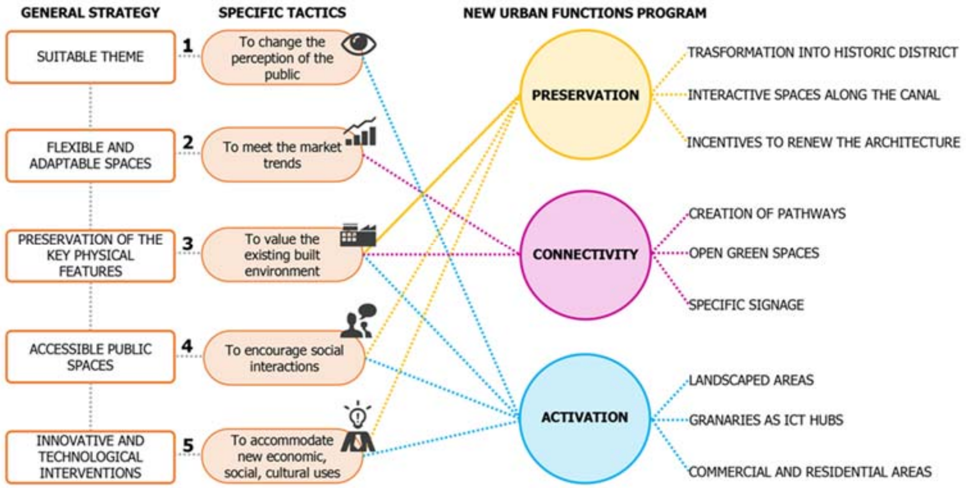

Fig. 8 Definition of the new Urban Functions Program

In particular, (Fig. 9) the aspect linked to preservation means:

- Transforming the entire urban area along the banks of the canal into a historic district (where the former granary is also located), enhancing the existing peculiarities of the built.
- Creating new public and interactive spaces along the canal to re-establish social relations existing before the area’s decline.
- Encouraging economic growth thanks to special incentives aimed to renew the architecture of the area.

The idea of connectivity looks at:

- Developing a series of new pathways through the surrounding neighborhoods that will connect residents to the Granary and historic district along the canal.
- Promoting a better circulation throughout the area using specific signage and open green spaces.

Finally, the activation element provides:

- Designing more open and landscaped areas where people can gather and interact.

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- Generating ICT hubs in the granaries and giving them new characterization
- Converting south and west area of the granary into a modern residential block.
- Developing a commercial space around the southeast area of the site.

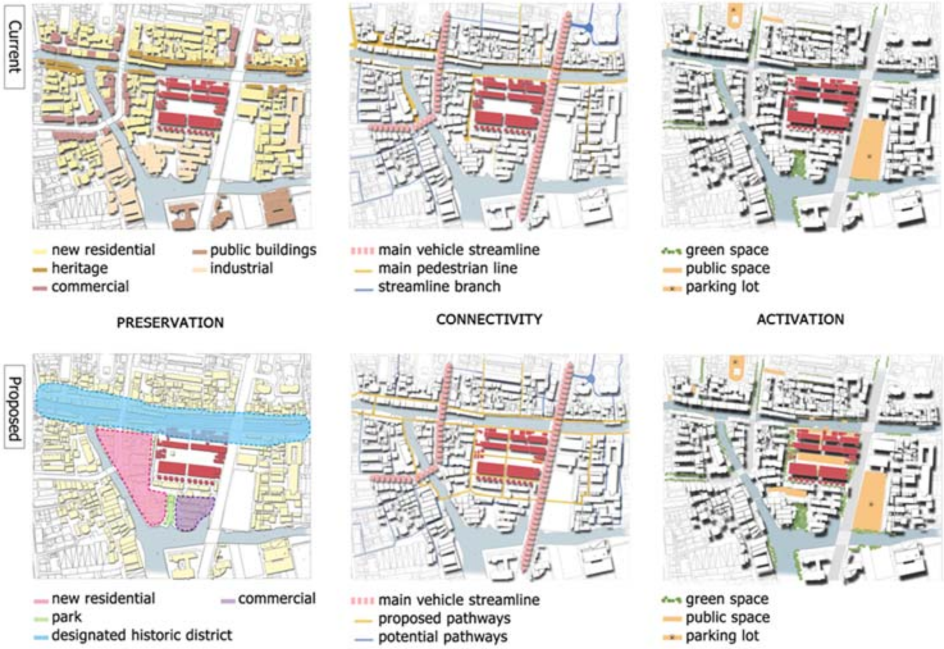

Fig. 9 Urban scheme derived from the defined program

The proposed solution is greatly reflected through the specific design of the new site that manages to combine all the basic points of the functional program with complete harmony and coherence, enhancing the existing elements (Fig. 10).

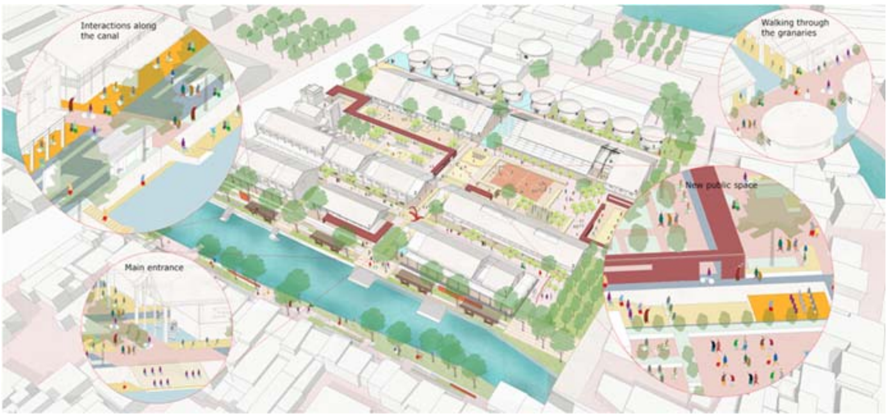

Fig. 10 Aerial view of the new urban functions

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The new center, Community Condenser, has been studied to influence social behavior, hence the name's justification, to transform it into a community catalyst in Lianshi Town and become a new point of reference for different categories: young people, children, adults and elderly.

4 DISCUSSION AND CONCLUSIONS

As shown in the previous descriptions, authors want to demonstrate how the presented examples have developed the common tools of the methodology generating solutions suitable for two different urban realities. Being regeneration conservation projects, the pre-existing elements are important. The involucre and the main structure of the individual buildings are maintained. At the Shanghai plant, the aim was to create new paths through and around the three buildings thanks to a system of walkways that connect different points, generating flows of visitors on multiple levels. Also in Lianshi defining a more accurate circulation both inside and outside the site was fundamental to enhance the individual architectures that constitute the industrial area, in particular the old granaries.

The general design, then, highlights the concept of sharing spaces, taking advantage of the landscape element represented by the presence of the water. Preservation measures integrating functional development and creation of open public spaces has to be adopted to achieve distinct themes and functional enhancement of riverfront heritage. This is why the regenerations projects aims to create new aggregation hubs.

Referring to Case A, the methodology has been specified through an analytical program more related to the site and its buildings. The reason comes from the large scale of the lot that implied a new and more balanced internal distribution; and from the fact that the area is located along a road that already has a strong characterization both on urban and historical level. The definition of the New Urban Function Program themes help to implement and focus on some specific project aspects and to enhance smart issues defined in the general strategy. In particular, here, it possible to highlight the importance of meeting the market trends, giving value to the existing built environment and accommodating new economic, social, cultural uses. This is clear because of the strategic position of the industrial area and because of the interest of the potential stakeholders. The existing surrounding community (potentially the entire city) will live with a new and in continuous movement ones: the participation to the planning process, the flexible use of the spaces, the new defined functions and a widespread use of technologies guarantee a high level of smartness to the community and to the site.

Case B presents instead smaller dimensions and an urban definition less precise than Case A (despite the presence of the water element), that is why the methodology has been defined with a functional and distributive program that includes, connects and develop other parts of

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the town. At the neighborhood scale (to which the project refers), the definition of the New Urban Function Program themes highlights the specific tactic "to value the existing built environment" as the most important and enhanced action implemented by the project. This is due to the strong maintenance of the anthropological value of the site and the strong interrelation with the context and the community. Moreover, the tactics "to encourage social interaction" and "to accommodate new economic, social, cultural uses" are well defined and implemented by "Activation" and "Preservation": the project need to find a balance between the conservation of the heritage (physical and perceptual elements) and the creation of new smart urban spaces where people can live, work, move, and socialize.

In both examples, Shanghai and Lianshi, the methods applied meet the needs of a modern community aware of its own smartness and constitute new reference models for industrial area regeneration.

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AUTHOR'S PROFILE

Caterina Pietra, Architect. PhD student in Building Engineering/Architecture XXXIV cycle, DICAR/Department of Civil Engineering and Architecture, University of Pavia.

Elisabetta Maria Venco, Engineer, Architect. Researcher in Urban Planning, PhD in Building Engineering/Architecture XXIX cycle, DICAR/Department of Civil Engineering and Architecture, University of Pavia.

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ENERGY AUTONOMY AS A STRUCTURAL ASSUMPTION FOR SYSTEMIC DEVELOPMENT AND CIRCULAR ECONOMY

MANLIO VENDITTELLI

Architecture Faculty Valle Giulia
Rome's University La Sapienza, Italy
e-mail: manliovendittelli@gmail.com

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ABSTRACT

Implementing a circular economy program means bringing both the economic and ecological systems on the same level, a plan in which the two systems exchange natural resources, production factors, economic goods and services, waste and residues.
The economic-settlement system is found in the wider ecological system, of which it has to respect physical, biological and climatic limits.

KEYWORDS
Circular economy

1 THE SCIENCE UNITY AS THE FOUNDATION OF THE CIRCULAR ECONOMY

By the circular economy, we enter the philosophy of the systemic project that evaluates settlement processes with holistic theories and methods. That means:
– to consider every new aspect by the territory modifications as a potential disorder of the equilibrium, so we need to organize to the way its management can be integrated into ecologically sustainable economic cycles;

- to transfer the item costs from the schedule of expenses to that of investments, according to circular criteria and functions;
- to find the economic complementarities that allow the production costs reduction by circularity of the existing processes.

In the circular economy projects, as a scientific needs, we have to know in a unitary way both the territorial system and its new configuration produced by the modifications.
When natural resources were large and the ability to metabolize changes was in the nature of things, science could specialize in different way of knowledge. Today, this is no more possible, and the unity of science becomes an incontrovertible datum, overcoming the disciplinary subjectivity that justifies its solutions built without any attention to the consequences on the systemic balances.
However, I do not disclaim the value of the specificity and the scientific autonomy; I just say the disciplines must find again their contact with the systemic synthesis. It is exactly this lack of systemic synthesis that has alienated them from a unitary relocation of knowledge. By this structural minus, the added value in production processes is reduced in waste and cost.
To address the issues of the circular economy with the right breath, I set three addresses:

- design projects with the control of the systemic balance of the proposed modifications;
- leave out management systems that have little to do with the holistic vision of modifications;
- leave out false melodies of the speculative economy and the reductive disciplinary and business difficulties, sectorial and thematic.

2 THE SYSTEMIC DESIGN

Therefore, it is in the nature of the systemic project that the needs of a science resides which finds the unitary values aimed at the utility of the result.

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The disciplines responsible to the study of territorial modifications have built their knowledge by the concept of substitution: naturalness with artificiality, biodiversity with abioticity, natural systemic equilibrium with a simplified balance in a few elements.
The consequence of this scientific and business distraction was not only to fill the world with waste but also to clash with the culture of redevelopment.
Therefore, it is not an abstraction to speak of a quality crisis, the result of the persistence of a number of different and competing elements such as land consumption, use of polluting and recycling inappropriate materials, lack of interest in energy conservation, health of the territory and its securing.
In the central or regional government debate, it is not planned to set up large-scale structural redevelopment projects for territory, production, and economy, which could guarantee scientific research, investment and work.
In the hypothesis of a new deal based on the processes of territorial redevelopment, the disciplines about built landscape as an expression of a culture that must be profoundly modified because it is harmful in economic terms and disqualifying for human activities, must play an important role. We need to bring energy communities to value by balancing the urban areas between used sources and their temporal use.
The values of quality must resume their role and guarantee a new large investment plan of urban regeneration.
The new fragilities of the territories and the bad values of urban settlements are under the eyes of all. It is the need to give value back to the present and respect the future, by actions based on the equilibrium of systemic and inclusive economies.
To respect the right of the future, we have to perform two related actions: designing the future and restoring the present.
We need not only to leave a testimony of the present to the future, but it is necessary that this testimony does not represent what they will have to demolish or regenerate.
It is the action the institution of systemic evaluation and durability imposes. We must move from the measurements of the pass phenomena and the proposed modifications to their place in the systemic balances that they produce.
Territory modifications must be designed no longer divided into parts but strongly interconnected with their complexity, by regarding the whole system of belonging together.
For the systemic project it is not enough to divide the territory into areas of use, but it is important to analyze the balances that define and control it as a unit, both in the positive and negative values that mark its induced fragility.
The projects propose modifications, they produce consequences; this space implies the passage (project) and the control (management) from one equilibrium to another. The terms

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of balance and waste, valorization and uneven overlap between local resources, load capacity and modifications occur precisely on the form and substance of this passage.

The design must re-articulate on the concepts of system, district and network: system as a goal of balance between elements, actions, different relationships; district as an interested local community; networks as a specific elements junction, they attempt to restore the capacity for regenerating even to the degraded and compromised places.

Systemic planning must no longer be just a cultural value, but become a normative instrument, a social instrument of participation and sharing, a tool for structuring planning and government activities.

The present city is the energetic place par excellence and therefore we must ask ourselves the theme of the deep conversion of its energy consumption; the conversion of energy cycles (production and consumption) can become the key for the systemic modification of the city and the territory.

Case study: The Anzasca valley (Monte Rosa, Piemonte)

Project drawn up by the Vendittelli-Imperio and associates Studio, with architect Pietro Currò and engineer Piero Polimeni.

The project focuses on the construction of an energy district, that can allow the entire community to use renewable energies, with the social and individual abatement of energy costs.

Local authorities, owners of the first and second homes, entrepreneurs in the valley can make their resources available (biomass, water, unusual surfaces, wind corridors, participation in capital making for co-financing) in order to contribute to the district construction, directly benefiting from their share of energy.

3 THE CIRCULAR ECONOMY IN A SYSTEMIC PLAN OF INTERVENTIONS

What we propose is the energetic district where, starting from the exploitation of the woods and the control of the waters, a plan is implemented that, besides producing energy, is suitable to revive:

- agriculture;
- sheep farming;
- the arts and works connected to them.

encouraging the revitalization of activities in the mountain pastures, which in turn will allow the emergence of a new type of tourism linked to the learning of the arts and crafts historically present in the area.

The Anzasca Valley is experiencing a profound crisis and, retracing its cornerstones, we see:

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- in the valley bottom, industrial settlements detached from the territorial resources of the overlying mountain areas;
- in the flat areas, concentration of the labor market with the relative growth of urban and semi-urban areas on the junction lines, without service facilities and with an inadequate and energy-consuming mobility system;
- progressive depopulation of the human resources of the internal and mountain areas;
- vertical decrease in the use of resources and productive sectors of mountain territories (agriculture and forests), with subsequent degradation of the landscape and therefore of tourism value;
- economically and socially insufficient use of the resources present.

So, up to now, and in the best of cases, we have moved the concept of growth to the concept of development. By the systemic project, organized on the circular economy, we will rearrange the sectors within them by measuring them with the balance they produce in the wealth formation, in the complementarity of investments, in the use of human resources.

The systemic project proposed for the Valley will be organized on the structural plan:

- The cultivation of the woods as an initial act for the redevelopment of the landscape, paths, mountain pastures and mountain agriculture. This regeneration is necessary both for the direct economic value and the revival of multi-season tourism. The cultivation of the woods is also the prerequisite for the energy production by biomass and therefore for
- The construction of the energy district to upgrade and local network of hydroelectric production, and to built pyrogasification implants of a size consistent with the territorial balance and localized in places with higher quality and resilient capacity. For all other forms of energy by renewable sources, the same principle applies: implants and used technologies must be chosen according to three criteria: congruity, suitable location and coherent size.

  The aim is to create an energy compendium by the construction of production implants from renewable sources (wind, solar, biomass, geothermal, etc.) always compatible with the ecological and landscape balance and with the resilience and systemisation of the implants (especially hydroelectric) for their use in the energy district of the valley.
- Rehabilitation of mountain pastures and paths for ecological, productive (energy and agriculture) and tourism purposes. This is why the point 'a' (proper cultivation of the woods) is basic.

  The values of agriculture and products at 0 Km are growing rapidly, the request for tourist-business stays to learn cultivation and culinary techniques; these new tourist

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inputs make it possible to balance, by their additional income (tourism and accommodation), the minus so far present in the alpine production. These minus occur when the productions depend exclusively on an external market. The value of the district, the system and the short supply chain is evident. The alpine system must rediscover its values by the landscape reconstruction with the cultivation of the woods, the restoration of clearings, the redevelopment of paths and stabling. Only in this way, we will have the floristic and faunistic recovery, restore correct ecological-food chains and be able to reintroduce the value of the collection by recalling a new type of tourists: the "collectors".

- Restructuring of the residential and industrial building heritage, involving the owners in the advantages expressed by the energy district. In mountain areas, one of the greatest expenses is represented by energy consumption; it is evident that a shrewd policy on the recovery of gaseous fuels deriving from pyrogassication, assisted by the electricity produced in the district, would produce significant savings not only in the management of public assets and services, but also in private assets. It is precisely on these tangible advantages, that a virtuous promotion and social action development campaign can begin.
- Cultural and documentary recovery. The area at issue holds great historical and documental values. Examples are the ecclesial system, the Walser housing typology, the mountain pastures. But, one thing makes this area unique: the presence of gold mines. We consider most important to build a territorial museum of the mine, with the establishment of a system (and service) of historical-anthropological and productive-popular values.

on the social level:

- The Plan is finalized to enhancing the value, development and sustainable territory specialization, by creating a real Park-Laboratory of Social and Economic Innovation, that can be a network tool for the Communities to develop neighborhood policies, cultivate converging interests in a perspective of integration and specialization of the whole territory.
  This sizing produces controllable works in casings and executions; these are transformed into an economic and work plan, which we will call Systemic and Sustainable Development Project with a circular economy, made up of intellectual and material activities, research and application, innovation and recovery-restoration-conservation. Each place will make available its building and technological heritage, no longer suitable for the current goals, in order to transform it into places and services available to the new plan. The culture of balance applies not only to ecological and territorial ecosystems,

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but also to social and business hierarchies; this project tries to delineate principles and actions by a new criterion of wealth formation and its social distribution.

On the management plan, the institutional reference is the Alpine Convention, the agreement between the states of the Alpine arc and the European Union.

The current protocols are related to the following areas: Territorial planning and sustainable development; Soil defense; Nature and landscape protection; Mountain agriculture; Mountain forests; Tourism; Transportation; Power; Settlement of disputes.

There are, at the moment, joint initiatives for the following subjects: Population and culture; Air quality preservation; Hydro-Economy; Waste economy.

In this framework, the project intends to:

- Implement interventions to create circular economy by innovative technologies application, such as systems and infrastructures for soft mobility, digital communication networks, basic and advanced vocational training to catch the opportunities of the 4.0 industry to value local knowledge.
- Implement measures to create a circular and sustainable economy, to retrain environment and territory, and achieve energy efficiency of the building stock.
- Implement measures to create a sustainable economy by the rational and balanced use of natural resources, as the supply chains that derive from both the forest and the biomass from agriculture and livestock.

4 LINES OF DESIGN ACTION

On the basis of the defined criteria and the initial cognitive analysis of the territory, the following lines of project action can be exemplified:

- Valleys and the Mountain awakening - The Centre of culture, identity and innovative training for sustainable development.
- Anzasca innovation - The technology Centre with FabLab_Avanza - Promotion of creative Fablab for business start-ups in innovative sectors.
- The Smart Valley - Reduction of energy consumption and enhancement of local energy sources in the networks of energy districts.
- ComPensano Valleys - Innovative forestation methodologies and actions for voluntary and certified compensation of unavoidable CO2 emissions.
- Anzasca welcomes - Creation of the "Anzasca supportive" reception Agency as a management and services Centre (information, training, promotion and networking) for the project and for the community district.

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- Eco-districts of Valle and Montagna - Quality, requalification and reuse as adaptation of services, improvement of quality, safety and decoration of the urban center, renovation of unused real estate assets.
- M.I.S.P.O.S.T.O. Sustainable - Sustainable Inter-communal Mobility of Organized Commuters and Oriented Tourists.
- Land and water trails - Responsible multi-season tourism and sustainable land management.
- Mountains and grasslands - Agro-forestry-pastoral sustainable re-qualification of the Anzasca rural territory, paths and pastures.
- The Gold Valleys - The territorial museum of the old mines (Pestarena, etc.); documentary cultural recovery and enhancement of gold mines brownfield sites, their redevelopment and integration in the tourism systemic economy.

5 THE PROPOSED METHODOLOGY TO LOCAL DEVELOPMENT AND SOCIAL PARTICIPATION

The proposed model goes in the direction of the enhancement of the main opportunities deriving from a careful reading of the territory, its ecosystems, its resources and its values. It is necessary to implement people active participation, and direct involvement of "stakeholders" and inhabitants (old and new) of the territory.
These activities can be carried out in specific *Territorial Laboratories*, where the participation processes of urban and rural planning are developed, by implementing new forms of work. Accordingly, we propose the activation of the following technical-administrative path, remembering that: the systemic project and its action plan for the construction of bottom-up development processes, based on the values of systemic and sustainable economy, has a value in itself: it allows each body to build its own vision of development in a logic of systemic use of resources and not of the exaltation of one to the detriment of others; the administrative territorial system, *especially if studied on the ecological values of local development*, is for definition a-scalar and therefore it does not depend on the territorial dimension on which it is implemented.
if every single territorial reality is endowed, in single or consortium form, with its own vision and a related Sustainable Development Plan, the advantages are for everyone: for the single Municipality it is the right tool to think in a structured way to its local development, for the communities it represents an instrument to activate virtuous processes of territorial cooperation. The Systemic and Sustainable Development Project contains the following essential elements:

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- a model of local development built from the bottom in the Territorial Laboratories; a compendium of the territorial resources, its potentialities and criticalities, analyzed according to the model of development identified;
- the definition of specific and operational objectives, by indication of the project actions to be undertaken in compliance with the current regulatory framework;
- the drafting for each individual action of project files, which constitute the basic document for making funding proposals. Its contents must be developed according to in-depth analysis required for participation in the various funding lines.

The realization of the necessary activities includes the following articulation:

- definition of the participatory model, and methods of work;
- construction of the Municipio Territorial Laboratory for the participatory process development, the knowledge making and the Community Vision development;
- elaboration / collection and systematization of preliminary data and studies for the Systemic and Sustainable Development Project to design the Community Profile, by composing the cognitive framework about detailed territorial, cultural, social, economic, landscape and environmental terms;
- participatory drafting of the Systemic and Sustainable Development Project for the Community, according to the criteria and guidelines specified above;
- possible drafting of the Sustainable Energy Action Plan, according to the Covenant of Mayors procedure, which represents an essential "conditionality" for the activation of projects and resources coming from the European Union in these sectors.

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AUTHOR'S PROFILE

Manlio Vendittelli, Degree in architecture in 1971, Professor ICAR 21 at Architecture Faculty Valle Giulia, Rome's University La Sapienza. The study of environment, territory management and of strategic evaluations to implement participated planning processes left a deep mark on my theoretical track, the research programs, the teaching and project activity.

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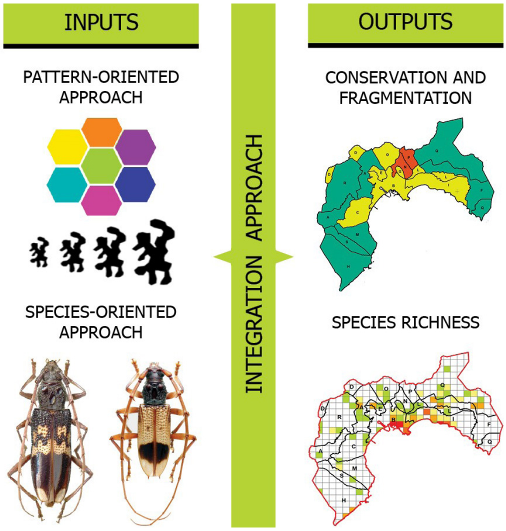

LANDSCAPE AND SPECIES INTEGRATION FOR A NATURE-BASED PLANNING OF A MEDITERRANEAN FUNCTIONAL URBAN AREA

ERIKA BAZZATO, MICHELA MARIGNANI

Department of Life and Environmental Sciences
Botany Division, University of Cagliari, Italy
e-mail: erika.bazzato@hotmail.it
marignani@unica.it

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ABSTRACT

In the last two centuries the impact of human activities on land has grown enormously. Anthropogenic land use change result in land alterations in the form of habitat loss and fragmentation that affect populations demographic structure, communities, and the ecosystems' dynamics. A growing need to incorporate fundamental ecologically-based methodologies into urban planning suggested to adopt multiple approaches to design appropriate regional planning strategies for the protection of the remaining natural areas and the species therein. At landscape level, we calculated landscape measures based on land composition and structure; multivariate analysis were performed to evaluate conservation and fragmentation status. At species level, we investigated the use of six generalist, alien and synanthropic beetles species to assess the conservation and fragmentation status of a Mediterranean functional urban area. To consider multiple levels of organization for a better nature-based planning, a pattern-oriented and a species-oriented approach were joined together. More than 400 original records were georeferenced. We observed a significant relationship between landscape-based measures describing fragmentation and species-based measures: species richness of functional group showed a gradient of richness intensification around the bigger city, decreasing towards natural and semi-natural areas. Results suggested that functional group show a strong response to conservation and fragmentation status and it can be usefully used as indicators for monitoring landscape evolution in time. Further studies are needed to sustain scientifically-sound decisions to design appropriate planning strategies to preserve biodiversity in the Mediterranean areas.

KEYWORDS
Land use planning; Conservation planning; Landscape management; Landscape fragmentation; Landscape and species approach integration

1 INTRODUCTION

In the last two centuries the impact of human activities on land has grown enormously. Human activity dominates ecosystems at multiple scales, transforming the natural heterogeneity of landscapes (Forman, 1995), biogeochemical cycles (Tilman, 1999), and plant and animal species diversity and community composition (Tylianakis et al., 2008). Anthropogenic land use change result in land alterations in the form of habitat loss and fragmentation: fragmentation process produces discontinuous habitat fragments, isolated from each other by a matrix of dissimilar habitats (Laurance, 2000; Bennet, 2003).

Transformation, destruction, reduction and the consequent isolation of remaining patches of habitat affect populations demographic structure, communities, and the ecosystems' dynamics (Saunders et al., 1991; Forman, 1995; Fahrig, 2003). Due to habitat fragmentation, specialist species decrease, whilst generalists or non-native species increase, leading to species turnover at the community level (Fahrig, 2003). In particular, arthropod species in remnant fragments could be subdivided in functional groups or feeding guilds differently sensitive to fragmentation (Gibb & Hochuli, 2002). Generalist feeding species, more likely than specialists, find sufficient resources within a fragment and have the highest chance of success in a fragmented landscape (Collinge, 2000).

Because of this, arthropods are considered as appropriate indicators of ecosystem integrity, because are sensitive and closely linked to the state of the environment (Dufrêne & Legendre, 1997). This is particularly true for species groups such as insects, which new estimates foresee 14 million species, 1.5 million of which are beetles (Stork et al., 2018), contributing to important ecosystem services (Losey & Vaughan, 2006).

From this perspective, insects can be used as a reliable and sensitive indicator that echoes the interactions between human activity, landscape fragmentation and the natural environment. Sustainable landscape planning requires fundamental ecologically based planning theories and methodologies founded on an interdisciplinary approach (Botequilha Leitão & Ahern, 2002).

Ecological studies are becoming more important in understanding how current and future planning strategies and decisions will affect ecosystem services and biodiversity conservation (Li et al., 2005). Ecologically based programs and project for biodiversity conservation tackle the complex problem of meeting the multiple and often competing goals of land use planning (Botequilha Leitão & Ahern, 2002).

Based on previous experiences (Blasi et al., 2008), we joined together a pattern-oriented and a species-oriented approach to consider multiple levels of organization for a better nature-based planning. Aim of this paper was to test the use of generalist, alien and synanthropic

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beetles species as functional group to study and assess the conservation and fragmentation status of a Mediterranean medium-sized functional urban area, using a multidisciplinary approach. We tested this methodological framework in Cagliari (Sardinia, Italy).

2 METHODOLOGY

2.1 STUDY AREA

The Metropolitan City of Cagliari (MCC hereafter) is a medium-sized functional urban area of about 125,000 hectares located in the Mediterranean basin (south Sardinia, Italy); MCC is composed by seventeen municipalities.

Given its large extension, MCC is characterized by a complex orographic pattern on different geological substrata, generating heterogeneous landscapes and hosting a wide variety of natural habitats. Geology and geomorphology of MCC is quite heterogeneous for age and typology: 21 geological units has been recognized (RAS, 2017b) including granite complexes (Gerrei, Sarrabus, Sulcis-Iglesiente); tectonic units (Sarrabus and Arburese); two volcanic districts (Sarroch and Siliqua); sedimentary successions from Oligocene and Miocene, Paleogene and Post "Discordanza Sarda" (Sardinian Unconformity) and sediments of various origin (alluvial, aeolian, lacustrine, littoral and slope movement related).

Climate is typically Mediterranean with an upper/lower thermomediterranean or mesomediterranean thermotype (Canu et al., 2014). Vegetation is mainly composed by evergreen oak matorral, Oleo-lentisc brush, Meso-Mediterranean silicicolous garrigues and maquis and lagoons, which collectively comprise more than 70% of MCC (Biondi & Blasi, 2009; Camarda et al., 2015; ISPRA, 2009).

2.2 DATA INTEGRATION

The flow chart of the methodological framework started with these two parallel entries (Fig. 1): the first entry represents the use of land use data to assess the conservation and fragmentation status at multiple spatial scale (medium and local scale, i.e. entire MCC and single municipalities).

The second entry represent the contribution of biotic data (beetle species-data) to quantify species-richness of the selected functional group.

Consequently, we combined multiple outputs to assess the relationship between landscape-based and species-based measures. All data processing and analysis were carried out using ArcGIS, Patch Analyst extension (Elkie et al., 1999; Rempel et al., 2012), R studio software (RStudio Team, 2016).

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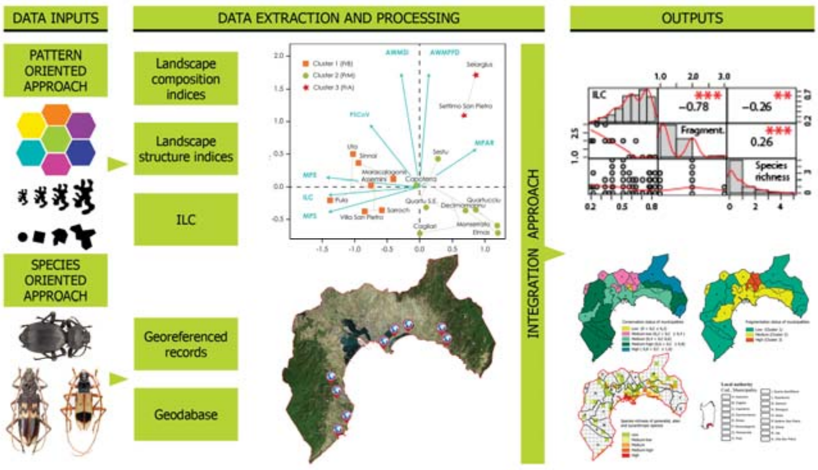

Fig. 1 Flow chart of the methodological framework

2.3 LANDSCAPE LEVEL

We assessed the status of conservation and fragmentation of each territorial local authority (i.e. entire MCC and single municipalities), using landscape-based measures based on land use composition and structure. We adopted a Land Use Map at the third hierarchical level of detail (scale 1:25.000; RAS, 2017a). We evaluated the conservation status with the Index of Landscape Conservation (ILC) (Pizzolotto & Brandmayr, 1996; Ferrari et al., 2008): ILC varies between 0 and 1, where 0 corresponds to a high anthropization level and 1 corresponds to a high conservation status and naturalness. To perform the assessment to each land use class we assigned an anthropization coefficient, derived by Corona et al. (2011). To portray patterns of conservation status of each municipality in the study area, ILC values were classified in three groups, in relation to their conservation status; accordingly, we produced maps of conservation status for each municipality. The structure of landscape and spatial relationships between patches were studied considering several metrics at landscape level (see McGarigal et al., 2002 for a complete description of each metric, Tab. 1). Landscape structure heterogeneity, in term of composition and configuration, were assessed combining all landscape-based measures: we assessed the fragmentation status performing a hierarchic clustering and Principal Components Analysis (PCA), in order to identify groups with higher similarity and reduce the original number of attributes into a small number of highly correlated factors. Groups identified through agglomerative hierarchical clustering were projected on the scatter plot of PCA, in order to subdivide cluster groups on the base of their structural and compositional features.

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ACRONYM	NAME OF METRIC	TYPE OF METRIC
NumP	Patch number	Dimension
MPS	Mean patch size	Dimension
PSCoV	Patch Size Coefficient of Variance	Dimension
TE	Total edge	Edge
MPE	Mean Patch Edge	Edge
MPAR	Mean Perimeter-area ratio	Shape
AWMSI	Area-weighted mean shape index	Shape
AWMPFD	Area-weighted mean patch fractal dimension	Shape

Tab. 1 Landscape-level metrics calculated for the analysis

2.4 SPECIES LEVEL

At species level, we selected a functional group of beetles composed by six species which take advantage from the fragmentation, being able to exploit a wide range of resources: common generalist species, alien species and synanthropic species (Tab. 2).

FAMILY	SPECIES	AUTHOR
Carabidae	*Licinus* (*Licinus*) *punctatulus*	(Fabricius, 1792)
Cerambycidae	*Phoracantha recurva*	Newmann, 1840
Cerambycidae	*Phoracantha semipunctata*	(Fabricius, 1775)
Tenebrionidae	*Akis trilineata barbara*	Solier, 1837
Tenebrionidae	*Blaps gigas*	(Linné, 1767)
Tenebrionidae	*Scaurus atratus*	Fabricius, 1775

Tab. 2 Selected species that benefit from landscape fragmentation: generalist, alien and synathropic species

Species occurrence were derived from public (Universities of Cagliari and Sassari) and private collections (Alamanni F., Ancona C., Atzori M.G., Bazzato E., Cabitta N., Cillo D., Lecis A., Leo P., Fancello L., Fois F., Rattu R.). Collectors' data were integrated with unpublished and published lists (CKmap project, Ruffo & Stoch, 2005); species occurrence was georeferenced following the levels of accuracy used in Ruffo & Stoch (2005).

For data analyses, we adopted a grid representation of the georeferenced records, assigning each species record to a 4 km2 grid cell; the study area was subdivided into 387 grid cells. Grid cells with aggregated point information were used to assess species richness and its spatial distribution on MCC; species richness was correlated to the status of conservation and fragmentation, using the Pearson correlation coefficient.

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3 RESULTS

3.1 LANDSCAPE LEVEL

The conservation status showed a high value (ILC=0.63) in the MCC. However, a more detailed analysis showed a heterogeneous degree of naturalness and conservation status on the municipalities, ranging from 0,20 to 0,83 (Fig. 2), related to a gradient of land use intensification from the central and northern part of the entire planning area to the peripheral ones.

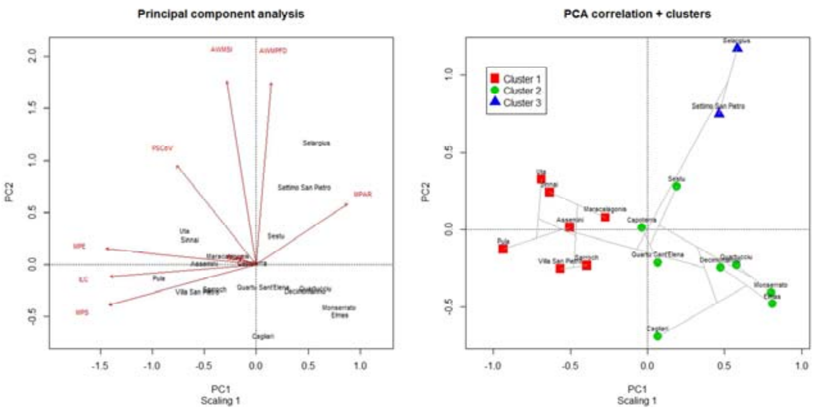

Fig. 2 On the left (a): Scatterplot showing the relative position of the 17 municipalities and landscape metrics; On the right (b): clusters subdivided on base on their structural and compositional features projected on the scatter plot of PCA

As regards the landscape heterogeneity, the number of the redundant metrics at landscape level was reduced using the PCA. The first two components accounted for 79% of total variance (Fig. 2a): The first component (47% of the total variance) was negatively correlated with the conservation status (ILC) and the size and edge metrics (MPS and MPE). The second component (32% of the total variance) was positively correlated with the structural parameters describing the shape of polygons (AWMSI e AWMPFD). The projection into the scatter plot of PCA of the three groups identified by hierarchical clustering allowed the groupings to be distinguished according to the highly correlated factors (Fig. 2b). The first cluster brought together municipalities (Villa San Pietro, Sarroch, Maracalagonis, Sinnai, Uta, Pula and Assemini) characterized by: high conservation status index; high average size of polygons (MPS) for the presence of large patches; high average edges of polygons (MPE), typical of landscapes characterized by patches with complex shapes. The second cluster brought together municipalities (Sestu, Capoterra, Quartu Sant'Elena, Quartucciu, Monserrato, Elmas, Decimomannu and Cagliari) characterized by: low average size of

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polygons (MPS) due to the presence of small patches; low average edges of polygons (MPE), typical of landscapes characterized by patches with regular shapes, as also confirmed by the equally low values obtained for the shape index weighted on the average area (AWMSI); uniformity in the patch size (low values of PSCov). The third group included the municipalities of Selargius and Settimo San Pietro, characterized by: low average size of the polygons (MPS) for the presence of small patches; average shape complex and irregular as suggests by the high values assumed by the form indexes (AWMSI, AWMPFD and MPAR); low conservation status. Analysis at landscape level confirmed the presence of three different levels of fragmentation (Fig. 2b): a low level of fragmentation (Cluster 1) for the municipalities characterized by patches of larger average size and more natural environments with a better degree of conservation.; a medium level of fragmentation (Cluster 2) characterized by patches with uniformly smaller dimensions and more anthropized environments; a high level of fragmentation (Cluster 3) defined by patches of small dimensions, complex shape and a low ILC conservation status. Conservation and fragmentation status maps show the value of status across municipalities (Fig. 3).

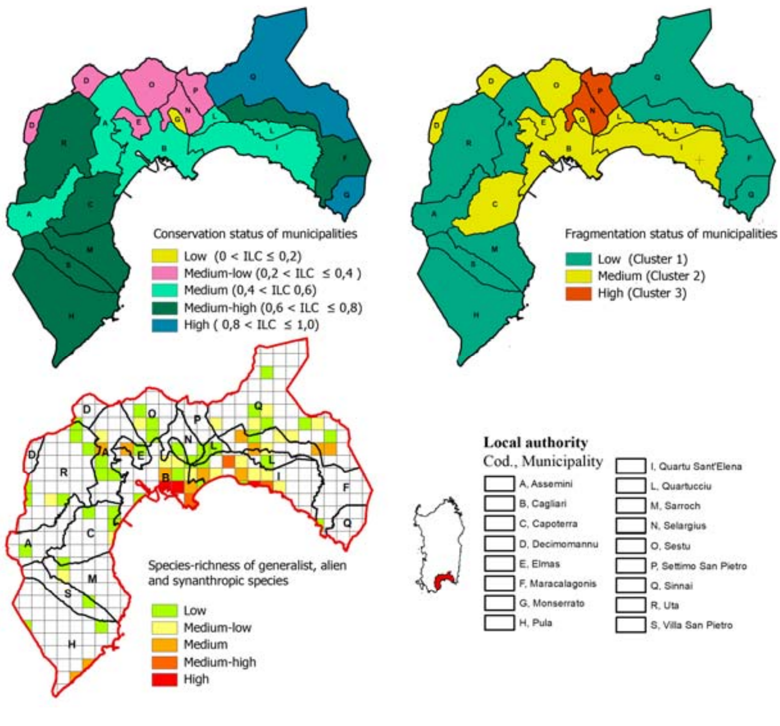

Fig. 3 Synthesis maps of conservation and fragmentation status, and species-richness at municipality level

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3.2 SPECIES LEVEL

We collected a total of 484 records for six species: species richness showed a gradient of richness intensification around the bigger city, decreasing towards natural and semi-natural areas (Fig. 3). Correlation among landscape-based measures and species-based measures showed that richness of the functional group (generalist, alien and synathropic species) was negatively correlated (r-value 0,26; p-value < 0.01) with conservation status index and negatively correlated (r-value 0,26; p-value < 0.001) with fragmentation status. Results show that areas with a higher conservation status are characterized by a low presence of generalist, alien or synanthropic species while, on the contrary, areas characterized by a high fragmentation and a low conservation status host a high number of alien, synanthropic species.

4 DISCUSSIONS

Decision-makers or planners have a difficult job, because they are called upon to make decisions that involve the future of many living organisms, in addition to human wants and needs: strengthen the collaboration between ecologists and planners and promoting a joint planning, can support this task. We propose an approach that combined pattern-oriented approach (with landscape-based measures) and species-oriented approach (with species-based measures) at multiple scales, as an instrument that can assist this multidisciplinary contamination. Synthesis maps show the conservation and fragmentation status and the species-richness at municipality level (Fig. 3), highlighting the municipalities with the most critical values. Species richness of the functional group of generalist, alien and synathropic species is correlated with landscape-based measures describing fragmentation, showing a strong response to conservation and fragmentation status in this Mediterranean medium-sized functional urban area. This functional group of species can be usefully used as indicators for monitoring landscape evolution in time. In the future, to support to the generality of this framework, it would be necessary to test this correlation in other study areas. We believe that this framework will be useful to local planning authorities: decision-makers and planners could, for example, use our outputs to determine where additional efforts or corrective actions are needed to achieve a long-term conservation of habitats and species.

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AUTHOR'S PROFILE

Erika Bazzato is a Ph.D. student at University of Cagliari, Botany Department. She has a doctoral project to define a methodology to assess and study the landscape fragmentation and the ecological network of Metropolitan City of Cagliari (South Sardinia), using plants and several groups of arthropod (ants, beetles, pseudoscorpion, ect.).

Michela Marignani is a Researcher at University of Cagliari, Botany Department. Her main research interests are the use of floristic and vegetation data to prioritize sites for the conservation of botanical diversity, the multitaxa approach, the landscape scale analyses, the studies on the effects of fragmentation on biodiversity, definition of ecological networks at different scale, planning and assessment of the effect of scale in monitoring actions of restoration ecology.

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TOURISM AND NATURAL DISASTERS

INTEGRATING RISK PREVENTION INTO THE PLAN FOR TOURISM

SELENA CANDIA, FRANCESCA PIRLONE

Department of civil, chemical and environmental engineering, University of Genoa, Italy
e-mail: selena.candia@edu.unige.it
francesca.pirlone@unige.it
URL: http://www.dicca.unige.it/ita
URL: http://www.dicca.unige.it/ita

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ABSTRACT

Recent floods occurring in parts of Europe helped us to remember how tourism is exposed to natural events. Normally we are inclined to consider that tourist security depends only on human actions: thefts, terrorist acts ... but natural disasters are often more deadly than acts perpetrated by humans. Proper planning is necessary to prevent the negative effects caused by these disasters. Tourists are more at risk than the inhabitants are because they do not know what to do in places and situations that are often very different from their daily life. Furthermore, tourists are not aware of the civil defence plans and they do not know how to react to the different levels of risk. This paper seeks to solve this lack by integrating risk prevention methods into the Plan for tourism. In recent years, many European countries have introduced plans and measures to manage tourism in a sustainable way. These plans provide useful means to improve sector policies and strategies. However, there is no mention about tourist security. The paper proposes new measures to be included in regional tourism plans. The authors apply the proposed methodology to a concrete case study: the plan for tourism of the Liguria region. This region is at high hydrological and geological risk and it is a popular tourist destination. In 2017, Liguria exceeded 15 million of visitors. One of the most fragile places, the Cinque Terre, is also one of the most visited with more than 2,5 million of people a year.

KEYWORDS
Plan for tourismL; Risk management; Natural disasters

1 INTRODUCTION

The tourism sector is one of the largest industries of the world. Over the past decades, international tourist arrivals have almost doubled: from 855.000 to 1.32 million of people. Tourism has positive impacts in terms of gains in income and employment, for these reasons, many countries rely on it to boost their economies. The tourism sector is, however, fragile in nature (Maditinos & Vassiliadis, 2008). It is extremely vulnerable to economic, social, and political changes in either the generating or host countries.

Many external factors can influence tourist arrivals: crime-related incidents, political instability, civil unrest, diseases, natural disasters, etc. Empirical evidence so far shows that the higher the frequency of such incidents and the more media coverage they obtain, the greater the negative impact on tourist demand (Mansfeld, 2006).

Therefore, relying only on this unstable sector of the economy is potentially risky. This paper proposes a new comprehensive approach – from theory to practical aspects - to help policy makers and planners in tourism management. In the first session, it assesses the close relationship between tourism and natural disasters. In the second one, the authors analyze the main existing tools in the field of tourism and risk management planning. The third session proposes an innovative approach to the creation of a single planning tool by integrating risk prevention into the plan for tourism. In the last session, the authors analyze a case study – the Liguria Region - to make the proposed methodology more concrete giving guidance to local authorities all over the world.

2 TOURISM AND NATURAL DISASTER

Normally we are inclined to consider that tourist security and safety depends only on human actions: thefts, kidnapping, terrorist acts; but natural disasters are often more deadly than acts perpetrated by humans. There were numerous cases in the world where natural disasters had a relevant impact on tourists and on the tourism industry such as the tsunami in the Indian Ocean in 2004, the eruption of Eyjafjöll volcano in Iceland in 2010 and the earthquake in Nepal in 2015.

Almost every year, Italy is affected by natural disasters that directly or indirectly, interest tourist destinations. Just to mention some recent examples: the flood in the Cinque Terre in 2011, the avalanche that destroyed the hotel Rigopiano in central Italy in 2017 and the earthquake in central Italy in 2016 and 2017. Every year the World Risk Report features an update of the World Risk Index (WRI), which calculates the vulnerability and exposure to natural hazards of over 170 countries and then ranks them based on their disaster risk. The

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risk of a natural event turning into a disaster only partly depends on the force of the natural event itself. The living conditions of the people in the regions affected and the options available to respond quickly and to provide assistance are just as significant (WTO, 1998).
Those who are prepared, who know what to do in the event of an extreme natural event, have a greater chance of survival (Heintze et al., 2018).
In the event of natural disaster, tourists are more at risk than the inhabitants are because they do not know what to do in places and situations that are often very different from their daily life. Furthermore, tourists are not aware of the civil defense programs and they do not know how to react to the different levels of risk. Although the literature on tourism sustainability often projects it as a process that demands professional management and planning, it has only recently addressed the issues of preparing for risks, crises and disasters (Cioccioa & Vassiliadi, 2008).

3 THE RISK MANAGEMENT PLAN AND THE TOURISM PLAN IN ITALY

Currently in Italy, the issue of risk management is addressed by Plans and Civil Defence Programs, according to the recent Law 100/2012 "Provisions for the reorganization of civil protection". These tools concern different scales of reference and consider, at the same time, all types of risks (natural and anthropogenic). The Regional Risk Prevention Program identifies the portions of territory most at risk and intends to reduce risk exposure and territorial vulnerability. It also contains the guidelines for provincial and municipal risk prevention plans. The Provincial Emergency Plan and the Municipal Emergency Plan, in principle, have the same functions but at a different scale. An emergency plan provides a set of operational measures to coordinate prevention and rescue activities to help people in danger.
Initially, it is necessary to know: what is happening and what will happen next; the kind of actions to be taken to mitigate the damage; the resources needed; the priority actions. The Plan analyses the territory, the civil defence measures, the risk scenarios and the intervention models. Municipal Emergency Plansare focused on emergencies even if they consider different risk scenarios that can be applied during the "peacetime". In fact, planning is essential to prepare local communities and authorities during the ordinary period to respond to a crisis. All the sectors of the civil protection system should implement operating procedures in a coordinate manner, in order to prevent and mitigate the impacts of natural disaster on people and things. Risk scenarios, apart from danger and vulnerability factors, should consider the exposure, of goods and people. These people could be also tourists. Regarding the tourism sector, in Italy, in 2017 the Ministry for Cultural Heritage and Activities established the Strategic Plan for Tourism Development (PST, 2017-2022). This tool proposes an "organized system" to promote the territory according to strategic lines and four main objectives:

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innovate, specialize and integrate the national offer; increase the competitiveness of the tourism system; develop an effective and innovative marketing; realize efficient and participated governance. This Plan is an important milestone in the tourism sector. It aims at giving a unified vision of Italian natural and cultural heritage, and it puts tourism policy at the hearth of Italian politics. Also, at the regional level there are different plans to promote and develop the tourism sector. At the local level there are few Plans for tourism, even for very important art cities such as Rome and Florence. In general, tourism plans in Europe, and in particular in Italy, do not take into account the concept of tourist safety and security. Some Plans consider man-made risks related to mugging, bag-snatching or terrorist attacks; however, no one analyzes and manages natural risks. Therefore, the paper wants to create a point of contact between Civil Defense Plans and Tourism Plans. Civil Defense Plans do not consider, among the exposed subjects in the risk scenarios analysis, the fluctuating population including tourists. Tourism Plans consider interesting parameters such as accessibility, but they do not concern security against risk. In paragraph 3, the authors report an approach aimed at integrating tourist safety and security within the Plans for Tourism. This study is of particular interest if we consider recent episodes (floods, earthquakes…) that had a relevant impact on tourists all over the word.

4 INTEGRATING RISK PREVENTION INTO THE PLAN FOR TOURISM

In recent years, many European countries adopted plans and measures to manage tourism in a sustainable way. These plans provides useful means to improve sector policies and strategies. However, there is no mention about touristsecurity and safety. For this reason, the authors recommend new risk prevention measures for regional tourism plans.The paper capitalizes different studies carried out by the research team in urban and territorial planning of the University of Genoa. In particular, this team developed the guidelines for preparing a Sustainable Tourism Action Plan – STAP: an innovative tool to manage and support sustainable tourism in European Countries. The authors want to update the STAP model introducing the concepts of risk prevention and tourist security. The STAP is different from existing tourism plans; it recommends a series of actions for tourism management considering all the topics which have connections with tourism – mobility, transport, waste, water resources, energy... – (Pirlone & Spadaro, 2017). The STAP promotes slow and sustainable tourism and considers tourists as an integral part of the place they visit. An eco-responsible tourist is a "temporary resident", who knows and follows the rules of the host destination. An informed and trained tourist decreases his risk exposure. The exposure is one of the three variables (exposure, vulnerability and danger) necessary to calculate the global level of risk. The risk perception of tourists may vary considerably in relation to social and cultural factors

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(Garg, 2017), for this reason, Tourist Plans should require precise measures to be followed to avoid dangerous situations. An Action Plan according to the Agenda 21 contains the following items: objectives, indicators, best practices, actions, actors involved, economic feasibility, participatory planning. Taking into account these elements, the STAP includes six different phases:

- phase 1. Background - problems related to territorial tourism management; European and national tourism legislation; working groups;
- phase 2. Diagnostic of the state of the art – *status quo* analysis; data collection; goals assessment – SWOT analysis;
- phase 3. Planning part – design and identification of actions/best practices;
- phase 4. Plan application;
- phase 5. Plan monitoring – through the identification of specific indicators;
- phase 6. Awareness and participation - it is important to specify that this last phase is transversal to the previous ones (Candia et al., 2018).

Risk prevention should be included in all phases of the STAP, especially in the first three sections:

- phase 1, introduction of the security issue as a general objective to be pursued,
- phase 2, analysis (using also the SWOT methodology) of all the possible risks considering the risk scenarios identified in Civil Defence Plans;
- phase 3, identification of measures to explain to tourists the procedures to be followed in case of an emergency (choice of the best alert systems such as information panels, Wireless Emergency Alerts…).

Fig. 1 Steps for the development of a Sustainable Tourism Action Plan

The authors apply the proposed methodology to a concrete case study by defining new risk prevention measures for the Tourism Plan of the Liguria Region. Furthermore, the paper proposes how to organize a safety conscious STAP for one of the most popular Ligurian destinations.

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5 CASE STUDY: THE LIGURIA REGION

The Tourism Plan 2020 of the Liguria Region (2017) indicates the main tourism development strategies of the Region starting from the analysis of current scenarios and trends. According to the Regional Tourist Observatory, tourism in Liguria accounts for 7.8% of the regional GDP, generating more than 10% of the workforce. In 2016, tourism grew both in terms of tourist numbers and arrivals with a growth rate of 4.35%. The plan analyses the tourism industry from an economic point of view and proposes a series of objectives to develop the sector (strengthening the region's international position as a tourism destination; promoting new tourism products…). This strategic tool does not take into account the concept of tourist security even if the Liguria Region is at high hydrological and geological risk.Over the past decades, recurring flood events and several landslides caused severe damage to coastal and inland areas of Liguria, sometimes involving human casualties.The SWOT analysis, included in the Plan, does not mention the risk prevention issue. Amongst the strengths are: the expansion of the tourism sector; the significant increase of international arrivals and the presence of natural and cultural beauties. The plan mentions as weaknesses: tourism concentration on the coast; strong seasonality; poor accessibility; poor coordination between the public and private sectors and short-term vision of marketing strategies. If this analysis was carried out in the light of risk management, the results would be very different. The presence of an increasing number of tourists is undoubtedly a strength from an economic point of view, but it can be a critical issue in the event of a natural disaster. The authors identified corrective measures for each paragraph of the Tourist Plan of the Liguria Region in order to increase tourist security (Tab. 1).

One of the most fragile places of the Liguria Region, the Cinque Terre[1], is also one of the most visited with more than 2,5 million of tourists a year. In 2011, storms and torrential rain caused extensive floods in the Cinque Terre.

The neighbouring village of Vernazza had to be evacuated by sea, with the Coast Guard rescuing stranded foreign tourists and locals. Nevertheless, there is no system to alert tourists in real time about the procedures to be followed in the event of a disastrous event. The tourism plan of the Liguria Region should force the Cinque Terre - and all other tourist destinations in hydrogeological risk zones - to realize a STAP. This plan should promote sustainable and safe tourism.

[1] The Cinque Terre is a portion of coast on the Italian Riviera. It is in the Region Liguriaand comprises five villages: Monterosso al Mare, Vernazza, Corniglia, Manarola, and Riomaggiore.

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PARAGRAPHS TO BE INTEGRATED	RISK PREVENTION MESURES RECCOMENDED
1.1 Background analysis	Regional map of risk where every tourist destination is classified according to its exposition to risk and its vulnerability
1.2 Legal framework	Main contents of the Civil Protection Programme and the Regional RiskPreventionProgram
1.3 Objectives	Tourist safety and security should be one of the main objective
2.3.2 Weaknesses	Difficulty in explaining to tourists the level of risk and the security measures to be followed; lack of communication between Tourism Plans and Risk Prevention Programs; lack of alert systems to inform tourists about natural disaster.
2.3.4 Threats	Almost every year, the Liguria Region is affected by natural disasters that very often, directly or indirectly, interest tourist destinations.
4.1 Methodology	The approach is aimed at integrating risk prevention within the Plans for Tourism. The Regional plan for tourism should suggest that the main tourist destinations prepare a STAP. The STAP includes also how to improve tourist safety and security.
4.5 Hospitality	A tourist destination is hospitable if and only if it is a safe place.
5.1.1 Performance indicators	The level of tourist safety/security must be included among the performance indicators
5.1.3 Budget	Funds to increase tourist destination security and to place alert systems to inform tourists on the level of risk

Tab. 1 Risk prevention measures for the Tourism Plan of the Liguria Region

The risk management approach to tourist health and safety highlights the importance of identifying sources of risk as a first step and then using this information to realize actions to decrease the level of exposure of tourists. Below are some measures to be included in the STAP to contribute significantly to the safety/security of tourists:

- SMS alert system;
- evacuation rotes by land and by sea;
- flyersand posters, in hotels and railway stations, explaining the measures to be taken in case of emergencies;
- selection of safe alternative tourist destinations to visit in case of emergencies;

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- incentives to reduce seasonality and the number of touristsexposed to risk (such as discount in hotels, museums or train tickets);
- closure of risk areas;
- safety"tips" app, which provides disaster information to international visitorsinto various languages;
- a flowchart showing evacuation actions to be taken in the light of surrounding circumstances.

The STAP should understand how the Cinque Terre can best respond to the threats natural disasters pose to tourist safety and wellbeing. Travelers should be familiar with risks for natural disasters at this destination and its warning systems, evacuation routes, and shelters. The best way for travelers to stay healthy and safe when journeying to a new place is to stay well informed. For this reason, the STAP should provide different practical solutions, like the aforementioned ones, to inform and train tourists. This case-study support the theoretical approach presented in the previous session by using it in a real world situation. It gives some indications and allow further elaboration and hypothesis creation on the same subject. The approach described is dynamic and it can be easily adapted to specific situations. As demonstrated by the application to the Ligurian case, local and regional authorities should develop Sustainable Tourism Action Plans striking a good balance between tourism development and tourists' security and safety. Worldwide many destinations are struggling to cope with natural disaster. With increasing global surface temperatures, the possibility of more droughts and increased intensity of storms will likely occur (Maarten, 2006). It is not just a security issue; natural disasters are affecting the tourism industry and are damaging local economies. The paper focus on the Liguria Region where these negative effects are evident. However, the paper could help policy makers, from all over the world, manage tourism in a sustainable way.

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AUTHOR'S PROFILE

Selena Candia is graduated in architecture and construction engineer. Actually, she is working for the University of Genoa – DICCA– as research fellow. She managed different European projects on sustainable development, eco-tourism and urban regeneration. She worked for the Municipality of Genoa – Culture and Tourism Department - as European project manager.

Francesca Pirlone is associate professor in town planning at Polytechnic School - University of Genoa, PhD, engineer. She is a teacher in three university courses of three Degree Courses. She has developed different lines of research, from requalification, natural risks, sustainability, waste, tourism, infrastructures and mobility, activities carried out in EU and national programs. Author of numerous publications and speaker at International and National Conferences.

ANNEX

Selena Candia: the author has done paragraphs 2 and 5. Francesca Pirlone: the author has done the paragraph 3 and 4.

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INTEGRATED MANAGEMENT OF WATER RESOURCES

AN OPERATIVE TOOLTO SIMPLIFY, DIRECT AND MEASURE INTERVENTIONS

VITTORIA CUGUSI, ALESSANDRO PLAISANT

Department of Architecture, Design and Urban Planning, University of Sassari, Italy
e-mail: vcugusi@yahoo.it, aplaisant@gmail.com

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ABSTRACT

The aim of this research is to support policymakers and technicians that perform integrated management of water resources through an operative evidence-based assessment tool, in order to analyse and simplify water planning processes. The tool provides objective outcomes: to overcome legislative fragmentation, to simplify the analysis process and to define integrated management policies. In particular, the tool is organized into four phases. The first defines the analysis processes, the second consists of acquiring data, the third analyzes the results and the fourth identifies intervention lines. To prove the feasibility of the tool, it was tested at a preliminary level in the basin area of the Posada river (Sardinia) where it was possible to systematize dimensions, define elements through careful analysis of water legislation and management processes, and identify areas of interest and specific objectives inherent to integrated management in order to overcome legislative fragmentation. Subsequently, through the identification of actors, criteria and indicators related to each specific objective, it was possible to simplify the process of analyzing critical issues related to water management in order to define integrated policies. Thus, the proposed tool was able to simplify, direct and measure coherent interventions of water resource management, enhancement and protection, as well as support strategic planning tools such as the river contract.

KEYWORDS

Integrated water resource management; water resource protection; water rights

1 INTRODUCTION

The management of water resources requires the integration of ecological, economic and socio-political elements, which operate in the territory within an interdisciplinary framework that seeks to guarantee resource protection (Bernasconi, 2005; Dir. 2000/60/CE; Dlgs 152/1999; Piano Stralcio di Bacino per l'utilizzo delle risorse idriche). Within a broader framework, water has an important "ecosystemic function", as it is able to provide "goods and services that directly or indirectly satisfy human needs and guarantee the life of all species" ("Cosa Sono I Servizi Ecosistemici," n.d.). The Millennium Ecosystem Assessment (2005) provides four ecosystem function classifications (Support, Regulation, Provisional, and Cultural), defining ecosystem function as a service provided by natural and semi-natural ecosystems ("Cosa Sono I Servizi Ecosistemici," n.d.).

The protection of ecosystems therefore directly affects the quality of the resource, and it becomes part of the management process; to guarantee integrated management means that ecosystem functions should be protected, enhancing the river asset and spreading the culture of the water landscape as a matrix of territorial development (Scolozzi, Morri & Santolini, 2012). Accordingly, integrated management implies the need to pursue a transdisciplinary process between government and water policy.

The varied use of the resource has led to legislative fragmentation, resulting in the proliferation of legislative and planning interventions.

Furthermore, water resource management is based on the consensus and participation of all the actors operating in the water basin/body, which results in planning complexity and difficulty in designing coherent governance strategies (Previdi, n.d.).

Based on these premises, it is clear there is need for simplification of management processes, which requires analysis of intervention areas and problems at the level of the river basin, defining integrated policies and lines of intervention.

2 MATERIALS AND METHODS

The construction of the tool was based on the methodology used in construction and operation of Decision Aid Systems (DAS) proposed by a study from the University of Girona (Poch et al., 2012). Originally, the tool was applied to sewage treatment systems, but it can be adapted to any complex problem that requires the evaluation of qualitative and quantitative processes applied to environmental systems, as does the integrated management of water resources.

The flexibility of the tool comes from integrated analysis of the spatial dimension through Geographic Information Systems (GIS, ArcGIS, etc.) (ibid.).

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Furthermore, it is necessary that the instrument allows:

- data management on a theoretical basis;
- combination of data and results from different areas;
- easy data recovery for the user;
- discussion of the proposals through explanation of the results obtained.

The utilization of the instrument consists of four phases that must be developed sequentially as follows.

Definition of the processes to be analyzed through:

- identification of the dimensions through the analysis of legislation; the dimensions represent the macro-categories into which the integrated management of the water resource is divided;
- identification of the defining elements, representing the sub-categories of the dimensions and defining the general topic to be investigated;
- identification of the areas of interest, which represent specific topics that are closely linked to the resource management tools and the legislation that generated them, helping to determine the instruments and plans that program the specific topics;
- identification of the specific objectives through the analysis of the legislation, which represents the purpose or the results that are intended to be achieved.

Acquisition of data, which requires:

- identification of the criteria relating to the specific objectives, i.e., the characteristics that can be evaluated to define the objective;
- identification of the actors involved in the processes examined;
- identification of indicators concerning the qualitative and quantitative criteria.

Analysis of the results and selection of models (artificial intelligence techniques, statistics, GIS, numerical simulation and/or optimization models) through:

- elaboration of the results related to the indicators in order to identify possible areas of intervention.

Identification of intervention lines. Once the results are obtained, actions can be defined to support territorial policies. Thus, the tool has two functions:

- identification of the critical issues inherent to the various integrated management processes;
- explanation of intervention lines that can lead to effective management of the resource.

The tool has the purpose of simplifying and, therefore, speeding up the evaluation process of integrated management within a river basin, providing support to decision makers.

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3 APPLICATION OF THE TOOL: THE RIVER BASIN OF RIO POSADA

In order to prove its feasibility, the tool was applied in the Posada River basin area, which was chosen as a study area because it is involved in numerous protection initiatives and water resource enhancement projects within the territory, such as the Tepilora Regional Natural Park and the UNESCO MaB award.[1]

As previously described, the first phase involves the identification of key dimensions. The following three were identified for the Posada River:

- Protection of the resource,
- Protection against water hazards, and
- Rights to the resource.

Secondly, for each dimension the defining elements, the areas of interest, the specific objectives, the criteria, the actors involved, and the relative indicators were identified, as described in the model construction phases (Section 2).

This section describes the process inherent to the dimension of the "resource right" (Fig. 1).

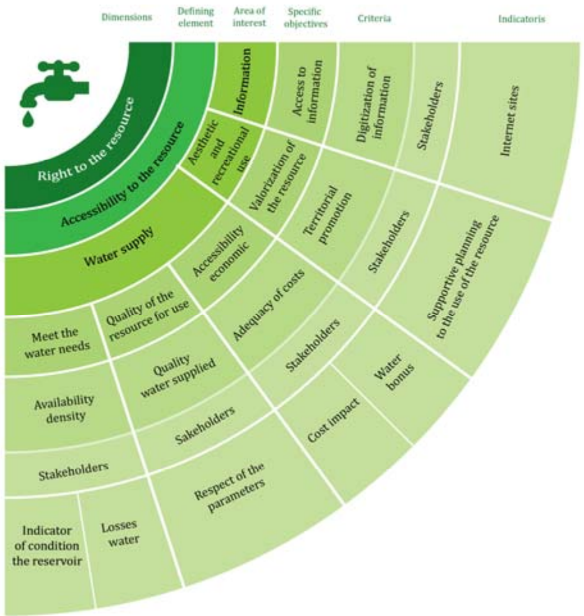

Fig. 1 Summary scheme, right to the resource. Own processing source

[1] For further information, please consult the following websites: http://www.parcotepilora.it/; http://www.unesco.it/it/ItaliaNellUnesco/Detail/186; ttp://www.unesco.it/it/RiserveBiosfera/Detail/365

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As defined by the first phase, the "resource right" dimension and the respective defining element "resource accessibility" were identified through the analysis of international, European, national and regional regulations.
Subsequently, the areas of interest and the specific objectives were identified through the analysis of the resource planning and management instruments.
For example, with regards to the area of interest "water supply," one of the specific objectives identified was "meet the water needs" (Tab. 1). Once the specific objective has been identified, the second phase begins. For example, in order to assess whether water needs were being met, we evaluated:

RELEVANT LEGISLATION	WATER RESOURCES PLANNING TOOLS	GOALS	PRACTICES	AREAS OF INTEREST
L. n. 129/1963	Piano Regolatore Generale degli Acquedotti (PRGA) L. n. 129/1963 Revision 2006	Govern the drinking water requirements	Update of the new PRGA (2004): Determines the water needs and the related equipment, construction of water purification, transport and distribution infrastructures	Water supply
L. n. 183/1989	Piano stralcio di Bacino Regionale per l'utilizzo delle risorse idriche (PSURI) L. n. 183/1989	Achieve the balance of water supply and demand at the regional level	Defines infrastructure and management interventions in the short- and medium-term time frames.	Water supply
d.lgsl 152/1999: 91/271/CEE 91/676/ CEE d.lgsl 152/2006 2000/60/CEE L. R. n. 19/2006 D. R n. 67/ 2006	Piano di gestione del Distretto Idrografico (2015) Dir. 2000/60/CEE	Plan, implement and monitor measures for the protection, remediation and improvement of surface and underground water bodies and facilitate sustainable use of water resources	Second planning cycle 2016-2020 Strategic Environmental Assessment (SEA) List of environmental objectives to be respected	Environmental protection, water supply

Tab. 1 Summary table, analysis of legislation and resource management tools for defining areas of interest and related objectives

- the criterion of volumetric water availability;
- the stakeholders and figures that work in pursuit of the objective (in this case represented by EGAS, ENAS, Abbanoa, municipal administrations, consortia, etc.);

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- the indicator of percentage of water losses in the basin distribution network, which indirectly measures the satisfaction of needs based on decreases in water supplied per year and water losses (Istituto Statistico Nazionale, 2015).

After the indicators have been calculated, the third phase involves analysis of the results and implementation of the models.

To summarize the results of the evaluations coming from each analysis file, a summary table (Tab. 2) was built to describe the actual integrated management within the river basin. In this way, it was possible to quickly identify the critical points at which to intervene.

The construction of the table required the evaluation criteria to be applied to each result coming from the calculation of the indicators, divided as follows:

- ++ Equivalent to a situation where the objective is fully achieved;
- + Equivalent to a situation in which the objective is reached, but completion operations are still necessary (such as planning policies or actions);
- - Equivalent to a situation where the objective is not achieved.

As indicated by Tab. 2, the critical issues inherent to integrated management of water resources within the Posada River hydrographic basin can be divided into three categories:

- the quality of the water body;
- the scarce availability of the resource for supply, attributable to the almost total dependence on artificial basins in conjunction with long dry periods and considerable water losses during distribution;
- the prevention of flood risks, which is indicated by the numerous evacuation orders seen by the inhabited center of Torpè.

According to the analyses, the intervention lines should act on three levels:

- water quality;
- supply;
- prevention of risks caused by floods.

After analyzing the results, phase four identifies and monitors intervention lines. Where possible, the graphic representation of the possible areas of intervention (geo-referenced by QGIS) is reported. For example, with respect to the indicator of water losses (Right to the resource, Tab. 2), a possible line of intervention could be the reduction of transport losses through improvement of the efficiency of distribution networks. The intervention, once put into practice, can be monitored through the same indicator.

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DIMENSIONS	DEFINITION ELEMENTS	GOALS	INDICATORS	RESOURCE MANAGEMENT ++	+	-
Protection of the resource	Protection of ecosystems	Protect aquatic and related ecosystems	Forecast of the minimum vital outflow DMV			
			Protected ecosystems			
	Quality of the resource	Reach a "good" status of water bodies	"Good" state of surface waters			
			"Good" state of lake water bodies			
			"Good" status for transitional water bodies			
	Quantitative conservation of supply sources	Ensure supply to future generations	Planning of uses of the resource			
			Reuse of wastewater			
			Differentiation of supply sources			
Right to the resource	Usability of the resource	Meet water needs	Alert status of the basin			
			Water losses			
		Guarantee quality water for different uses	Compliance with regulatory parameters			
		Guarantee affordability	Cost impact			
			Incentives for economically disadvantaged families			
		Ensure the use of water spaces	Design supporting use of the resource			
		Ensure access to information regarding the resource	Internet sites			
Prevention of natural risks from water	Floods	Minimize the risks from floods	Evacuation orders			
	Landslides	Minimize the risk of hydrogeological instability	Potential erosion avoided			

Tab. 2 Evaluation results using the analysis forms; own processing source

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4 CONCLUSIONS

The application of the instrument has highlighted its own limitations, which should be optimized. It is proposed that implementation of four operational phases (definition of the analysis processes, data acquisition, analysis of results and selection of GIS models, and identification of lines of intervention aimed at integrated management of water resources) allows the professional using the tool to encounter less difficulty because it facilitates:

- Overcoming legislative fragmentation by defining dimensions, elements, areas of interest and specific objectives, which are derived from the study of the legislation and the instruments applied to the territory;
- Simplification of the analysis processes by identifying actors, criteria and indicators that provide general information on the territory, with respect to the fields of interest analyzed;
- Defining integrated policies with respect to the results obtained by the indicators, and focusing the lines of intervention only in the occurrence of a negative outcome, through the involvement of the bodies taking part in the process.

However, it is useful to note that challenges have been found in the attribution of the criteria for the evaluation of the indicators, as there is no universally calibrated evaluation system available. It is therefore recommended that further shared and accurate encoding modes for criteria should be defined through research. Difficulties have also been found in the definition of indicators based on the findings of data, as it is possible that additional indicators should be included. Improvements in these areas could allow the professional to take full advantage of the tool. Nonetheless, in a context of normative and managerial fragmentation, the operational tool simplifies, directs and measures planning interventions aimed at the integrated management of the water resource. In addition, it helps to build greater consciousness and awareness among local actors and communities, providing valid support for decisions or intervention proposals defined within negotiated planning instruments such as the river contract.

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URL:http://www.lifemgn- serviziecosistemici.eu/IT/progetto/Pages/se.aspx

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AUTHOR'S PROFILE

Vittoria Cugusi, graduated (December2018) in "Planning and policies for the city, the environment, and landscape" (LM-48) at the Department of Architecture, Design and Urban Planning, Alghero, Italy, University of Sassari. In 2016 she received a degree in "Urban Planning. Planning of the city, the territory, the environment and the landscape" at the same university (L-21). During her university

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career, she focused on issues related to the integrated management of water resources through the three-year the sisen titled, "From the Rio Posada to the Tepilora Park. A proposal for the integrated use of landscapes of water" and the master's thesis entitled "Integrated management of water resources. An operative tool to simplify, direct and measure the interventions." During the specialist course, she obtained the European master's degree in "Planning and policies for the city, the environment and the landscape" and collaborated as a curricular trainee at the LEQUIA research studio at the University of Girona, where she studied to pics related to aiding decision-making for purification plants.

Alessandro Plaisant, an associate professor of the Department of Architecture, Design and Urban Planning, at the University of Sassari, where he teaches Urban Planning and Analysis of urban systems. He holds a Ph.D. from the University of Cagliari, after spending eight months as a fellow at the School of Anthropology, Geography and Environmental Studies, at the University of Melbourne, focusing his research on decision-making processes in public policymaking, strategic planning, policies and pluralism-oriented tools. He combines my research activities with higher education, international and institutional cooperation activities as director of the level II International Master's Program "Advanced Methods and Tools for Sustainable Planning," developed in academic cooperation with Harbin Institute of Technology, and as scientific coordinator of the activities planned for the funded national call "extraordinary Program of intervention for urban redevelopment and security of the metropolitan suburbs," specifically in the Sant'Avendrace district of the Municipality of Cagliari (Sardinia, Italy). Among his recent publications: Urban regeneration of peripheral areas: the critical role of the connective space in an Italian city. (Aa.Vv) Urban Design Journal, 2018; Risk Prevention and Management. A Multi-actor and Knowledge-Based Approach in Low Density Territories (Aa.Vv.), Computational Science and its Applications (ICCSA 2017), in Gervasi, O., Murgante, B. et. al. (Eds.), Springer (ISBN 978-3-319-62397-9), Switzerland.

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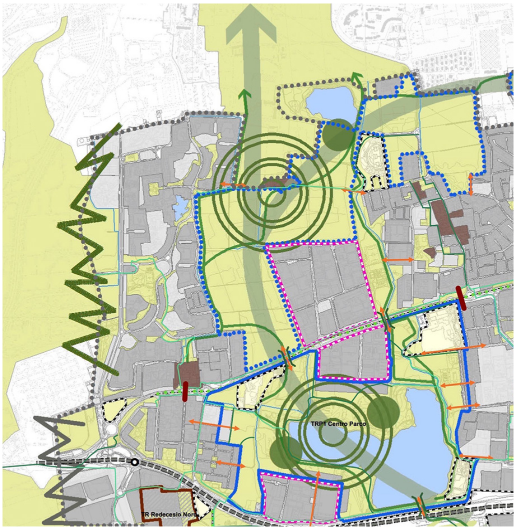

APPLICATION OF NBS TO THE CITY PLAN OF SEGRATE MUNICIPALITY: SPATIAL IMPLICATIONS

ROBERTO DE LOTTO

Department of Civil Engineering and Architecture
University of Pavia, Italy
e-mail: roberto.delotto@unipv.it
URL: www. http://uplab.unipv.it

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ABSTRACT

The aim of the paper is to describe and analyze the various Nature based Solutions applied in the 2017 City Plan of Segrate municipality (Italy, Milan Metropolitan city) with reference to the spatial implications. The new Segrate's City Plan aimed to increase the green urban patrimony in two main spatial dimensions: the metropolitan scale and the very local scale. In particular, with specific reference to the Lombardy Region structure if the City Plan (so called: Piano di Governo del Territorio – PGT, that means plan for the government of the urban territory), in the paper the various aspects of the application of NbS are described and analyzed for their consequences in the spatial urban organization. At first author define NbS in relation with the recent and diffused environmental measures applied in city planning, then the city of Segrate is described together with the past planning solutions. Then, author describes the 2017 city plan focusing on main strategies and normative clarifications; during this description for each aspect the spatial implications are declared.
Finally, starting from this practical example, author discuss about some enabler and barriers in the applications of NbS in city planning.

KEYWORDS
New city plan for greener city; Nature based Solutions; spatial planning at the Municipality level in Lombardy Region; Segrate Municipality

1 INTRODUCTION

In last decades scholars several times destabilized and re-assembled city planning following the changing of paradigms of "planning theory" (Thomas, 1979). According to the complex system approach, the urban development and management is still based on the relations among social groups and physical elements (Portugali, 2000). This approach carried to focus also on the procedure together with specific spatial aspects (that were the basis of the modern urban planning); the spatial analysis and planning developed fast in the last decades with the availability of computer-based instruments.

The "environmental issue" has been always a part of the classical city and regional planning and, even if the theme of respecting and safeguarding environment has become more and more relevant and urgent, it is not possible to consider this as a "new" theme for urban planning. In example, considering the urban expansion (sometimes a real explosion happened in ex-emerging economy contexts – such as China), the measure of soils consumption and the spatial implications in the relation between enlargement of cities and natural or agricultural territory have been underlined with the critics to the sprawl (Duany et al., 2000). To reinforce this statement, in Italian context the territorial plans have the main goal "to protect environment" and landscape, as well as to pursue social and economic development.

The whole process that carried to recognize sustainability as main strategical behavior for all human beings, started in the early seventies (with the U.N. Conference on the Human Environment in 1972, in Stockholm) and the principles exposed in 1972 should be applied to every human action (individual and collective), considering urban and regional panning as a key point. The goals of sustainability, developed during time by UN and EU until the New Urban Agenda, always refer to behaviors more than to specific spatial indications; so it is an interesting issue to analyze in which way these goals may be achieved throughout spatially oriented actions.

The ecological planning has been schematized by the landscape ecology (among all, Steiner, 2000), that is the science of studying the complex relationships between ecological processes in the environment and ecosystems. Key research topics in landscape ecology include ecological flows in landscape mosaics, land use and land cover change, scaling, relating landscape pattern analysis with ecological processes, and landscape conservation and sustainability (Douglas & James, 2015). From the introduction of the Strategic Environmental Assessment (SEA), defined in Europe by the Directive 42/2001, the process of regional, urban and city planning has been sustained using specific techniques, methodologies and indicators (see i.e: Meadows, 1998; Clark, 2000; Weber, 2001; Feldman, 2001).

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Nature-based Solutions (NbS) emerged in the last years as answer to critical forecasts about the impact of urbanization on the environment. So, a basic question could be: in which way NbS can be translated in specific spatial actions in urban and city planning?

1.1 METHODOLOGY

The methodological structure of the paper starts from the definition of NbS according to the most diffuse annotations; then the planning situation of Segrate is presented with reference to NbS introduced in the 2017 city plan.

Segrate's new city plan is strongly oriented to environmental protection: according to Lombardy Region legislative structure, the strategic decisions and the actualization of small-scale actions belong to different documents. So, the environmental goals are translated at the big scale and at the small one in a complementary way. In the paper authors specify the Segrate's city plan big scale strategies that have a NbS nature, and for each of them the spatial implications are underlined. Also, specific actions are described according to the NbS classification (see Chapter 2), and remarks about spatial implication are introduced. Finally, comments and conclusions argue about enablers and barriers in the activation of cited NbS measures.

2 DEFINITION OF NBS

Nature-based Solutions were defined to synthesize the different approaches and actions that work "with" and "for" the environment; they are a multi scalar and interdisciplinary strategies, tactics and operational actions that directly involve city planning and in general the management of the city.

Following Eggermont et al (2015) there are three types of NBS:

"Type 1 consists of no or minimal intervention in ecosystems, with the objectives of maintaining or improving the delivery of a range of ES both inside and outside of these preserved ecosystems. Examples include the protection of mangroves in coastal areas to limit risks associated to extreme weather conditions and to provide benefits and opportunities to local populations; and the establishment of marine protected areas to conserve biodiversity within these areas while exporting biomass into fishing grounds (Grorud-Colvert et al., 2014). [...] Type 2 corresponds to the definition and implementation of management approaches that develop sustainable and multifunctional ecosystems and landscapes (extensively or intensively managed), which improves the delivery of selected ES compared to what would be obtained with a more conventional intervention.

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Examples include innovative planning of agricultural landscapes to increase their multi-functionality; and approaches for enhancing tree species and genetic diversity to increase forest resilience to extreme events. […]

Type 3 consists of managing ecosystems in very intrusive ways or even creating new ecosystems (e.g., artificial ecosystems with new assemblages of organisms for green roofs and walls to mitigate city warming and clean polluted air). Type 3 is linked to concepts like green and blue infrastructures (Benedict & McMahon, 2006) and objectives like restoration of heavily degraded or polluted areas."

From these definitions, that have been acquired by the scientific associations, it is quite clear how much NbS keep origin from classical studies about the relation between human beings and ecological systems. All these three types can have a direct translation into city plans, but Type 3 is the one that best fits with artificial actions to improve natural capital. Some already known "labels" can now be considered as part of NbS: Green Infrastructures (Benedict et al., 2006), ecological networks, eco-building, city greening, and so on.

3 SEGRATE'S 2017 CITY PLAN

Segrate is a Municipality in Milan metropolitan area, close to Milan on east. It is 17,49 sqkm wide, it has 35.234 inhabitants with a density about 2.000 inhabitants per sqkm. As it happened in many municipalities in the close ring of Milan, Segrate is a recent settlement that grew from the sixties of the XX century from a rural origin. Segrate never had a strong industrial core and it developed mainly as residential settlement with some tertiary excellences: Mondadori (designed by Niemeyer), Fininvest, IBM, Microsoft (now moved).

The city was designed by separated neighborhoods, some of which with a very high quality of urban fabric and architecture.

The 2017 city plan is a revision of the 2012 city plan that supposed to cover all the greenfield with urban transformation, mostly for residential function. The new city plan has a clear orientation toward environment protection, sustainability and limitation of built volumes (together with the restriction of soil consumption) and it was the occasion to test how much Nature-based Solution could be translated into real spatial actions both at the strategic level and in the normative one.

The Lombardy Region City Plan (so called: Piano di Governo del Territorio – PGT, introduced in 2005 by Regional Law n. 12) divides the strategic phase (in the so called: Documento di Piano - DdP) from the design of the public city (so called: Piano dei Servizi - PdS) and from the normative apparatus regarding the existing city (so called: Piano delle Regole - PdR).

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3.1 STRATEGIC DECISIONS

In the strategic phase (DdP) there have been defined some objectives regarding NbS as follows:

- 1, preservation of greenfield and limitation of soil consumption;
- 2, construction of a local Ecological Network (Segrate is not involved in the Regional Ecological Network);
- 3, definition of three main territorial big scale parks;
- 4, usage of SEA verification in every step of actuation planning.
- 5, limitation of buildable volumes in already planned transformation area (reduction of density indexes);
- 6, improvement of ecological performance of existing city;

It is easy to recognize all these 6 strategic lines into the previously stated definition of Type 3 of NbS.

3.2 SPATIAL IMPLICATIONS OF STRATEGIC DECISIONS

Objectives 1), 2) and 3) (Fig. 1) are related to a general approach to urban land that aims to preserve the green spaces and to improve quality, identity and awareness about the existing environmental territorial potentialities. Looking at classical definitions of such NbS objectives, they are very close to the "green infrastructures" improvement. The spatial implications are immediately evident: specific parts of the territory are devoted to maintain their original characteristics of green spaces. If the simple maintenance of an existing green function is strong enough to be considered a Type 3 NbS, the effects on the close space depends on the specific function forecasted. In this sense, Objective 1) expresses the wish to preserve a quality of the space, while Objective 2) inserts it in a wider scale.

The local Ecological Network has a multifunctional character and it involves parks and green spaces in order to have a spatial continuity with other green spaces; in particular, the southern part, composed by agricultural land belonging the Agricultural Park of South Milan (Parco Agricolo Sud Milano) and by the Idroscalo area (with leisure and sport attitude) are connected with the "Grande Parco Forlanini" that is a big scale park that will link the eastern part of Milan to the Idroscalo lake.

The spatial implication of such a new cross-urban green structures, involves the perceived and real quality of all the near neighborhoods and implies the definition of new collective functions and the necessity to use private and public spaces in a sustainable but usable way. These functions imply the need of bicycle and pedestrian paths and diffused parking area. In the central part of the city, the presence of a big lake (that is the result of 40 years of

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excavation activities) and the existing ex-excavation sites, suggest the creation of a mixed "blue and green" infrastructure with the aim to create a new central park with the extension of almost 1 sqkm.

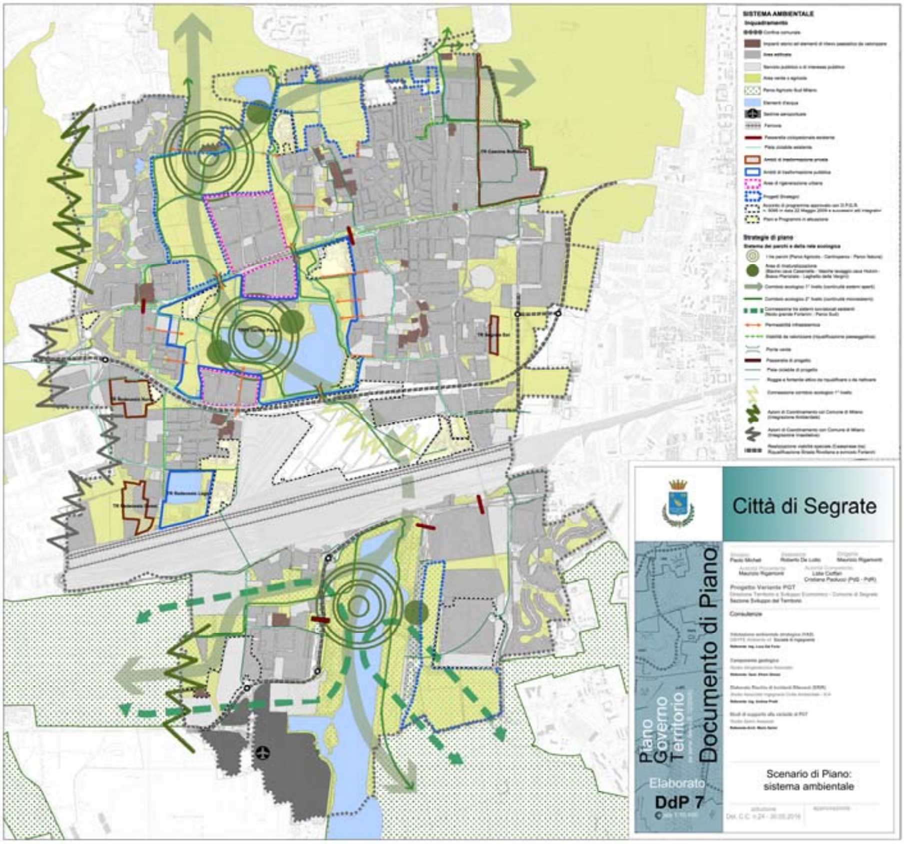

Fig. 1 Segrate 2017 city plan: Environmental System

This specific park cannot be considered as a pure natural context, because in the past decades the territory has been tormented by hard human activities. In this site, many ex-excavations sites have been filled with low quality material (i.e. rests of buildings demolitions) so a renaturalization is desirable but maybe not really effective in all the site.

So, NbS solutions have to focus on letting nature recover the space where it is possible and focus on some leisure and sport functions for people.

The spatial consequence are the modification of the functions and the need by the Municipality to acquire the property of the area. This means to use expropriation processes (that is possible only for small area) or perequative instruments (that imply the creation of building rights). To

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be more effective considering the wideness of the area, some spaces were defined as building area (around 10% of the whole park surface), and the rest is now under a design process. Of course, the leisure functions need to have accessory functions that guarantee control and maintenance.
On north, the third park has been characterized as agricultural park. In this case NbS strategy is in between Type 2 and Type 3 because it aims to preserve actual agricultural destinations. The spatial implications in a preservation strategy is easily defined by the limits of the area. No specific other accessory functions are planned, so there is not the need to use further spaces to let the area reach the planned functions.
The implications are at the legal level, as long as the owners of the area, in 2012, were offered to have a conspicuous economic advantage transforming the agricultural land in buildable land. Objective 4) is a procedural NbS strategy, that does not have any direct spatial implication.
Objective 5) aims to limit the built density in all approved development plans in greenfield. The spatial implications of such a strategic NbS is the preservation of green land and the reduction of spaced devoted to streets, parking area and public services.
So, both directly and indirectly this objective has positive spatial consequences on the environment.
Objective 6) is enounced in the strategic document (DdP), but it finds application in the normative part of the city plan (PdR).

3.4 OPERATIVE AND NORMATIVE DECISIONS

In Lombardy Region the operative aspects are specified in the Services Plan (PdS) end in the Regulation Plan (PdR). In Segrate 2017 city plan NbS were specifically defined by regulations and spaces in the PdS (that considers all the urban green public equipment), and only by regulations in the PdR about the diffuse private already built space. Moreover, in PdS they were defined specific NbS measures to improve trees equipment in all transformations area.
The PdS considered all the green spaces and the total number of existing trees as a starting point to improve urban quality. Generally speaking, Segrate Municipality has a very big quantity of public services measured in sqm for each inhabitants: 44 (sqm/inhab). So, the main issue of 2017 PdS was not quantitative but qualitative, not only for the usability but mainly for the environmental quality.
The PdR, according to the strategic Objective 6., aimed to improve the environmental quality in existing private city. To reach this goal, a specific parameter has been defined: the Biotope Area Factor (BAF). It comes from Berlin's Landscape program (https://www.berlin.de/senuvk/umwelt/landschaftsplanung/bff/index_en.shtml) and it is a

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parameter that measure the evapotranspiration of soil and built spaces. The related studies started in the middle of the nineties and from the beginning of the millennium many other urban indexes developed in Italy and abroad. The decision to use the BAF instead of other indexes (such as, in example, the RIA used in Bolzano, Italy) is that it is simple to be used and it is not a building parameter but a city planning one. This aspect reflects the sphere of application of NbS that is surely related to artificial objects like Type 3. (i.e. green roofs and green walls) but can be opportunely applied also at the city planning scale. Defining the appropriate indexes, and apart from the big strategical objectives (already seen in the previous chapter), NbS may find place also in the normative and more detailed parts of the city plan; then they can be applied in the building regulatory documents (in Italy: Regolamento Edilizio). In Segrate 2017 city plan, from the technical point of view BAF was used imitating the Berlin data and targets: for each urban functions, and depending on the covered ratio, specific BAF targets are defined according to an abacus of parametric elements that evaluate the biotic capacity of certain surfaces (at the ground floor, in the roofs, in the facades). Then, a specific incentivization measure was defined in order to enable NbS application. This measure can be synthesized as: one a set of targets are defined for each urban zone, if a private stakeholder is able to overcome the minimum requested, it receives a volumetric premium calculated as 50% of the better reached environmental performance. In example, in a certain urban context:

- BAF target: 0,6;
- Obtained BAF: 0,66;
- Hypothesis of Percentage of better performance: 10%;
- Hypothesis of Volumetric bonus: 5%.

This means that, in general, the urban density of existing city may raise, but only respecting good environmental efficiency. This is an NbS that involves different typologies of intervention (from limiting soil sealing to improve garden spaces) and that is applicable to all the territory.

3.5 SPATIAL IMPLICATIONS IN OPERATIVE AND NORMATIVE DECISIONS

In PdS NbS measures have limited spatial implications, because they are concentrated on the environmental efficiency of existing green spaces and not in the creation (or regeneration) of new green spaces (public or private). The NbS in PdR are mainly related to BAF. The spatial implications of BAF are difficult to be evaluated with precise detail: the spatial application of BAF is for the whole existing city, and the tendency is to improve the use of NbS to renature existing city, having a volumetric bonus to enable this measure. Because the increase of BAF implies a cost, the volumetric premium permits to have a partial or total coverage of this cost.

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But because it is referred to specific and territorially diffused phenomena, the spatial implications must be monitored to evaluate the efficacy of this measure. Very recently, a proposal arrived to the Municipality: a quite big tertiary building (around 10.000 sqm) was designed to be renewed, and with the appropriate use of BAF the stakeholders are able to arrive to a premium of volume around 1.500 sqm. That is a very good results both for the stakeholders (who have a substantial increase of real estate value) and for the Municipality (that has a very good increase of environmental performances). On the other hand, the direct spatial implications are related to: occupation of space for new volumes, new space needed for parking area, possible need of new private roads. The undirect spatial implications regard the modification of fluxes (of people and goods) from and to the new settlement, the need of accessory functional spaces for new offices users (such as cafeteria, gym, commercial activities, …). In another example, related to a request regarding a private villa around 200 sqm, the bonus was about 12 smq (more or less a new room); so spatial implications are limited to the building itself. Generalized to the whole urban fabric, the volumetric bonus (that is an enabler of NbS application), may have spatial consequences that could imply considerable modifications in urban settlement.

4 DISCUSSION AND CONCLUSIONS

From the analysis of the 2017 city plan Segrate Municipality, it emerged that various kind of NbS can be defined according to different scales and to different semantic roles of strategies and actions in a city plan.

Because NbS were born to include under the same "umbrella label" a multiplicity of technical and practical solutions toward a better quality of urban and territorial space; so the city plan is a privileged place where to specify and actualize sustainability objectives oriented to improve urban quality. Blue and green infrastructures, ecosystem services, ecological networks, green improvement, usage of artificial technical solutions that increase urban environment, are all measures included in NbS definition.

In 2017 Segrate city plan, the attempt was to enclose the larger number of NbS typologies in the same "container" in order to better organize and monitor the reaching of certain results.

The spatial implications of NbS have been carefully analyzed before the measure were defined. For what discussed Chapter 4 the strategic objectives, that usually are quite fuzzy, have precise geographic and spatial definition. Related NbS can be clearly observed in their process. The relevance of strategic big scale NbS, does not need specific drivers because the knowledge about them is nowadays diffused.

It is not the same about small scale and diffused solutions: once the NbS depends on the private actions, it is necessary that some enablers come directly from the public

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administration. The level of knowledge about the efficiency or, better, about the collective advantage in using NbS is still weak in population. Moreover, tomotive the initial investment it is not clear whether a certain investment in NbS can (or could) create certain advantages (economic, healthy, wellbeing…) that, or not. So, for strategic NbS the role of public administration is necessary and often sufficient; for operative NbS the role of public is necessary but not sufficient. From the spatial point of view, NbS are often considered as intangible measures or small-scale activities (like green roofs and facades), while the range of applications and the spatial and visible physical spheres are many and wide.

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AUTHOR'S PROFILE

Roberto De Lotto is Associate Professor of Urban Planning, Department of Civil Engineering and Architecture (DICAr), University of Pavia. Director of the Urban Project Laboratory of DICAr. Editorial Board Member of the ISI "Journal of Urban Planning and Development" of the American Society of Civil Engineers (ASCE) since 2008, Editorial Board Member of the Journal of "Urban Transportation and Construction", reviewer for many international ISI and Class A Journals. Director of the Double Master Degree in "Building Engineering and Architecture" between University of Pavia and Tongji University in Shanghai. Visiting Professor at Tongji University, College of Architecture and Urban Planning (CAUP) since 2013. Member of the Association of Italian Academics in China (AAIIC). Author or more than 150 scientific publications among papers, book, chapter of books, and other scientific products. Consultant for Public Administration in City Planning and Strategic Environmental Assessment. Council Member for Urban Planning in Segrate Municipality (MI).

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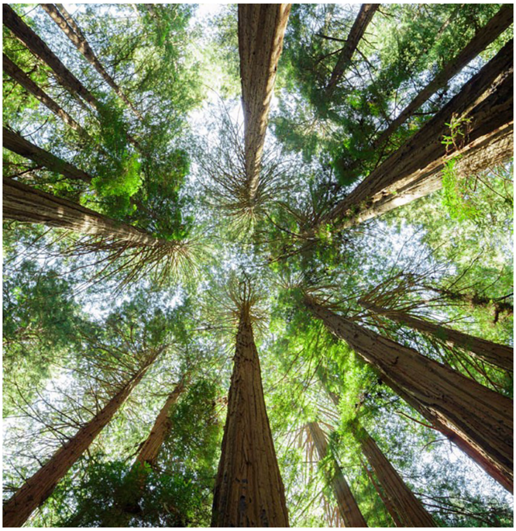

NATURE-BASED SOLUTIONS IMPACT ASSESSMENT: METHODOLOGICAL FRAMEWORK TO ASSESS QUALITY, FUNCTIONS AND USES IN URBAN AREAS

CLAUDIA DE LUCA, SIMONA TONDELLI

Department of Architecture, Alma Mater Studiorum, University of Bologna, Italy
e-mail: claudia.deluca5@unibo.it
simona.tondelli@unibo.it
URL: www.unibo.it/sitoweb/claudia.deluca5
URL: www.unibo.it/sitoweb/simona.tondelli

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ABSTRACT

Urban Green Areas quality assessment has been at centre of the discussion in planning disciplines for decades already but has rarely been effectively and efficaciously integrated into planning tools and strategies. Building on several methodologies to evaluate public space quality (Mehta, 2013), on the millennium ecosystem assessment (MEA, 2005) and on the expert groups report of the EKLISPE framework on the impact evaluation on NBS (Reynolds et al. 2016), in this paper we propose a comprehensive methodological framework to evaluate Urban Green Areas (UGAs) quality and performance aiming at integrating the ecosystem services they provide as parameters able to guide urban planning strategies and choices, thus boosting both the implementation of high quality and performant green urban areas and enhancing the overall city quality and liveability. Within the scope of this paper, we will focus on the so-called ecosystem based NBSs and we propose and introduce three different indexes to be assessed: i) Green space quality index ii) Green space services index iii)Green space uses index.

KEYWORDS
Nature Based Solutions; Quality and performance assessment; Urban GreenAreas; Ecosystem Services

1 INTRODUCTION

Urban areas in Europe and beyond are now bordering a fundamental dilemma; they are facing, and they will more severely face, many controversial and multifaced challenges, among which climate changes, social inequalities, environmental degradation and economic crisis. On the other side, cities are at the core of the economic, social and environmental innovation and are fertile environments for problem solving and innovative solutions. The knowledge hubs they nurture represent a valuable resource to switch the paradigm towards development of sustainable strategies and plans to cope with climate change, increase urban resilience and make cities more livable. In this direction, cities can rely on nature to tackle these challenges. Nature Based Solutions (NBSs) include diverse types and scales of intervention and range from green and blue infrastructures to ecological based solutions, as, for instance, areas of green coverage, wetlands, green walls and roofs, creation of artificial water bodies, rain gardens, etc. Within the scope of this paper, we will focus on the so-called ecosystem based NBS, hereinafter also called Urban Green Areas (UGAs), examples being urban parks, urban gardens and orchards, natural embankments, and green squares. These NBS are embedded in the urban environment and they are expected to perform diverse functions, delivering numerous ecosystem services to citizens and to the environment. Moreover, the focus of this study is limited to open public green spaces and do not include private spaces.

The paper proposes a methodological framework to evaluate UGAs quality in terms of performances and relevant uses and functions provided by the space, discussing different approaches and methodologies (section 2). Also, it provides insights on how to further integrate ecosystem services and NBS in planning tools, and how multi- criteria analysis can support decision makers in doing so (section 3).

2 EVALUATING QUALITY OF URBAN GREEN AREAS: A PROPOSAL FOR A METHODOLOGICAL FRAMEWORK

The functions that UGAs can potentially provide to the city in terms of climate adaptation and mitigation, health and wellbeing of citizens, food security, water management and heat waves reduction are well known (Reynold et al., 2016; Wolch et. al 2014). Nevertheless, the mere presence of UGAs doesn’t ensure the provision of the relative benefits, functions and services. Indeed, the services and functions that UGAs produce are strictly connected with physical, functional and usage characteristics of the space and in general terms with its overall quality. Space quality assessment has been at center of the discussion in planning disciplines for decades already but has rarely been effectively and efficaciously integrated into planning tools

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and strategies. Building on several methodologies to evaluate public space quality (Mehta, 2013), on the millennium ecosystem assessment (MEA, 2005) and on the expert groups report of the EKLISPE framework on the impact evaluation on NBS (Reynolds et al., 2016), in this paper we propose a comprehensive methodological framework to evaluate UGAs quality and performance aiming at integrating ecosystem services as parameters able to guide urban planning strategies and choices, thus boosting both the implementation of high quality and performant UGAs and enhancing the overall city quality and livability.
The proposed framework considers three main indexes to be evaluated:

- green space quality index: it defines the quality of a space based on indicators evaluating the structure and the physical characteristics of the space (accessibility, connectivity, safety, and maintenance, and urban design features)
- green space services index: it assesses the services and functions provided by the space and it is based on the Mapping and assessing Ecosystem and their services (MAES, 2016)
- green space uses index: it aims at assessing the effective use of the space and builds on different potential approaches (surveys, direct observation and big data analysis)

2.1 GREEN SPACE QUALITY INDEX

The UGAs quality index aims to assess different characteristics of the space; this index doesn't aim at being comprehensive, but it identifies the main categories to be assessed:

- *Accessibility of the area*: in accordance with SDG N11.7, each city should work on providing 'by 2030, universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.For decades already, several authors (Harrison et. al., 1995; Van De Voorde, 2016) proposed methods to assess accessibility. In this context we consider as a comprehensive method the one proposed by Pafi et al. in 2016. The methodology clearly explains how to evaluate the intersections and the nodes of access to green areas in urban environment and provide practical example on how to do it in a GIS environment;
- *Connectivity among different areas*: connectivity among urban and peri-urban green areas is of great importance for biodiversity functions and resilience and it influences the use and the access to the area itself. An interesting example of connectivity analysis has been proposed by Tian et al. (2017), where resistance weight, structural connectivity index and the ecological barrier effect index are evaluated through GIS;
- *Safety and maintenance*: perceived safety from crime is affected by the physical condition and maintenance of the area. Moreover, the presence of people and of stores and other non-residential properties the maintenance and the design of a place contribute

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to make it perceived as safer (Sakip et al., 2012). There's no one agreed index to assess safety and maintenance, but we suggest including in the evaluation at least: physical condition of the features, lighting conditions, presence of external security devices;

- *Urban design and features:* quality of such structures is crucial in relation with the potential use of the space (i.e children playgrounds, sport facilities, etc.) and the assessment of urban features is an important part of the overall concept. Interesting insights on this have been provided by King et al. 2015.

2.2 GREEN SPACE SERVICES INDEX

UGAs have so far mostly been considered in terms of aesthetics quality and use, as playground for children and relax areas for adults and elderly, but increasing attention is now focused on the whole range of benefits that UGAs can bring to the society. In this context, the benefits derived from UGAsare called services in accordance with the definition given by the MEA, 2015. Ecosystem services are divided into 4 main categories:

- *Supporting services*: they refer to basic services for ecosystem healthy maintenance such as nutrient recycling, primary production, soil formation, habitat provision and pollination. These services are fundamental to keep alive most of other relevant provisioning and regulating services;
- *Provisioning services*: they include basic functions of the ecosystem that provides necessary goods for humans such as food, crops, wild foods, and spices, raw materials, genetic resources, water, medicinal resources, energy, ornamental resources;
- *Regulating services*: they are mostly related with climate regulation and purification services, carbon sequestration and climate regulation, predation regulates prey populations, waste decomposition and detoxification, purification of water and air, pest and disease control;
- *Cultural services* (CES): they refer to spiritual and historical recognition of a particular place, recreational and tourism experiences (mostly eco-tourism, hiking and outdoor sports), therapeutic effects, culture and education.

Most of the provision, regulating and supporting services are assessed through quantitative indicators and modelling systems while more qualitative assessment methodologies have been developed for CES. Moreover, the Mapping and Assessing ecosystem services framework was firstly developed and used to evaluate and to further estimate the economic value of landscapes, natural features, Natura 2000 sites, etc. Only in the last years, the attention on potential benefit that urban ecosystem can bring to population raised enormously. The Urban MAES pilot and the following report form the JRC 'Mapping and Assessment of Ecosystems

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and their Services Urban ecosystems' (2016), provides indicators and methodology on how to apply the ecosystem services framework to the urban ecosystem. Moreover, the EKLIPSE framework (Reynold et al. 2016) proposed some valuable inputs to assess those services in urban areas, relating them to 10 categories of identified urban challenges.

On the other side, cultural services are related with the design, features and historical value of the place and with the perception that people get from them. To get a clear perception of the effective value of ecosystem in terms of cultural ecosystem provision, there is the need to analyse the effective use of the space and the relative perceptions of the users.

2.3 GREEN SPACE USES INDEX

To evaluate and assess the effective use of the space, this contribution considers three main methods that can be applied:

- *Survey the users of green public spaces:* to better understand the perceived benefits of the users of UGAs, dedicated survey campaign can be used (Burges et al., 1988). This methodology can provide some valuable evidences, but it also presents several limitations. The design and the submission methods of the survey is crucial not to incur in potential leaning evaluation and it could be problematic and really time-consuming to get a valuable number of answers;
- *Direct observation of the space*: observing and knowing the space is fundamental to be able to extract sound conclusions from the analysis mentioned above. Direct observation of the space in different days, time of the day, seasons, and from different position of the space has been used to evaluate users' habits and activities (i.e Parra et al., 2010). Nevertheless, observations can be limited in time and are subject to the personal evaluation of the observers;
- *Big data analysis:* in the last years, big data analysis coming from social media and other sources (App, Google, etc.) is raising as an innovative way to evaluate users' perception of UGAs. This method allows to analyse geo-referenced and open access data, with fast coding support or pictures observation. As for the social media, FlickR and Instagram seem to be the most interesting platforms for this kind of analysis (Tenkanen, 2017), main limitations being the cohorts of users and the quality of the data uploaded. FlickR is used mainly by semi-professional photographers that provide high-quality professional pictures, but the numbers of the users is often pretty low; Instagram, it is really useful to understand the different uses of the spaces, but limitations are given by the demographic cohorts of the users, being almost 60% of the users aged 18-34; also it is

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difficult to infer how reflective a user's online behaviour is of their offline behaviour without information on them from other sources (GSR, 2016).

Each of the 3 methods presents benefits and limitations, but the integration among the 3 could bring interesting results.

3 FROM ASSESSMENT TO ACTUAL INTEGRATION OF NBS IN PLANNING: RECOMMENDATIONS AND FUTURE DEVELOPMENT

The methodological framework presented aims at evaluating UGAsquality, services and uses through the assessment of the 3 different indexes presented.

Nevertheless, it is important to underline that all the variables considered can assume different importance in different contexts.

It is then suggested to use a multicriteria analysis to assign different weightsto the different indicators based on a deep knowledge of the area analysed, the objective of the analysis and experts' and decision makers' judgement.

A clear assessment and understanding of the quality, services and uses of UGA as NBS can then strongly support a further integration of those into planning strategies and tools. Indeed, the three indexes could be use in different planning strategies and phases:

- Green space quality index: it is already partly integrated into technical guidelines and requirements (Green Public Procurement, technical guidelines on green maintenance, minimum legal requirement and planning standard for green area), but further work would be necessary to adapt those to evaluate constant cities' transformations;
- Green space services index: required performance and needed functions of UGA should be included in urban and metropolitan plan objectives, starting from a mapping and a supply and demand analysis of related Urban Ecosystem Services;
- Green space uses index: to improve the use of UGAs, public engagement and civil society participation in the planning and design is crucial and can strongly support better use, maintenance and management of the area.

4 CONCLUSION

The main difficulty in developing a methodological framework to evaluate NBS quality, services and uses in urban areas is to provide universal applicable recipes, since the territorial and context information (in terms of socio-economic, climate, environmental and cultural features and background) highly influences the choices to be made and the different features and services to be analyzed.

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Both in the planning and in the assessment phase it is then recommended to embedded specific objectives, and context related information, integrating and valorizing existing strategic impact assessment procedures. Further research would be needed for the test, tailor and integration of the proposed framework in real case study areas, evaluation protocol and procedures and planning strategies.

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AUTHOR'S PROFILE

Claudia de Luca is a Ph.D. candidate at the department of Architecture, University of Bologna. Environmental scientist (MSc), now focusing on sustainable urban planning and urban regeneration processes related with the use of nature into the cities (Nature Based Solutions). Involved in the Planning and Regeneration research groups, leaded by Prof. Simona Tondelli, she is actively involved in several H2020 and INTERREG funded project (RURITAGE, ClimateKIC NBS and MATCH-UP).

Simona Tondelli is an Environmental engineer, Ph.D. in Building&Spatial Engineering and Associate professor of Urban Planning. She has 20 years of research experience in sustainable urban planning and regeneration. She is the scrintific responsible of the Refurbishment and Restoration division of the UNIBO Interdepartmental Centre for Applied Research on Buildings and Construction (CIRI-EC). Coordinator of RURITAGE H2020 project, of MATCH-UP INTERREG EUROPE project, ECOTALE INTERREG IVC project, and currently partner in one ERA-NET JPI Urban Europe project (SPN), SHELTER H2020 project, SEERRI H2020 project and many Erasmus + projects, and scientific responsible of many regional/local Research Projects. Vice-Director of the Emilia-Romagna section of the National Urban Planning Institute - INU. Member of the scientific board of the UNIBO Ph.D. Programme in Architecture and Design Cultures. Author of over 100 publications.

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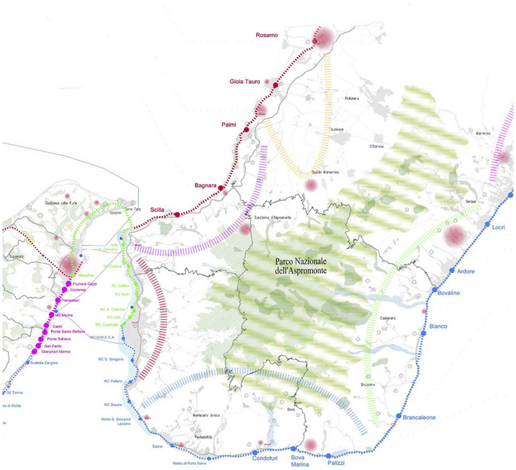

THE RECOGNITION OF THE ASPROMONTE NATIONAL PARK ECOSYSTEM NETWORKS IN THE URBAN STRUCTURE PROJECT OF METROPOLITAN CITY OF REGGIO CALABRIA

CONCETTA FALLANCA, NATALINA CARRÀ
ANTONIO TACCONE

Department of Heritage, Architecture, Urban Planning, Mediterranean University of Reggio Calabria, Italy
e-mail: cfallanca@unirc.it, bncarra@unirc.it
cataccone@unirc.it

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ABSTRACT

The Metropolitan City of Reggio Calabria is characterized by a complex territorial system with different fields and contexts from the morphological, settlement and economic point of view. Inside of the metropolitan city we find the Aspromonte National Park, which takes the role of a 'metropolitan garden', a mountainous park of more than 65,650 hectares, which is a very representative example at the European level. The Park is in fact one of the five homogeneous territorial areas as identified in the latest Statute of the metropolitan city. The territory of the Aspromonte National Park is a kind of programming, full of history and culture provide the established communities with a sense of belonging, also for the significant relationships between man and nature which could become a source of interest to the potential opportunities of project. The paper emphasizes how an overall and coordinated planning strategy of the Aspromonte National Park's ecosystem networks, aimed at combining territorial and economic capital and enhancing the systems of cultural and landscape resources with environmental protection, and which is optimal to imagine a different model of development.

KEYWORDS
Enhancement strategies; Metropolitan City; Social capital; Connective and Networks

1 THE TERRITORIAL CONTEXT, STRATEGIC SCENARIOS FOR THE DESIGN OF PLACES

The territory of the metropolitan city of Reggio Calabria is complex and fragile; such complexity derives from its territorial and social structure, the consequence ad millennia of man's relationship to nature, resulting in the correlation between the natural environment and those anthropic elements which forge its shape and structure. The fragility lies in the physical-urban dimension[1] and to aspects of building for social structures, whilst also concerning itself with the management of services and public spaces, connections and urban and territorial infrastructures, as well as certain demographic aspects: many of these urban centres have, over the last decade, undergone abandonment and depopulation at levels often above the national average[2].

The south east side Reggio Calabria territory, in particular, is characterised by the presence of small villages dotted along the hillsides, overlooking valleys and rivers that have suffered from the depopulation phenomena, often following natural disasters, yet with one common element: the breaking up or replacement of the old city centre with new settlements; city centres that have suffered, since the 60s, from another phenomena attributable to the economic miracle; that of migration towards the north of the peninsula.

Over the last thirty years, the development of this territory (as with many others with equal conditions) has been conceived as a paradigm of the capitalisation of goods and resources, concentrating funds and planning on individual redevelopment interventions aimed at forms of cultural tourist development. This paradigm is strongly limiting as it focuses attention only on landscape value to the detriment of other equally qualifying places, with a clear separation of the formal from the structural question, without therefore taking into consideration the problems linked to the fragility of the territory, the risks or the territorial endowment and/or urban infrastructure and primary services (De Rossi & Mascino, 2018).

Interventions on a territory with these characteristics are therefore primarily linked to a requirement to adapt to new needs, and therefore in this specific case; to a change in the

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[1] Aspromonte Park Authority, Park Plan, art. 12, paragraph 4, of Law 394/1991 and subsequent amendments, in January 2007. Consultants for the Mediterranean University of Reggio Calabria, Group Environments settlement, Scientific Director prof. Concetta Fallanca with archh. Natalina Carrà, and Antonio Taccone.

[2] https://osservatorio.urbanit.it/wp-content/uploads/2016/06/Allegato_III_-_RC_Strategia_di_Sviluppo_Urbano_Sostenibile.pdf

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concept of efficiency which is rigidly related to the notion of use, function and quality of space and of places, aimed at the new metropolitan territorial structure.

The conception of an all-embracing and coordinated planning strategy for the Aspromonte National Park eco-social networks with village networks, the beating heart of this context, means imagining a metropolitan area aimed at increasing the efficiency of services, spaces and common area. It means strengthening the cultural level of the community to create awareness and commitment towards the protection and enhancement of the identities of places. Networking also means facilitating physical and social accessibility to places and services; this plays a fundamental role in the equilibrium of the metropolitan area because it affects the propensity of users to experience the metropolitan space in conditions of safety.

The Metropolitan City of Reggio Calabria is characterised by a complex territorial system with different settings and contexts for each morphological form, natural settlement and level of economic growth. The territory encompasses the administrative boundary of the old province of Reggio Calabria, linking alternative vocations found in other territorial systems marked by their differing detail and identities. The Aspromonte National Park is one of five homogeneous territorial areas composing the metropolitan city of Reggio Calabria (the others being the plain of Gioia Tauro, the Strait, Locride and the Grecanica area)[3]. This choice represents one of the most innovative aspects of the Statute that recognises the Park Area as a metropolitan territory on a par with other territorial contexts in order to activate forms of development and enhancement consistent with the peculiarities of those places. The presence of a protected area (the Aspromonte National Park, a mountainous park covering more than 65,000 hectares) included in the metropolitan perimeter, is a unique example on a European level. It is an area which is characterised by an extraordinary landscape, cultural heritage and a rural, but also mountain settlement system, in which the residential side is ever more connected to attracting tourism through cultural, landscape, historical, archeological, enogastronomic and naturalistic goals. Inside the park lie a mixture of locations characterised by their rural worlds, combining a thousand different narratives, yet pushing toward a common future whilst maintaining their own peculiarities. The territory of the Aspromonte National Park is a slide-show of historical and cultural riches unique in each established community[4]. Its barycentric position in the 'vast' context of metropolitan territory, which includes 37 municipalities, one

[3] Article 39 of the Metropolitan City Statute, approved by the Metropolitan Conference on December 29, 2016, BURC January 13, 2017

[4] Natura e cultura. Le aree protette, luoghi di turismo sostenibile, created by the Ministry of the Environment with the collaboration of Unioncamere, the Sustainable Development Foundation and Federparchi, 2017, https://www.minambiente.it/sites/default/files/archivio/allegati/biodiversita/Rapporto_Natura_Cultura.pdf, last accessed April 2019

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third of those that make up the entire area, represents a strength in the metropolis process of the city of Reggio Calabria. In addition, the multiplicity and variety of so many local contexts give rise to a plethora of settlement systems, which are most often fragile within the metropolitan context. They also produce a geography, taking on a different view, for which forms of aggregation and specific areas for intervention in the process of constituting the Metropolitan City are necessary, especially in preserving the homogeneity that characterises the territory of the Park. Geography, therefore, reveals a territory that has experienced more or less positive events, the depopulation phenomena, demographic and economic crisis, and ultimately the phenomena of physical degradation of the territory, all accompanied or otherwise resulting in a general depletion of the Territory itself. Here, therefore, processes are opening up to new geographies that intercept new issues: environmental, cultural-identity, strategic-infrastructural, bringing attention to the upgrading of the territory and the infrastructure network, the reorganisation of services and public space, on the necessity of physical accessibility, not of places and things, but of reconnecting different parts of the city and of the territory through the recognition and the planning of social and ecological networks within the territory.

2 THE RECOGNITION OF ECOSYSTEM NETWORKS IN THE ASSET MODEL

The evolution of the concept of ecological network identifies the construction of polyvalent ecological networks in which the ecosystem connects culturally with the landscape, producing functional results which fit effectively into consolidated and innovative territorial governance. Ecological networks have become a common tool for spatial planning, but their role in the overall system of governance needs to be better understood. The recognition of ecosystem networks, understood as polyvalent networks (which include environmental, cultural, economic values) involves the integration of three strategic approaches: the latest generation of polyvalent ecological networks; the territorialisation of policies through the enhancement of local identities; the increase of local resilience capabilities against critical changes in progress[5]. The ecosystem networks[6] are here considered as a natural evolution in the field of

[5] RETIPOLIVALENTI.it (edit by S. Malcevschi et al.), 2014. Reti eco-sociali locali e nuovi strumenti informativi; una ricerca attraverso sistemi di luoghi a Pavia e dintorni. URL: www.retipolivalenti.it/i-ricerca2014, last accessed April 2019

[6] Defined as the expression of close and recognized relationships between humans and their places of life, the eco social networks have always existed. The small populations of prehistory could not survive if they did not understand the ecosystem (its resources, its pitfalls) in which they were inserted. The small villages of the middle ages have had to do the same. It is in the twentieth century that it was thought to be able to disregard respect for its environment, but the disconnections and breakages produced are

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traditional ecological networks that have been developed in recent years in Italy; alongside those components which are most closely related to biodiversity (safeguarding natural connectivity, reducing ecological fragmentation), it was opportune to consider contextually the relationship with human activities and with the environmental impact produced by them.

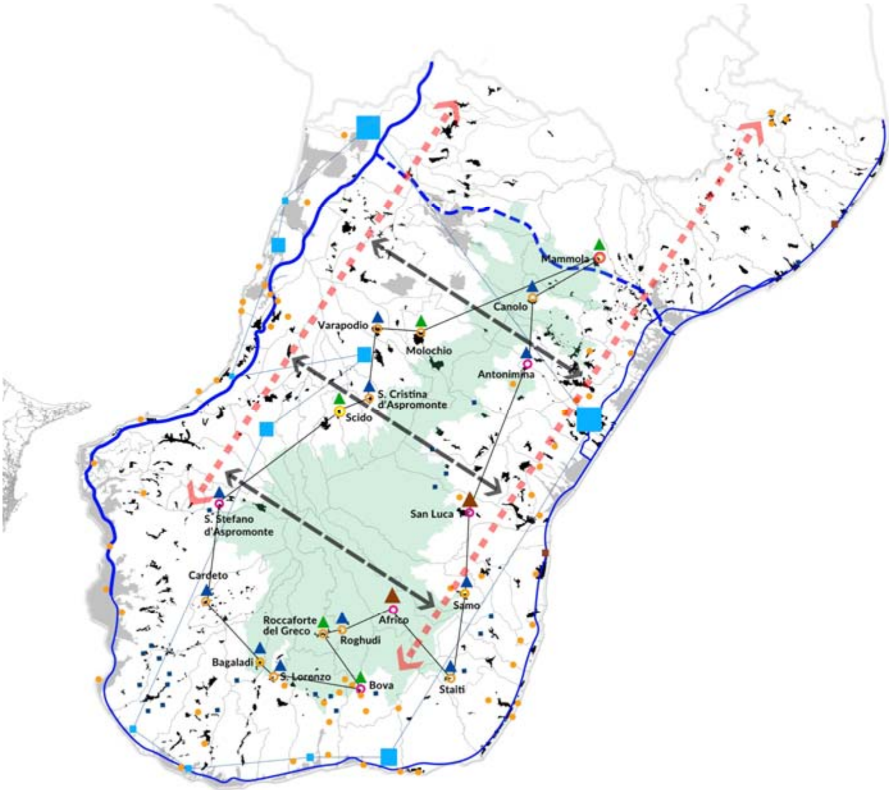

Fig. 1 Spatial planning model. Ecosystem components and networks

The awareness of the *ecological landscape* and cultural value of locations, and the positive opportunities offered to the territories by ecosystem services, are essential prerequisites for rebalancing fragmented ecological and social networks.

The fragmentation of complex *ecological landscape* systems, such as the PNA in the metropolitan context of RC and the networks of relations that cross them, has increased and has grown exponentially in recent years. In particular, the problem of fragmentation remains

producing ever greater damage and risks. We need answers through an improvement in the relationship with the places of life and the remote ecosystems that can condition them, and many experiences are already already going in this direction.

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one of the most serious in terms of sustainability prospects, both from an ecological and social point of view. Fragments produced by the existence of different types of barriers:

- ecological barriers: the functionality of ecological networks and ecosystem services is one of the premises, through the provision of ecosystem services, to provide better functioning of the territorial and social system;
- generational and technological gaps: the historical knowledge of past generations related to the best relationships with environmental risks (for example hydrogeological ones) are currently disappearing at a time when such risks are actually increasing due to an ever greater unpredictability of the system; such knowledge is almost never transmitted to new generations, at least as awareness or attitude towards risk;
- fragmentation of knowledge: information, perceptions; despite the enormous increase in the volumes of information produced at each level, the fragmentation of knowledge is increasing, local identities are being diluted, reducing the levels of cohesion and the capacity for an organised collective response;
- regulatory and administrative fragmentation: despite the declared subsidiarity objectives, the multilevel administrative between Municipalities and supra-municipal bodies has not always functioned at its best in the recent past; on the contrary, the ongoing abolition of the Provinces imposes redesigns in modes of governance and governance, even in very delicate sectors such as that of Civil Defence;
- cultural fragmentation: to a degree, cultural fragmentation is the most worrying element; where social segments are oriented differently to issues of sustainability and the effective recognition of its foundations (for example the value of natural capital and the importance of its protection through the system of protected areas)[7].

The need to integrate complex interests, which exceed individual municipal boundaries, leads to the configuration of some urban areas as a single whole, strongly integrated or hierarchically organised, with a huge demand for common services and essential places for life social. This phenomenon, amplified over the years, and more generally the extension of the settlements on the territory adjacent to the existing conurbations, gives rise to places of intersection and, at the same time, to the fragmentation of different economic, social and cultural relations, with a variety and complexity of spatial and social problems that must be faced with governmental models, which go beyond administrative boundaries.

The urban structure project of the Metropolitan City of Reggio Calabria represents a complex, articulated and laborious goal, achievable through a cultural / socio-political process / process

[7] Retipolivalenti.it op. cit.

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between citizens and institutions, through the establishment of forms of physical, social and cultural activities to communities which are larger than those original ones, which share means, capacities and problems of a wider scope, and consequently need innovative forms of governance, constituted by structural frameworks that are also compliant and adapted towards the complex and complete time and reticularity that respect the peculiarities and the identities of the places[8].

3 THE STRUCTURAL CHARACTERISTICS AND THE IDENTITY CHARACTERISTICS OF THE SETTLEMENT SYSTEM

The identity of the settlement characteristics of the Aspromonte National Park system have created structured links between urban centres and defines active contexts in local projects that are expressed in the search for forms of related development. From a functional point of view these areas present types of integration and exchange, identifying the character of settlement systems, which are strongly influenced by various morphological configurations, allowing the aggregation associated the primary vocation of unitarily supporting a comprehensive metropolitan city project. The settlement of the Aspromonte Park land characters singles out macro cultural areas, according to different homologous and identity matrices and functional relationships that are present in the park territory, which have created structured links between centres and areas. The configuration of the metropolitan city territory is therefore closely linked to the presence of the Aspromonte massif. The rugged orography does not favour the establishment of inhabited centres and productive settlements; the greatest concentration of soil is recorded along the coastal strip of the territory with the poles of greater aggregation species in the municipalities of Reggio Calabria, Palmi and Gioia Tauro on the Tyrrhenian side and in the municipalities of Marina di Gioiosa Ionica, Siderno, Bovalino and Locri on the Ionic slope[9]. The most impervious centres and least accessible areas of the territory do not reach a thousand inhabitants. Analysis of the metropolitan city's territorial system reflects the twentieth-century settlements dynamics and is characterised by the presence of a fragile infrastructure web both in connection with the vast territory and in the

[8] Reference is made to the theories expressed in: Dematteis G. (1994), Nodi e reti nello sviluppo locale, in Magnaghi A. (edit by), Il territorio dell'abitare. Lo sviluppo locale come alternativa strategica, Milano, Franco Angeli.

[9] The territory of the metropolitan city of Reggio Calabria has an extension of 3,183 sq km (about 1/5 of the regional area) and includes 97 municipalities with a total population of about 28% of the population of Calabria, of these, 26 are those with a population of more than 5,000 inhabitants, while 71 are those with a population of less than 5,000 inhabitants, or 73% of the municipalities of the metropolitan area have a resident population of less than 5,000 inhabitants, a percentage that is higher than the national population of around 70%.

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relationships between the inner areas and the progressive abandonment of the inner centres for the benefit of Coastal areas, a process that tends to increasingly marginalise them. These considerations lead to the definition of a settlement system in the heart of the metropolitan city, that is, regarding the Aspromonte National Park, functional to the design of the metropolitan city, determining the structuring of a polycentric territorial armour made up of carriers, over-local systems and Local area systems that require both a functional system of services and an accessibility network to converge and contribute to the design process of the metropolitan city. The system can be read through its features:

Settlement centres are the urban centres that represent the central settlements of the Park territory, as the 'directional' poles of a network of related mountain settlements. Equipped with discreet accessibility, they permit easy penetration to the highest points. The territories of these municipalities are rich in interesting landscapes and have no significant environmental detractors. The factors of tourist attraction, in particular for Gerace and San Giorgio Morgeto, are distinguished by the rarity of the offer, enhanced by urban quality, image and atmosphere. The level of services for residence and tourism is satisfactory and excels Gambarie in winter sports, with the presence of interregional reconnaissance facilities.

Centres with strong identity and landscaping have compact and closed urban planning matrices and locations with impressive landscapes and views. Characterised by a perched and defensive position, camouflaged in the landscape and not visible from the coast, dominating the surrounding area with a wide view of the Mediterranean. They mainly belong to the Grecanic area and the Ionian hinterland, and are united by urban matrices, dwelling forms and building technologies, which together define a cultural lab that feeds and is renewed even under unfavorable conditions. The territories of the communes are rich in interesting landscapes and the factors of tourist attraction are predominantly historical-cultural and landscaping. In the case of Bova, the particularly striking atmosphere of urban locations is enriched with numerous monumental-testimonial emergencies. Accessibility has critical elements in the Grecanic area, which appears more appropriate to local needs. The level of services for residence and tourism is very modest despite the presence of tourist accommodation along the coast.

Sea-mountain integration centres are located in the 'pre-pard' spatial area. These centres are characterised by a barycentric or strategic position in the coast-mountain relationship in a sort of 'hinged areas' between the strong coastal settlement system and the weak mountain linkage system. On the Tyrrhenian side, these centres represent the crown of hilly centres with a good level of infrastructure – logistic and cultural – that mark the Plane as a fan whose summit is Gioia Tauro with the corresponding arch of the coastline stretching from Palmi to San Ferdinando. In the Strait area, the integration axis between Gambarie and the coastal

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area is strengthened by the presence of Santo Stefano d'Aspromonte, which marks a crucial stage of introduction to the strategic park infrastructure. The Ionian side can be interpreted as a kind of bijective mountain-coast relationship by linking the centres to an area characterised by the possibility of passing, in little more than half an hour, from mountain tourism to coastal-bathing. Overall development is achieved through a dense integration of the roles and the mutual support of mutual collaboration between mountain and coastal centres and the strengthening of relations between the Tyrrhenian and Ionic side.

The centres of the rural economy are not otherwise characterisable, but as agricultural centres that experience a difficult balance between the landscape quality of the sites and the extreme weakness of the territorial dynamics. They exhibit weak identity matrices and are affected by the progressive phenomena of depopulation and the consequent shrinking of valuable crops.

Bosch and Forestry Economics Centres are characterized by rather fragile development dynamics that are amplified in relation to depopulation processes. The urban matrices from the centers have characteristics typical of fragile economy agglomerations, often associated with low quality and recognizable building growth.

Settlement islands of great cultural and landscape interest have strong elements of fragility both from a physical and socio-economic point of view. The process of depopulation of some centres due to flooding and instability is associated with the abandonment of other villages such as Amendolea of Condofuri for the migration processes towards the coast and the progressive demographic decline of the entire cultural area of Grecanica. The pyre of potential can be a considerable opportunity for settlements of great potential, such as places of pilgrimage (Polsi of San Luca), of solidarity (meeting community of Don Gelmini in Zervò) and of high altitude and climatic settlement. The future of these places and the highlands around is closely linked to the ability to understand the various potentialities in a network logic.

The Rural Fractions of the Rural Economy are characterised by the close relationship between residence and the agricultural management of funds. They are affected by the progressive phenomena of depopulation and have very weak identity matrices.

The rural nucleus of the territory consists of the rural nuclei of the Grecanica and the Ionian slopes that serve as a function of mountainous territory. They are linked to the valorisation of hiking trails, as they compose, together with the forty-two forest trails, a potential network of hiking service (huts, shelters, information).

In the typology of the *Places of Memory*, ancient settlements fall under the condition of no longer recoverable ruin that can be of tourist interest as sites of memory (organised in thematic networks) that further offer areas of extraordinary landscape interest. The creation of thematic networks and integrated nature-culture-memory routes is of extreme interest to the metropolitan city project as they allow the relationship between little known natural

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resources, the network of memory centres, complex archeological works and the numerous Architectural testimonies of Calabrian history in favour of a cultural tourism which is strongly rooted in the complex character of the Aspromonte territory (Fallanca et al., 2017).

4 DESIGN THEMES AND LINES OF ACTION

Besides the natural elements (the PNA is the European park with the highest rate of anthropisation), the territory of the PNA houses the works of man: monuments, individual buildings, gardens and parks, urban areas, population centres, infrastructure and remarkable historical artefacts. Particular is these groups are their common histories, identities recognisable by local populations, senses and meanings that intertwine in decipherable landscapes through the gaze and knowledge of what has been written about them. The design themes that emerge from the interpretations of the settlement system lead to the possibility of exploiting the potential expressed by the 'new metropolitan city' to overcome their current fragmentation. The strengthening the prospects for functional integration through conscious and innovative use of resources as an important complex challenge could potentially produce important benefits for the metropolitan area in its entirety. Any analysis can be summarised into four values to guide all formation process planning by the metropolitan city: *quality, vivacity, identity and productivity*.

Quality of landscapes, beginning with those most frequently perceived by the main axes of penetration and quality of settlements and built in terms of image and atmosphere of the resort, urban furnishings, characteristics of the settlement and urban fabric.

Vivacity in seizing the opportunities and in the ability to valorise strengths and to transform fragile elements into favourable ones; Vivacity in adopting a new level of technical procedures and methods and expressions of hospitality, receptivity, cordiality and conviviality.

The propensity to innovate can certainly coexist with sentiments of tradition and the concept of identity that can be combined with the historical, cultural and environmental peculiarities of places, whilst the area of typical enogastronomic products, more than any other issue, attracts attention and Tourism.

Productivity as the capacity to enhance visibility and recognition in a precise market segment and progressively refine the product, gain quality awards, promote its diffusion and marketing. It certainly represents an advantage for the planning of the Park's residential environment, in the metropolitan context, pursuing these values that already belong to the context, yet stunted however by the many obstacles to development that permeate most of the internal territories.

Working on the progressive implementation of these values means directing all energy, every opportunity that is determined by the Park territory project towards the metropolitan context,

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outwardly towards the guiding principle of the continuous, progressive and shared improvement process.

The design *vision* should aspire to a model of structure that sets in motion, even in the outlying areas, reticularity aimed at enhancing the environmental, cultural and economic opportunities, through functions and attractors able to profoundly affect the quality of the life-styles of the city as a whole. This set-up model requires the overall redesign of the infrastructural system, with actions aimed at creating new urban centres, attractors and enhancing environmental and cultural resources, intended as quality catalysts and urban regeneration.

Recognition and systematisation of eco-social networks understood as new competitive places/contexts, which preserve historical identity on the one hand, and individual specificities on the other, highlighting new ways of involving and activating processes which are capable of preserving small communities and projecting them into the future.

The administrative level, of the metropolitan city, constitutes a fundamental step to *re-appropriating* its territory while contributing to its revitalisation. Activating development processes by investing in the enhancement of ecosystem networks means focusing on local identities, on the environment and on cultural and human heritage; that is, putting the territory and its identities in the field, leading to *new networks of relationships* that go further, they go towards local development models that need social cohesion and authenticity for the promotion of development.

The phenomena of spatial development as an effect of the innovative processes and synergies that occur on the territory *due to the good governance/management* of territorial capital, understood as a set of relationships that lead to a unity of the local system of production and management of nature and of culture, generating a dynamic process of learning and collective innovation, are at the base of the construction of the future structure model.

The setting up of tools for the qualitative growth of the territory, operates on different levels of intervention, but the specific objectives through which this model is built, tend towards a process of integrated enhancement, in infra-sectorial and inter-sectorial terms of the *culture/nature* resource identity of the metropolitan area, with the ability to influence design choices related to different areas, from transport infrastructure, to urban planning, to the planning of activities for the promotion and enhancement of locations.

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AUTHOR'S PROFILE

Concetta Fallanca, Professor of Urban Planning (ICAR 21), PAU Department, Mediterranean University of Reggio Calabria. Architect, she conducts research in the ambit of design and urban planning, territorial and environmental at the Department of Architecture and Analysis of the Mediterranean City, of which she is the director from 2005 to 2012, and then to the Department PAU. Member of the board in the Master in Planning and Design of the Mediterranean city since 2001; since 2007 scientific director of curriculum in PPCM within the doctorate „Architecture". From 2013 she is a member of the international research doctorate Urban Regeneration and Safety Assessment. Component of the internal Evaluation Committee; from 2014 to 2016 she is member of the Presidium of Quality of the University of Reggio Calabria. She is the scientific coordinator of the Research Laboratory LASTRE, Integrated Laboratory for the Strait area for the development of the territory. From 2016 she is the coordinator of the 2nd Cycle Degree Course: Architecture – Restoration (LM4).

Natalina Carrà, University researcher for the scientific-disciplinary field ICAR/21 Urban planning, at the University of Mediterranean Studies of Reggio Calabria. Qualified as second-level university professor for the Scientific Disciplinary field ICAR / 21, in the first round of 2012. PhD in Urban and Urban Planning, (XII cycle) "La Sapienza" University of Rome. Member of the Board of Professors of the Research Doctorate Urban Regeneration and Economic Development. Both in teaching and research activities, as in applications, it mainly deals with environmental planning issues and urban and territorial recovery issues.

Antonio Taccone. University researcher for the scientific sector-ICAR/21 Urban planning, PAU Department of the Mediterranean University of Reggio Calabria. Architect, he is doctor of research (PhD) in "Territorial planning" (2000). From 2013 he is Member of the board of the international research doctorate Urban Regeneration and Safety Assessment. He is the technical director of the Research Laboratory LASTRE. From 2016 he is member of the Presidium of Quality of the University of Reggio Calabria. He has obtained the Italian National Scientific Habilitation (ASN) as Associate Professor in Urban Planning (Icar/21).

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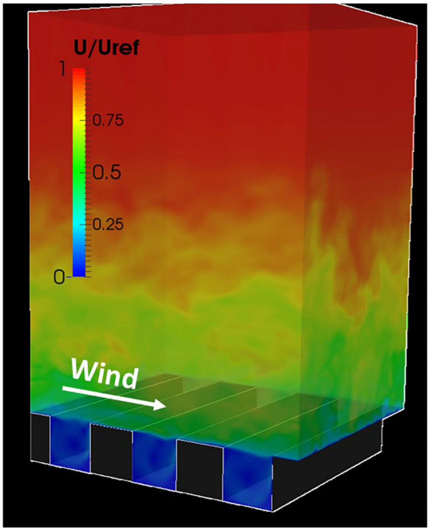

SHAPING THE URBAN ENVIRONMENT FOR BREATHABLE CITIES

***MICHELA GARAU, M. GRAZIA BADAS**
GIORGIO QUERZOLI

Department of Environmental, Civil Engineering and Architecture, University of Cagliari, Italy
e-mail: mi.garau@unica.it

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ABSTRACT
Nowadays, cities occupy 2% of the world soil, collecting 50% of global population. In an urban environment so complex and fragile, 75% of pollutant and 80% of CO2 are emitted. As a consequence, finding healthy way to live cities is pressing, especially in relation to the continuous urbanisation process. Inside the urban pattern, ventilation plays a key role in dispersion and comfort, so that many researches dealt with it by facing several specific subjects and by employing different models, scales and techniques.The influence of two specific geometrical parameters was investigated with the aim to study the wind flow and ventilation mechanism: the building aspect ratio (i.e. the building width to height ratio) and the gable roof slope variability instead of the more common flat roofs were studied in case of 2D street canyons by means both numerical (Large Eddy Simulation) and experimental (water channel) techniques. By fixing the canyon aspect ratios (AR_C=0.5,1.0,2.0),the building aspect ratio (AR_b=0.1-2.0) and the roof slope variability (0°, 10°, 20°, 30°, 45°gabled roof)where analysed, then the influence of the extreme cases was investigated by exploring the entire range of flow regimes (Oke 1988). All the outcomes demonstrate the positive influence of roofs on ventilation and air exchange mechanism related to the turbulence increment especially in the upper part of the canyon. This study represents a first step toward suggesting that more attention in urban planning and in building design could positively affect comfort and healthy air into urban canopy.

KEYWORDS
Urban Built Environment; Air Quality in Cities; Numerical Simulations; Roof Shape

* The other authors are: Simone Ferrari, Alessandro Seoni, Luca Salvadori.

1 INTRODUCTION

Air quality is a key environmental and a social issue since pollution has got significant impacts on health, especially in urban areas, which continue to grow, becoming very densely populated. Pollution is a considerable economic problem since it reduces life expectation and increases medical assistance costs. Indeed, many cities in the world still exceed the pollutant concentration limits suggested by the World Health Organization Air Quality Guidelines or, in Europe, by the Air Quality Directive. In the meantime, ensuring good air quality is a complex problem that poses multiple challenges in terms of management and mitigation of harmful pollutants. Due to the complexity and the multidisciplinarity of the problem, solutions, rules, research arguments and methods involve different subjects, ranging from the mathematic or chemical science to the legal and social matters. Among these, studies on fluid dynamics through buildings play a crucial role: ventilation promotes pollutants removal from streets to the highest levels of the urban boundary layer where air is cleaner. The pioneering works, as discussed in a review paper by Vardoulakis et al., (2003), were able to understand the main features of ventilation and transport in basic element compounding a city, such as the street canyon. However, international directives and the increasing population in cities request a more accurate assessment, to provide previsions of the present and future scenarios, that, in turn, request to model air quality both at different temporal and spatial different scales (i.e. Blocken, 2015).As a matter of fact, spatial scales involved in the Urban Boundary Layer (UBL) that is the region of the Planetary Boundary Layer (PBL) closest to the ground, can vary depending on the objectives of the study: street scale (of order 10-100 m), neighborhood scale (100-1000 m) or city scale (1-20 Km).

Taking into account all these aspects, the urban environment for the air quality research studies can be shaped considering two- or three-dimensional basic elements, such as the street canyon configuration or a series of identical parallelepiped elements regularly disposed, or with more complex geometries and increasing level of details, depending on the objectives, the simulation method and the available tools. But of course, the dynamics by employing heterogeneous instead of homogeneous or detailed instead of simplified urban canopies, differ substantially (Fernando, 2009). Complicated arrays of obstacles are usually employed with the aim of understanding the influence of density in 3D areas or the interaction between different elements such as building heights. Semi-idealized canopy are considered to understand the mechanisms at street intersections (i.e. Carpentieri & Robins, 2015), or more complex morphology interactions. Finally, very detailed urban models are sometimes employed to study specific cases in cities. Anyway, street canyons or single building arrays are usually preferred to understand the dynamics of basic topics like the influence of

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geometrical elements (Rafailidis, 1997) or the stratification (Nazarian et al., 2018) or the basic flow structures and dispersion mechanism around buildings (Stabile et al., 2015). Indeed, attention was extensively paid in literature to simple building configurations such as the street canyon unit. Focusing on the latest, the majority of literature works, both numerical and experimental, employed square buildings with the aspect ratio equal to $AR_b = 1$ (defined as the ratio of the building height, H, to its width, $W_b = 1$), the canyon aspect ratio $AR_C = 1$ (defined as the ratio of the building height, H, to canyon width, W), and the flat roof instead of different shapes like the gabled one. Particular attention was spent in varying the AR_Cin order to investigate different flow regimes from the narrow canyons ($AR_C < 1$) in the skimming flow regime, to the widest ones, in the so-called isolated building regime (Oke, 1988; Badas et al., 2017).

The present work deals with the influence of two building geometrical characteristics on the flow and dispersion. In particular, we focus on the building width $AR_b$and the roof shape, that are interesting topic not yet deeply tacked. To this aim, the 2D street canyon configuration was employed with both numerical and laboratory experiments, firstly by varying the building width or, in turns, the AR_b, secondly by varying the gable roof slope.

The main results and implication for urban planning are discussed in the follow (section 3), after the experimental techniques description.

2 METHODS

We focused on the flow in urban canyons formed by a virtually infinite array of identical buildings immersed in a neutrally stratified boundary layer. Buildings were modelled like parallelepipeds and the wind direction was established orthogonal to the canyon axis in all cases. Computational Fluid Dynamic (CFD) simulations were employed for two series of analysis. The first one was aimed at studying the effect of the variability of the building aspect ratio $AR_b = 0.1, 0.2, 0.3, 0.4, 0.5, 1.0, 1.5, 2.0$, by keeping constant the canyon width ($AR_C = 0.5, 1.0$), for a total number of sixteen different cases.

The second one aimed at investigating the roof role: the gable roof slope changed from $0°$ to $45°$ ($0°, 10°, 20°, 30°, 45°$), by fixing the canyon width ($AR_C = 1.0, 2.0$). Laboratory experiments were carried out by means the water channel facility, where 2D street canyon series were performed with variable aspect ratio ranging from 1 to 6, with either flat or gable roof ($45°$ sloped).

The canonical case with $1H$ canyon spacing was experimented in order to validate the CFD simulations and results were reported in a previous work (Garau et al., 2019).

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2.1 NUMERICAL SIMULATIONS

Following the classical LES scheme, we directly solved the filtered governing equation and modelled the sub-grid scale (SGS) motions for which we have employed the Smagorinsky model (Smagorinsky, 1963) with OpenFOAM 2.3. The computational domain includes fourparallelepipedal buildings perpendicular to the wind direction and the three canyons between them, resulting in a $3(W_b + W)$ length in the stream-wise direction, while in the vertical and span-wise directions is $9H$ (where H is the height of the building). Employing cyclic boundary conditions both in stream-wise and span-wise faces of the domain allows us to reproduce an indefinite series of canyons of indefinite longitudinal length, i.e. an idealised two-dimensional canopy.The symmetry condition was employed on the top and the Spalding law (Spalding, 1962) was applied both on the ground and in the building walls. A structured mesh with grid stretching both in stream-wise and vertical direction was employed and an expansion ratio lower than 1.2 was used for both the horizontal and vertical axes (x and z, respectively). The resolution was defined as$\Delta x = \Delta z = 0.016\ H$ in the proximity of the building walls and the ground, whist in the canyon central cell size is doubled. The configuration respects the best practice guidelines (Franke et al., 2011; Blocken, 2015; Tominaga et al., 2008). All LES runs were initialized by means of a RANS solution, and data managed for computing statistics were collected after a sufficient interval of time for the complete development of turbulence. The mean stream-wise velocity was imposed to obtain a Reynolds number at the building height $Re_H = U_H H/\nu\ = 7000$, i.e. higher than the minimum value (3400) suggested by Hoydysh et al., (1974)for the flow to be independent of the Reynolds number. The dimensional time-step increment was set in order to assure that the Courant number was always smaller than 0.6 at all grid nodes. The results were averaged both in time, over a minimum of 1350 time steps, and spatially in the span-wise direction in order to enhance the statistical robustness of the dataset. As regards numerical methods, the second order-accurate schemes were used for the time and space derivatives. More details can be found in (Garau et al., 2019).

2.2 EXPERIMENTAL SIMULATIONS

The closed-loop water channel of the Hydraulic Laboratory of the University of Cagliari was employed to reproduce a neutral boundary layer above an ideal infinite array of 2D street canyons built by employing twenty identical prismatic obstacles. The same characteristics of about the facility and the model are here reported, however more details are feasible in Garau et al., (2018).The facility is $8.0\ m$ long with the cross section equal to$0.40\ m$ wide and 0.50 m high. The array of obstacles were placed $6.0\ m$ downstream from the head of the channel. To

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allow a complete evolution of the turbulence and to achieve a logarithmic velocity profile, a grid with a honeycomb structure was placed at the head of the channel and a $3\ m$ long series of panels with loose gravel was set on the channel bottom. A sharp-crested weir at the end of the channel regulated the water depth to $0.4\ m$. The vertical stream-wise mid-plane of the channel was illuminated by a diode laser, 2W in power, emitting green light ($2mm$ thick, $532\ nm$ in wavelength), through an optical system consisting of a cylindrical lens and a mirror. A high-speed camera (2240×1760 pixels resolution) recorded images at a $310\ Hz$ frequency. The imageswere recorded in 40 sessions (1200 images in a period of $3.9s$ each, for a total of 48000 images) separate by a proper time interval that assure statistical independence, in order to increase the statistical robustness of the velocity dataset. Velocity field was evaluated by tracking neutrally buoyant particles (pine pollen) homogeneously dispersed in the flow through an image analysis technique called Feature Tracking Velocimetry. This technique is better described in (Besalduch et al., 2013, 2014). The incoming velocity profile follows the typical logarithmic law of the turbulent boundary layer up to about $z = 0.14\ m$ (corresponding to $7H$), with a maximum velocity of $0.36\ m/s$, and it was found in good agreement with the data of Farell, Iyengar, (1999). At the building height (H), a Reynolds number $Re_H = U_H H/\nu = 5000$ was obtained.

3 RESULTS AND DISCUSSION

The vertical velocity component is firstly discussed as it have a key role in driving the air exchange between the canyon and the overlaying air; the vertical velocity fields are reported in Fig.1, with variable AR_C(Fig. 1 a, b, c) and roof slope(Fig. 1 d-h). The streamlines are superimposed on the velocity component $(\overline{w}/U_{ref})$ colour map showing the flow structure variability. Qualitative results obtained for the flat roof cases and the canyon aspect ratio variability show a completely different behaviour inside the canyon in accordance with other literature works(i.e. Soulhac et al., 2008): instead of a single main vortex (Fig. 1b), two counter-rotating vortexes vertically disposed are shown in the narrower canyon (Fig. 1a), while in the largest case (Fig. 1c) the two counter-rotating vortexes are horizontally disposed. Differences in magnitude are relevant especially at the pedestrian level: the narrow canyon gives lower velocity values and this could represent a negative aspect for air quality, depending on the pollutant source location. The entire region included into the lower vortex (for$AR_C = 0.5$) is characterised by very small values. Furthermore, areas with large vertical velocities are smaller respect to the case with $AR_C = 1$ and lower values are observed at the roof level too. In case of wider canyon ($AR_C = 2$) ventilation is better and highest values are visible in larger part of the canyon both at pedestrian and at roof levels.

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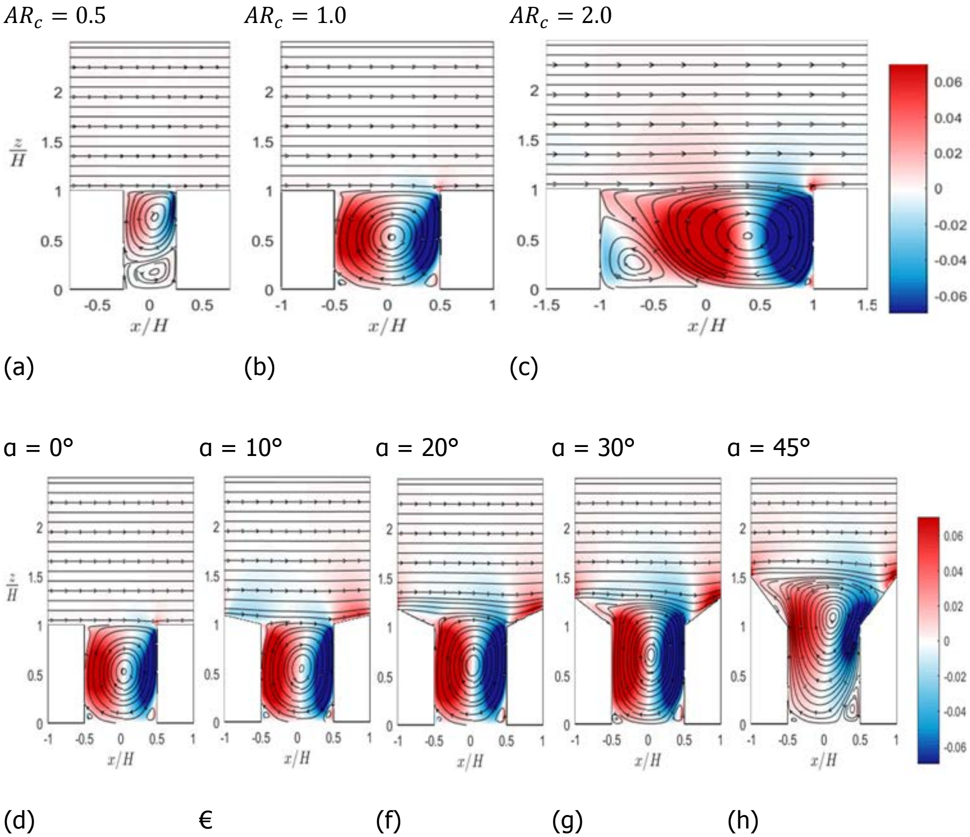

Fig. 1 Streamlines of the mean velocity field and mean vertical velocity component, made non dimensional by the free-stream velocity ($\overline{w}/U_{ref}$). Flat roof with $AR_C = 0.5$(a); $AR_C = 1$(b); $AR_C = 2$(c). Canyon aspect ratios, $AR_C = 1$, $\alpha = 0°$ (d); $\alpha = 10°$ (e); $\alpha = 20°$ (f); $\alpha = 30°$ (g); $\alpha = 45°$ (h). Colour scale is common for all the panels

In case of unitary aspect ratio (skimming flow regime), a unique main vortex with two small recirculation vortexes is everywhere present. Main vortex centre move up in from $z/H \approx 0.55$ in the flat roof case to $z/H \approx 1.05$in the $45°$ slope roof configuration, where the difference do not appear justifiable with the increased building height. Indeed, looking at the entire series, the increasing height of the vortex centre appears moving up regularly with the increasing height of the building since the $30°$ sloped roof: ratio between the centre and the edifice heights was estimated around $z_C/h_{tot} \approx 0.5$ from flat roof to $30°$ sloped and $z_C/h_{tot} \approx 0.75$ for the $45°$ sloped case. Regarding the interface flow, between the canyon and the overlaying air, the streamlines appear more and more perturbed with the increasing slope of pitches. The higher perturbation is sit in the downwind building, where the reattachment point gradually move up from the windward building corner (flat roofs), to the windward pitch above

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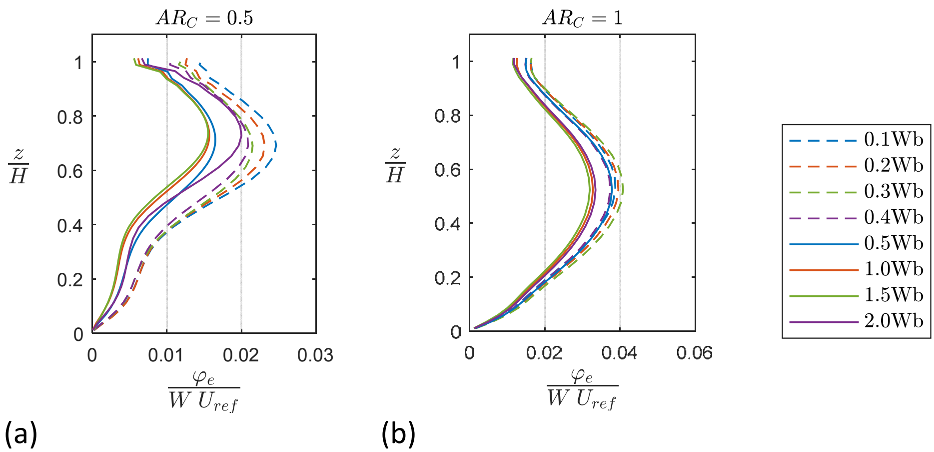
the eaves. Looking at the vertical velocity fields, another big difference is visible between the $45°$ sloped roof and all the other cases: the lowest quantities are registered at pedestrian levels, and the highest velocity areas are smaller, positioned around both the downwind and the upwind eaves corner. As already mentioned in the previous works (Garau et al., 2018, 2019), the bulk air exchange between the canyon and the external boundary layer occurs at the interfacial surface at the roof level and, under the ideal case of a well-mixed box, where the pollutant concentration is assumed constant within the canyon, the outflow rate on the top would be sufficient to describe the phenomenon. Anyway, considering the real world, the pollutant concentration may significantly vary into the canyon with height thus it is important to estimate this behaviour. With this aim, the outflow rate per unit span-wise length across a generic horizontal section of the canyon at height z, from the bottom to the top, was estimated as in Eq. 1:

$$\varphi_e(z) = \frac{1}{2}\int_W \lceil \overline{w(t)} \rceil dx \qquad (1)$$



(a) (b)

Fig. 2 Non –dimensional vertical profiles of outflow rates (φ_e) calculated for $AR_C = 0.5$(left panel) and $AR_C = 1.0$(right panel), for different heights (z/H) inside the canyon. Values were made non dimensional by the free stream velocity at $z/H = 9$ and the canyon width (W). Different colours and styles, indicate different building aspect ratios

Vertical profiles $\varphi_e(z)$ were computed by integrating the instantaneous velocity fields over 32 horizontal lines connecting the canyon sidewalls. Results are reported in Fig. 2a, b respectively for narrow and unitary canyons and considering the AR_Bvariability. The qualitative comparisons between the two series of data shown completely different trends according to the different topology of the flow, and quantities appear very low in the narrow canyons, where pecks are quite halved respect to the larger canyon widths.Indeed, while on the right

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panel curves present only one maximum around $z/H = 0.5$, on the left panel curves are not monotonic and presented one maximum at around$z/H = 0.7$and a relative minimum around $z/H = 0.35$are visible. For $z/H < 0.5$ the lower vortex generates only a weak vertical air exchange, and the turbulence contribution is predominant. Anyway, in that region, the overall outflow rate is meaningfully smaller compared to the region corresponding to the upper vortex, confirming a poor air ventilation in narrow canyons, especially at the pedestrian level. Despite differences, these two scenarios are highly influenced by the building aspect ratio. Discrepancies are more appreciable at the maximum point and at the roof level and values increase with a decreasing AR_b for the entire canyon depth and even if they are very small, are not negligible.In order to understand the influence of roofs on the exchange mechanism, both the medium and total flux exchange indexes were evaluated, where the mean quantities are calculated with Eq. 2:

$$\varphi_{em}(z) = \frac{1}{2}\int_{\lambda(z)} |\overline{w}| dx \tag{2}$$

Results are reported in Fig. 3 a,brespectively for the unitary canyon aspect ratio and the doubled one, and $z$levels are in all cases made non-dimensional respect to the eaves level H. Results confirmed the influenceof roofs on ventilation, not only at the roof level, but also into the canyon. As matter of fact, looking at solid lines in Fig. 3a, a little slope in roofs (orange line) seems able to increase ventilation around the 23% considering the maximum point at $z/H \approx 0.55$. By increasing the slope, differences grow up in the upper part of the canyon since the 30° sloped roof, for which the maximum is reached at $z/H \approx 0.7$ and it is 40% higher than the flat roof case. Down to the maximum, differences tends to be minimised and at $z/H \approx 0.35$, curves from $10°$ to $30°$ overlap each other in a singular line, with a smaller and smaller gap respect to flat roofs. Above the maximum point, where turbulence level became significant (see the differences between the dashed and the solid lines), differences grow up faster and at roof top the higher discrepancy is registered between flat roof and $30°$ tilt angle, approximately equal to 75%. Similar observation can be done by focusing on the eaves level, for which the viola line appear around 43% higher than the blue one. The green lines representing the 45° roof case, completely differs from the others, assuming a quite linear trend, with increasing values from the ground to the half part of pitches for both the two quantities (medium and total exchange fluxes respectively represented with dashed and solid line). This curves intersect the flat roof lines (blue) only around $z/H \approx 0.75$ and above eaves became similar to the $30°$ case (viola).This behaviour confirmed the previous analysis and support the idea that the $45°$ slope represent a critical case for which a different flow regime have to be identified. In addition to this this is the only configuration in which differences between medium and total quantities substantially differs for the entire canyon depth. Looking

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at the larger canyon configurations (Fig. 3b), trends became more similar and regular, reducing discrepancies for the entire profile height. The $45°$ case tend to the others even if registered the minimum flux index values since $z/H \approx 0.5$. Turbulence levels, which can be identify by the differences occurring between dashed and solid lines, do not substantially varied up to the eaves level with the increasing roof slopes.

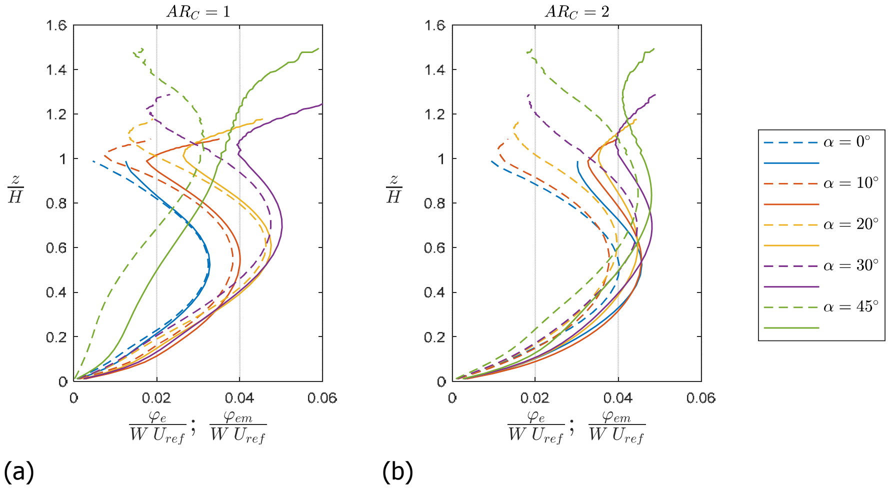

Fig. 3 Non-dimensional vertical profiles of exchange fluxes, φ_e(solid lines) and φ_{em}(dashed lines) calculated for flat roof with variable slope in case of $AR_C = 1, 2$ (a,b), at different height (z/H) inside the canyon. Values were made non dimensional by the free-stream velocity (U_{ref}) and the canyon width (W). Different colours indicate different canyon aspect ratios.

4 CONCLUSIONS

In this work the flow above arrays of two-dimensional, prismatic obstacles was analysed with the aim of highlighting the effect of gable roof as building covering and the building aspect ratio variability.As the importance of the two geometric characteristics in ventilation process was demonstrated in this work, this study represents a first step suggesting that more attention in urban planning and in building design, could positively affect comfort and healthy air into urban canopy.For some specific simple configurations, such as the street canyon for various regime, analysis on model with high level of simplification, can be extensively applied in order to create tables of roof shapes air ventilation efficiency, with respect to the building geometric parameters and the wind direction. This tables could be employed by designers as guidelines not only for new construction, but also for refurbishments or building extensions. If urban shapes are more complex and interactions through buildings very influent, tabulated values are not eligible and specific experiments or numerical evaluations will be needed.Anyway, with particular regards to old cities, by classifying and studying the traditional

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shapes behaviour, some generalisation should be individuated and put forward to urban planners and designers. The development of guidelines for 'wide-ranging construction' will allow to give an additional value to projects. In addition to this, tabulated values could be employed for a multi-criteria analyses to estimate the breathability performance certificate of a building, such as the already existing energy performance certificate. Paying attention to these aspects would be relevant not only for existing cities (new construction, rehabilitation projects of derelict areas, vertical extension of existing housing), but also in the developing countries, where the urbanisation process has recently begun and very fast increase without a proper control on ventilation and the future air quality problems.

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AUTHOR'S PROFILE

Michela Garau received her PhD in Civil Engineering and Architecture from the University of Cagliari in 2019. Her main research interests include atmospheric boundary layer, numerical modelling of urban canopies and dispersion models.

Maria Grazia Badas has been an Aggregate Professor in Hydraulics II at the University of Cagliari (Italy), since 2006. She received her PhD in Territorial Engineering from the University of Cagliari in 2005. Her research topics include turbulence and mixing in civil, environmental and biological flows.

Giorgio Querzoli has been a Full Professor in Fluid Mechanics at the University of Cagliari, Italy since 2006. He received his PhD in Environmental Monitoring at the University of Florence, Italy in 1996. He

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teaches 'Hydraulics' and 'Environmental Hydraulics'. His research topics are turbulence and dispersion in biologic and environmental flows, such as atmospheric boundary layer and ocean outfalls.

Simone Ferrari has been an Aggregate Professor in Fluid Mechanics at the University of Cagliari (Italy), since 2011. He received his PhD in Territorial Engineering from the University of Cagliari, in collaboration with the Imperial College London (UK) in 2007. His research interests include turbulence and mixing in civil, environmental, industrial and biological flows.

Alessandro Seoni has been a Graduate Technician in Hydraulics and Hydraulic Structures and Infrastructures since 2007. He has been teaching assistant at the University of Cagliari in Hydrology and Hydraulic Structures since 2008, and in Hydraulics since 2013. He received his PhD in Territorial Engineering in 2014 from the University of Cagliari, Italy. His research interests include turbulence, hydrology and flow measurements.

Luca Salvadori is a PhD student in Civil Engineering and Architecture. His main research topics are about pollutant dispersion in environmental flows, especially related to problem solutions like urban sites characterization methods.

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DEFENSE, ADAPTATION AND RELOCATION

THREE STRATEGIES FOR URBAN PLANNING OF COASTAL AREAS AT RISK OF FLOODING

CARMELA MARIANO, MARSIA MARINO

Department of Planning, Design
and Technology of Architecture
University of Rome - Sapienza, Italy
e-mail: carmela.mariano@uniroma1.it
marsia.marino@uniroma1.it

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ABSTRACT

The term Anthropocene was coined in the 80s of last century to indicate the current geological era. This stands out from those that preceded it for the decisive impact of man on the climate and the environment. In order to understand how it is possible to direct a sustainable development of the planet, it is worth considering that for at least twenty years there has been a considerable increase in the world population and that this tends to concentrate, with increasing percentages, in urban areas. It is therefore understandable that urban areas will be the part of the planet where the major social costs of global warming will be paid (Musco, Zanchini, 2014). The purpose of this contribution is to frame the strategies adopted in contexts degraded by the action of climate change, which respond to the guidelines suggested by the European Union regarding territorial adaptation. Starting from studies on the subject so far, at least three differential approaches have been identified, and these are applied to as many specific manifestations of the phenomenon: defense, adaptation and relocation. The authors' intention is to underline the relevance of the issue and to stimulate debate on the adaptation of cities to disasters, proposing, even in a very concise manner, a systematization that considers as a priority, a transdisciplinary approach.

KEYWORDS
Defense; Adaptation; Relocation; Urban resilience

1 WELCOME TO THE ANTHROPOCENE

The term Anthropocene was coined in the 80's of the last centuries by the American biologist Eugene Filmore Stoermer, to indicate the current geological era, which is different from those that preceded it for the decisive impact of human beings on the climate and the environment. The Dutch scientist Paul Crutzen, Nobel Prize in Chemistry in 1995, says that, geologically speaking, in a very short time our species has radically altered all the existing ecosystems, up to generate comparable, if not even superiors, concentrations of greenhouse gases to those that, in the past, put an end to the glaciations (Crutzen, 2005).

The fifth IPCC report, *Intergovernmental Panel on Climate Change*,[1] dated back to 2013, represents the current state of knowledge on climate change and its potential environmental and socio-economic impacts, starting from the assumption that humans beings responsibility for such changes is now undeniable.

In order to understand how it is possible to direct a sustainable development of the planet, it is worth considering that, for at least twenty years, there has been a considerable increase in the world population, as emerges from the *World Population Prospects 2017*,[2] which shows how the numerical data are growing compared to what they should be according to the 2015 predictions. Together with the above-mentioned forecasts regarding to the demographic increase, the same authority draws up the *World Urbanization Prospects*,[3] where estimates and projections of urban and rural populations of all the countries in the world and their main urban agglomerations are made. The latest version, updated to 2018, highlights that more than 50% of the world's population is currently living in urban areas, a percentage that is destinated to increase by 2050; also, again by this date, the population increase could add about 2.5 billion people to urban populations.[4]

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[1] Scientific group, formed in 1988, from two organisms of United Nations, the World Meteorological Organization (WMO) and the United Nation Environment Programme (UNEP), with the specific scope of studying world global warmingand climate change in general.

[2] Estimates and official projections about United Nations population, elaborated by the "division for the population" of the "Department for Economic and Social Affairs of the United Nations Secretariat". The results, presented in Excel files, show the key demographic indicators for each development band, income group, region, sub-region and country or area for the period between 1950 and 2100.

[3] Estimates and official projections about United Nations population, elaborated by the "division for the population" of the "Department for Economic and Social Affairs of the United Nations Secretariat", from 1988. The results, presented in Excel files, show revisions and projections of urban and rural populations of all the countries of the world and their main urban agglomerations.

[4] Data collected in the Excel file WUP 2018-F02-Proportion Urban.xls, in the "Urban and Rural Population" section of the World Urbanization Prospects 2018, downloadable from the dedicated section of the United Nations website.

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In light of these data, it is possible to understand how urban areas will be the part of the planet where the major social costs of global warming will be paid (Musco & Zanchini, 2014). It is therefore necessary to assume the question of adaptation to climate change from a transdisciplinary point of view. Starting from the analysis of statistical data, it is needed to pass through the deepening of the Community policies concerning this matter, also taking into account the aspect linked to the territorial planning and urban planning; this is done in order to guarantee a resilient development of the territories in the current new geological era (Mariano & Marino, 2018a).

2 TERRITORIAL ADAPTATION STRATEGIES: THE EU APPROACH

The purpose of this contribution is to frame the strategies adopted in contexts compromised by the action of climate change, which respond to the guidelines suggested by the European Union regarding territorial adaptation.

The *European Environment Agency* (EEA)[5] in the report "Climate change, impacts and vulnerability in Europe 2016", shows the need for European countries to define strategies and plans for territorial adaptation at national, regional and local levels for prevention and management of the risk linked to the climate crisis.

Specifically, it is here intended to limit the field of analysis to those coastal areas, in an urban environment, which are subject to flood risk due to the combined effect of rising sea levels and disastrous meteorological phenomena (Mariano & Marino 2018 b).

The EU strategy for adaptation to climate change (The EU Strategy on adaptation to climate change, 2013), later declined at national level (in Italy in 2015 with the National Strategy for adaptation to climate change), shows, among other numerous documents, an in-depth analysis on the topic called "Climate change adaptation, marine and coastal issues, Commission Staff Working Document, (SWD 133, 2013), in which the phenomena linked to the events of hydrogeological instability and coastal erosion are specifically addressed: reported data and reference regulations are provided, together with initial approaches of integrated management of coastal areas, to promote resilient urban development (COM 216, 2013).

Furthermore, the European legislation, with the "Protocol on the integrated management of the Mediterranean coastal zones" (ICZM), has placed the burden on the Member States to draft a National Strategy for the integrated management of coastal areas, as a tool for governance, with binding effects for coastal-marine areas.

[5] The European Environmental Agency (EEA) is an agency of the European Union that has the role of providing reliable and independent information on the environment.

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In this regard, the Protocol, in art. 23 "Coastal Erosion", establishes the parties' commitment "to take the necessary measures to preserve or restore the natural ability of the coast to adapt to changes, including those changes caused by rising sea levels", in order to prevent and mitigate the impact of coastal erosion on the territory.

3 SYSTEMATIZATION OF THE PHENOMENON

Within this thematic framework, it is here intended to propose in an extremely concise manner, while remaining in the sphere of strategic planning, a schematization of three different strategies corresponding to as many identified cases.

Starting from the state of the art, it was found that, from the point of view of urban and territorial changes, the floods in question have had, and continue to have, different repercussions on the affected territories, according to the orographic and geomorphological characteristics of the territory (Abbate et al., 2009).

If it is true that these manifestations require appropriate differentiations that take account of their singularities, it is possible, however, to find some common characteristics that would allow a systematization of the cases, consideredfundamental for the progress of knowledge on the subject.

At least three differentiated approaches, applied to as many specific manifestations of the phenomenon, have been identified. These will be presented in the following paragraphs in relation to some analyzed case studies. It should be noted that this systematization derives from the awareness that such a complex subject needs a transdisciplinary and integrated approach.

3.1 DEFENSE: THE ENGINEERING-ENVIRONMENTAL APPROACH

In some cases, such as those that will be exposed in this paragraph, the public administrations have deemed it appropriate to deploy impressive defensive strategies.

The MOSE (Electromagnetic Experimental Module), is undoubtedly the best-known case in Italy and it consists in the construction of mobile disappearing sluice gates, placed at the so-called "port mouths"[6] (the gates that connect the lagoon with the open sea, through which the ebb and flow of the tide is put into effect).

The aim of the project is to protect the urban lagoon area from the phenomenon of high water, which has become increasingly frequent due to the combined effect of subsidence (lowering of the ground level) and eustatism (rising sea level), due to natural and

[6] In italian: “bocche di porto”.

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anthropogenic phenomena and to disastrous events (Spampani, 1996). The MOSE has been designed to protect from tides of up to three meters[7], and it is hoped that it will be able to ensure the protection of the lagoon even if sea growth of up to 60 cm should occur (recent IPCC estimates, provide for a rise of the sea in the next hundred years between 18 and 59 cm).

It should be noted that this impressive project is not an isolated work, but falls within the General Plan of Interventions for the protection of Venice and the lagoon (Piano Generale di Interventi per la salvaguardia di Venezia e dellalaguna)[8], within the framework of the Special Law for Venice (Legge Speciale per Venezia)[9], defined as a consequence to the flood of November 4, 1966 (Consorzio Venezia Nuova, 2015).

This intervention is inspired by a larger scale structural project carried out in the Netherlands at the end of the 1990s.

The Delta Plan (Deltawerken) had the ambition to increase the security of the topographically most depressed areas of the Rhine, the Meuse and the Schelde deltas, defending them from flooding. It is important to remember that more than a third of the country is below sea level and, therefore, the target was particularly complex to reach: first, the coastal dunes have been raised of over five meters, and the islands of Zeeland have been connected by dams. The most complex of the actions of the Plan is the Oosterscheldekering, a 9-kilometer barrier that can be closed to protect the bay, but which usually remains open to maintain its salinity (Bobbink, Meyer & Nijhuis, 2010). Although the Oosterscheldekering is considered by some to be the "eighth wonder of the world" and the America Society of Civil Engineers has named it among the "seven wonders of the modern world", there is still a heated debate around the Delta Plan, which is due to the awareness that the altimetry of the earth level is lowering, while the level of the sea is rising.

The dams will certainly have to be reinforced and raised, intensifying the process of subsidence of the ground. For these reasons, there are those who believe that more resilient measures should be adopted, limiting defense works in favor of interventions of territorial adaptation (Bell, 2017).

[7] More information on the link: https://www.mosevenezia.eu/cronologia/

[8] More information on the link: https://www.mosevenezia.eu/piano-general-interventi/

[9] The Special Legislation for Venice, is constituted by the law n. 171/73, which declares the safeguard of Venice and its lagoon, as a problem of pre-eminent national interest, to which law n. 798/84 and the n. 139/92 are following: a regulatory system that defines the general objectives of the interventions, the most appropriate procedures to implement them and the responsibilities of the various implementing entities.

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3.2 ADAPTATION: ECOLOGICAL REGENERATION STRATEGIES

In this paragraph, it is intended to underline the second of the identified approaches, which more specifically relates to the field of urban transformations.

The theme, in this case, is that of adapting the urban form to the environmental context of reference, through actions of reconfiguration of the morphological components that consider, as priority elements, the flexibility and diversity (Boller, 2017), characterized as real opportunities to implement an ecological transformation of degraded territories, due to the aforementioned effects of climate change.

Although this contribution is part of the EU Union framework, it appears necessary to cite the sensational event that affected the city of New York in October 2012, when Hurricane Sally hit hard the coast of Manhattan, causing an economic damage of about 19 billion dollars (The city of New York - Department of city planning, 2013).

Following this event, again in 2013, the "Rebuilt by Design" competition was announced by the public administration to make the city resilient to the effects of climate change: the project "The Big U" by the Danish firm BIG - Bjarke Ingels Group, won the competition imagining a barrier between the city and the water, able to act as protection and not as a limit, a "bridge" between the natural element and the anthropic product.

This design proposal is configured as an urban project that arises from the need for an ecological transformation of the area and it provides for the regeneration of the entire south coast of Manhattan with resilient interventions; in some cases, these interventions allow the entry of water into the project area (Mariano & Marino, 2018 a).

The work will start in the spring of 2019, becoming one of the most interesting urban projects aimed at adapting an urban area to the effects of climate change, which can be counted as one of the few structural measures in this field of study.[10]

It is also important to remember how the administration of the city of New York decided to include the problems related to the coastal floods, caused by disastrous phenomena, in the agenda of its urban resilience strategy: One New York The Plan for in Strong and Just City (2015), which is still in force (The city of New York - Department of city planning, 2015).

3.3 RELOCATION: THE MIGRANTS OF THE CLIMATE CRISIS

The third identified approach, is certainly the most experimental, which still does not find space between the strategic policies outlined by the European Union.

[10] More information on the link: http://www.rebuildbydesign.org/our-work/all-proposals/winning-projects/big-u

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The term "environmental refugee" was coined by Lester Brown, founder of the *Worldwatch Institute*,[11] in the 1970s.

According to the proposed definition, the category of "environmental refugees" includes individuals forced to leave their traditional habitat, temporarily or permanently, due to a serious environmental upheaval that has endangered their existence and/or has severely affected on the quality of life (El-Hinnawi, 1985).

However, there is no agreement yet on the term to use for this case. The United Nations, for example, criticize the definition of "refugee" since the 1951 Geneva Convention grants refugee status only to those who are persecuted by race, religion, citizenship, for belonging to a social group or for their political opinions.

For what it concerns Italy's position on the matter, there was some opening by the National Commission for the right to asylum with the recognition of some cases: in case of floods with loss of the house and of all goods as a form of vulnerability that requires protection (Maccarone , 2017), but even in this case, there are no guidelines, and above all, no legislation in this field, capable of providing an adequate management address.

In this regard, the study conducted by Professor Brent D. Rayan, from the MIT of Boston, appears to be very relevant, which questions the situation of the city of Boston following the floods expected in 2100, caused by the rise in sea level: "Several conclusions were drawn based on the initial impact study. Given six inches of sea level rise by 2100, much of coastal metropolitan Boston will experience population displacement. Fifty percent of the population of towns such as Hull and Salisbury stand to be inundated under current scenarios. Boston stands to see almost 120,000 people displaced, with Cambridge enduring displacement of nearly 40,000, or 37% of its population. While these displacement statistics are in some ways misleading, given the overall timeframe of impact and the land use and policy changes likely to respond to different scenarios, they provide a rough outline of the potential for risk and damage at a significant scale. In addition to widespread population displacement, the initial study revealed significant losses in critical infrastructure and businesses. Interstate 93 and Route 1, both major regional arteries, stand to suffer significant damage due to their proximity to the imperiled coast. The city's subway network, moreover, a hub-and-spoke system centered on downtown Boston, will be among the hardest hit elements of the transportation network, a significant challenge in a coastal region with the fourth-highest subway ridership in the nation" (D. Ryan, Vega-Barachowitz & Perkins-High, 2015).

[11] The Worldwatch Institute was born on 1974 and is considered, since decades, the most influential observatory of the environmental trend on our planet.

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Furthermore, the aforementioned study proposes three relocation strategies, depending on specific cases: within the same city, in neighboring cities, in other urban centers.
This position opens up still in-depth research scenarios that this contribution aims to stimulate.

4 CONCLUSIONS

The authors' intent was to highlight the relevance of the issue and to stimulate debate on the measures to adapt cities to disasters, highlighting, in an extremely concise manner, three strategies of intervention. This was done starting from the analysis of some case studies, through a systematization that considers as a priority a transdisciplinary approach. The authors' intent was to highlight the relevance of the issue and to stimulate debate on the measures to adapt cities to disasters, highlighting, in an extremely concise manner, three strategies of intervention. This was done starting from the analysis of some case studies, through a systematization that considers as a priority a transdisciplinary approach.

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AUTHOR'S PROFILE

Carmela Mariano is an Associate Professor of Urban Planning, Department of "Pianificazione, Design e Tecnologia dell'Architetura" at Sapienza University of Rome.PhD in "Riqualificazione e Recupero Insediativo", President of the CdLm in "Architettura – Rigenerazione Urbana", Department of "Pianificazione, Design e Tecnologia dell'Architetura" at Sapienza University of Rome, Coordinator of the Commission "Progetto didattico PDTA"; member of the Academic Board of the PhD Program "Pianificazione, Design, Tecnologia", member of the School of Specialization in "Beni Naturali e Territoriali" of the Faculty of Architecture, member of the Scientific Teaching Council of the II level

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Master "Capitale Naturale e Aree Protette. Pianificazione, Progettazione e Gestione" of the PDTA Department.

Marsia Marino is an Architect and Ph.D. student in "Pianificazione, Design e Tecnologia dell'Architetura" at Sapienza University of Rome.She graduated with honors in 2016, after a period of research at Aalborg University (Denmark) where she carried out part of the studies related to hermaster's thesis, which was an urban project in a central area of Aalborg (DK) involved from flooding caused by the progressive rising in sea level. After the graduation she get a Master's Degree in Landscape Design (CURSA, A.S.B., UNISCAPE) and she is currently a PhD student in "Pianificazione, Design e Tecnologia dell'Architettura" at La Sapienza - University of Rome, where she carriyng out a research on the territorial and urban planning of coastal areas subjected to flooding as a result of climate change. She is author of some publications on the subject.

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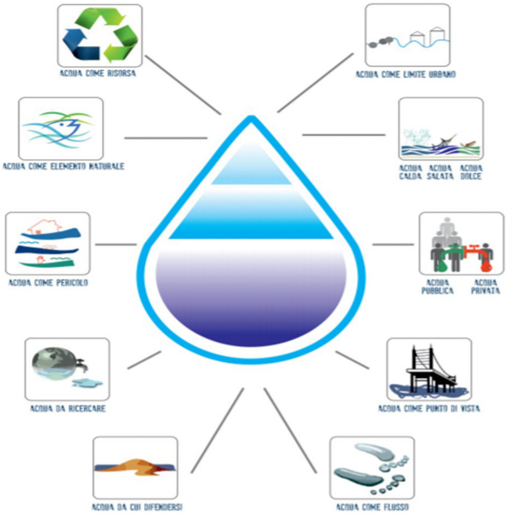

THERMAL URBAN NATURAL ENVIRONMENT DEVELOPMENT

FRANCESCA MORACI[a], CELESTINA FAZIA[a]
MAURIZIO FRANCESCO ERRIGO[b]

[a] Department of DARTE
University of Reggio Calabria, Italy
e-mail: fmoraci@unirc.it, celestina.fazia@unirc.it
URL: www.unirc.it

[b] Faculty of Engineering and Architecture
University of Enna Kore, Italy
e-mail: maurizio.errigo@unikore.it
URL: www.unikore.it

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ABSTRACT

Thermal wells are a historical, cultural identity space; but often a fragmented and marginal sector of the city; it has characterized by an unplanned development. Sometimes there is a lack of regional and municipal management of this resource; wellness tourism is not developed or is weakly linked to tourist flows involving provincial or regional area in which this resource is present. The management often suffers from a lack of professionalism and planning but also a lack of knowledge and attention. Four cities will be studied as best practices and front runner in this area, the city of Viterbo in Italy, Turnhout in Belgium, Heerlen in The Netherlands and the town of Caldes de Montbui in Spain. In the whole process will be engaged all partners and followers cities to take advantage from the relationship and from involvement in the experimentation of nature based innovations procedure and technologies for cities and environment. Viterbo is front runner for the enhancement of the thermal resource from an health and economic point of view; Caldes de Montbui as regards the use of waste water of the spa process for agricultural purposes. Turnhout and Heerleen for an energy transition with the use of geothermal energy as a lever towards a carbon neutral society. The front runner cities are conceived as "living laboratories" and are coaching cities; the followers city will carry out a local implementation of achievements developed in the front runner cities and will enhance the development of sustainable urban planning.

KEYWORDS
Sustainable design; Integrated water management;Thermal springs

1 INTRODUCTION

The project is based on the use of the environmental resource of thermal waters to create a redevelopment of the whole urban system, favoring the creation of a project that is able to locate the hot springs and the ability of pumping of each of them and thus creating a project of territorial development that, based on the aims already synthesized and on a compatible and sustainable use of environmental, historical and cultural resources, can promote the use of thermal springs of Viterbo, Turnhout, Heerlen and Caldes de Montbui, developing attention to the waste water spa treatment that will be used for the creation of urban gardens and for the upgrading of existing urban gardens, with promotion of biological agriculture, and for an energy transition with the use of geothermal energy as a lever towards a carbon neutral society. The main goal of this project is to pursue leadership in "innovating with nature" through locally implementable actions (in the four front runner cities of Viterbo, Turnhout, Heerlen and Caldes de Montbui) aimed at developing natural urbanization, promoting the reuse and enhancement of elements that are part of their territorial capital. Overall goal is to create healthier and greener living environments in some European cities through the widest possible participation of civil society, implementing of nature-based solutions focused on improving the quality of life in the study contexts. The methodology and organization of the proposed work plan allows to maximize the effectiveness of environmental improvement projects and also the faster replication of the processes and operations, even in contexts in different regions and states. The presence and distinction between front runners and followers is dictated by the desire to increase the effectiveness of actions and to pursue the replicability of the results in different contexts. The development of nature-based activities is promoted in relation to two main environmental systems, two ecological trails, as stated in the call: blue infrastructure and green infrastructure. The blue infrastructure corresponds to the network of the water, water and groundwater surface; springs and thermal waters are at the center of an enhancement process and of urban and regional regeneration also able of acting on occupational improvement, also economic because less not renewable energy will be imported and replaced by locally bought renewable energy. Green infrastructures are the environmental routes that connect together the area's resources; are ecological paths that develop urban links "creating a system of environmental resources"; they are high natural spaces included in the thermal basin and are spaces that link the different spatial areas using bioengineering and so innovative mobility solutions, able to create added value in the project. Moreover the geothermal energy can be an enabler in abating climate change, supporting a transition towards carbon neutral cities. Projects and actions that will affect the spaces of the water and the high natural areas will be implemented in Viterbo, Turnhout, Heerlen and in Caldes de

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Montbui; these actions will produce a sustainable development connecting territories, and will get social, environmental and economic consequences and benefits; social because they will contribute to improving the quality of life and will be participatory; environmental, as they will favor the nature-based solutions, attribute to transformation of cities and the full respect of the environment; economic, as they will have very significant implications for employment in related sectors (hospitality industry and agriculture especially).
From a landscape point of view, the actions are important because the different thermal baths that form the thermal basin, are, themselves, landscape units characterized by high naturalness and historicity; urban gardens, which are promoted, are natural actions of control of spatial morphology but also actions that lead to an improvement of the urban naturalness through discovery and exploitation of a sector, the agriculture, that is strategic for environmental sustainability and capable of triggering autopropulsive actions (agricultural cooperatives, 0 km products, slow food) able to increase the employment. Geothermal energy as a heat source can be integrated in the existing environment, without jeopardizing the existing historical buildings and city quarters. As such a solution is provided to reconcile the challenges in climate change with cultural heritage, which cannot be made energy efficient. These nature-based activities will increase urban and regional resilience, especially water resilience, and encourage climate change adaptation.
The challenge facing the proposal, is to improve, on the one hand, climate and water resilience, and, secondly, to pursue an inclusive urban regeneration, promoting employment. Another result to be achieved is the protection and enhancement of biodiversity; biodiversity protection that belongs to the thermal environments and increasing the biodiversity of urban gardens using organic farming experiments. The research aims to demonstrate the feasibility of such interventions, using the project as a space of verification and knowledge. One of the aims is to contribute, through the landscape and architectural project, to improve the preservation and enjoyment of thermal areas, the recovery of water through nature-based architectural interventions; to rationalize and optimize the use of thermal fields and sources, encouraging both "new abstraction, rationalization, restructuring and protection of the existing intake structures of mineral water for spa use ..." that "investigations and hydrogeological studies for the discovery of mineralized aquifers suitable for thermal use and promote studies of the therapeutic qualities of the different waters".

2 METHODOLOGY

The project is based on the use of the environmental resource of thermal waters to create a redevelopment of the whole urban system, favoring the creation of a project that is able to locate the hot springs and the ability of pumping of each of them and thus creating a project

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of territorial development that, based on the aims already synthesized and on a compatible and sustainable use of environmental, historical and cultural resources, can promote the use of thermal springs of Viterbo, Turnhout, Heerlen and Caldes de Montbui, developing attention to the waste water spa treatment that will be used for the creation of urban gardens and for the upgrading of existing urban gardens, with promotion of biological agriculture, and for an energy transition with the use of geothermal energy as a lever towards a carbon neutral society. Four cities will be studied as best practices and front runner; the city of Viterbo in Italy, Turnhout in Belgium, Heerlen in The Netherlands and Caldes de Montbui in Spain. These cities will be assumed for pilot projects and they will test and implement the project activities according to the priorities listed in the four-master plan for urban development. Viterbo was chosen because, within the territory, for years has been present a heated debate on the spa town (not yet built), because inside there are numerous hot springs, some of which are not used in thermal plants but are lost in the territory, because of the spa district area it is very large (30 sq km) with a pumping capacity of 105 l/s; Furthermore Viterbo Baths are characterized by exceptional historical, we also find traces in famous works such The Divine Comedy by Dante. Caldes de Montbui was selected for the innovative contribution of wastewater reuse projects of thermal process that made it possible to create a strong circular economy and to use resources, diversifying the uses and thus creating the greatest economic and environmental sustainability. Turnhout was chosen because of the good experiences with thermal water at the municipal swimming pool from the 1950's until 2005. Since then, a strong support has grown in the city region to use this geothermal resource as a key enabler in the transition towards a low-carbon society. A very proactive plan to provide sustainable heating in the city region, involving various sources inclusing geothermal energy is being worked out. The masterplan includes a sustainable heat net in the city, with a planned integration of using geothermal heat. In 2016, the first small district heating grid in the city (one of the first in the country) was taken into service with a bio mass boiler as the transitional technology. This system is being expanded as we speak, to supply 600 homes an office building. The goal is to scale the system up, to be able to support a business case for additional wells to be drilled for geothermal sources. At this moment a second area in the city could be integrated in a heat grid, including 2.800 new houses and an existing, but to be expanded, large regional hospital. Historical heritage (eg. The Castle of Turnhout, built in the 12th century, today in use as a court house) that could be connected to a heat grid with renewable geothermal energy, can be converted to a sustainable building, without impacting its Cultural and historical value. Heerlen implemented a strong use/recovery of energy from water; Heerlen has an actual grid of heat and colling provided from minewater at 25 °C. They are very advanced in getting heat and cooling energy out of water; the water is in mine pits all

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over the city. Mijnwater BV is the operating company of the Municipality of Heerlen to develop, exploit and innovate the low-exergy DHC-grid based on shallow geothermal energy. In the different areas of study have already been drawn up studies and projects for the exploitation of thermal, energy and agricultural fields; considerations that make the pilot project very interesting and especially implementable given the copious amount of work that has been produced. The five follower cities, which should benefit the project are the city of Maribor in Slovenia, the city of Levico Terme in Trentino Alto Adige, the city of Cahul in Moldova Republic with involvements of Ecological Counseling Center Cahul, the town of Sassari in Sardinia and the island of Pantelleria in Sicily. The last two seats, belonging to two islands and then forming a unified and concluded territory, were chosen because they have many undeveloped thermal resources and could benefit from the pilot actions undertaken in the project, because they could duplicate it. Sardinia has already undertaken a regional project on "System of Sardinia's spas". On the island of Pantelleria there are many events of secondary volcanism. Nowadays, the use of the island's thermal system is presented as "ancillary" activities to the most popular summer tourism. Slovenia's spa facilities are a strong attraction for tourism, which focuses on spas not only as treatment centers, but as places of relaxation and fun; in Levico Terme we have a lot thermal springs and University of Trento and Edmund Mach Foundation are developing topics related to enhancement of quality of life through very strong attention to biological agriculture and energy saving. In the follower cities will carry out a local implementation of some achievements developed in the front runner cities and will be enhanced the development of sustainable urban planning that will replicate and adapt to the local context, the based solutions tested in pilot projects. The Followers will have a privileged contact point with research partners and will have access to all the know-how experienced and to all achieved outputs and actively participate in the definition of the methodology that has to be implemented to allow replication of the results. The other universities of the networks are located on very important thermal basins and have developed an expertise level, distinguished by particular projects relating to the spas, that will be very useful and will be applied within the four pilot projects in Viterbo, Turnhout, Heerlen and in Caldes de Montbui.The methodology allows to maximize the effectiveness of environmental improvement projects and also the faster replication of the processes and operations, even in contexts in different regions and states. The presence and distinction between front runners and followers is dictated by the desire to increase the effectiveness of actions and to pursue the replicability of the results in different contexts. To improve this, we plan to build a a e-learning, co-creation and participation platform (DEDiP) that will enable the synchronous exchange of experience and expertise among the various partners and the continuous updating of the actions. The platform will alos provide a Geographic Information System,

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which will also ensure the updating of maps. The DEDiP platform, with its participation function, informs and involves the local community to express and participate along the whole project activity, in the various phases of implementation; in that way ensuring a collaborative project implementation. For mediating conflicts and to reduce the complexity while increasing the efficiency, we will use participation with all stakeholers or selected stakeholders or actors, depending on the issue and implementation phases. In Viterbo, Turnhout, Heerlen and Caldes de Montbui will be designed a master plan that will provide the promotion of the whole spa; Municipal Basin will be divided into zones that constitute the priorities for action in case of European funding. Masterplan will provide a design that will take place on four elements:

- Enhancement spas basins and architecture creating public baths based on bioengineering actions compatible with the environment but which helps to highlight the spa area;
- Actions on urban mobility. It will include a set-system of the whole spa area. Will be developed actions as creations of green infrastructures and of sustainable mobility to connect the areas with each other and with the city center, in respect of environmental characteristics of the area;
- Agricultural production enhancement: will be developed a design of urban gardens in areas close to the thermal areas; in these urban gardens will be developed the production of fruits and vegetables farm through the use of the thermal waste water that will be conveyed into special tanks phytore mediation to lower the temperature and to purify water; the waters are so used for agricultural purposes. This method, tested by the University of Barcelona to Caldes de Montbui in Spain, has already received two prestigious European awards for agriculture in 2016;
- Exploitation and innovation through the low-exergy DHC-grid based on shallow geothermal energy.

3 AMBITION AND EXPECTED IMPACTS

TUNED aims to contribute to the improvement of the attractiveness of thermal areas, to the diversification of the economic base of the involved cities, to the creation of urban circular economy that values the natural aspect and the primary sector, to the improvement of quality of life, innovation and quality of governance. The involved cities, Viterbo, Turnhout, Heerlen and Caldes de Montbui, but also the followers, must be designed and treated as environmental testing laboratories, living landscapes, based on innovative practices and a wide popular participation which results in a mutual cultural enrichment. From an operational point of view, the project wants to be an element of urban and environmental regeneration of the thermal

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territoriesthrough the implementation of engineering and architectural solutions characterized by the highest environmental sustainability.

STATE OF ART	PROJECT AMBITION	HOW IS ACHIEVED
The thermal resources are used in a poor way; each city often promotes a single or (at least) double use of thermal resources	Creation of urban circular economy	Through a complete use of thermal water (for baths, for care and therapeutic aims, for the creation of urban gardens and for the use in the heating system with energy saving. There is no waste of waterand it is created a circular scheme with the use of water from the spring till the end of their life in agricolture with the enhancement of urban gardens and biological products.
Thermal water are often lost and there is no resuse of them (except in Caldes de Montbui).	Regulating the use of waste thermal waters.	Through a constructed wetland process tha lowers tha temperature and allow their use in irrigation farming.
The thermal springs are not razionalized.	Rationalize the use of hot springs.	With the implementation of a masterplan that describe the total amount of water that could be used by each thermal spring.
There is no urban or policy project that managew the thermal sector.	Develop a design implementation.	Will be implemented a masterplan with pilot projects based on funding and priorities established and agreed with the City Council
The employment in private or public sectors involved with thermal re source is not well defined and developed. There is no engagement between thermal springs and Energy sectors except in Belgium and in the Netherlands. The employment in thermal sector is low in each thermal city.	Develop employment able to check the results in the four main cities.	In both the Spa industry, which in those sectors linked to its supply chain, that in the management of urban gardens and social management co-operatives.
Today is not well definde and development the use of water for heating and for the promotion of sustainable heating using hot springs.	Develop energy use of water (especially for heating).	Enlarging the methodology developed in Heerleen project, replicating it in the pilot projects and encouraging the replication on a larger scale. Develop a very proactive plan to provide sustainable heating involving various sources.

Tab. 1 Explanation of the main achievements

The assumed project, and its territorial implementation, in line with what is stipulated in the field of Smart and Sustainable Cities, is aimed at achieving efficient management of natural resources through a number of actions concerning energy efficiency (which you get with the reuse of thermal waters), mobility (through the development of a system of green infrastructures and means of electric and hybrid mobility), water quality (through constructed wetlands trails and sewage for agricultural purposes), air quality through solutions aiming to favor the development of alternative mobility (also in TPL) to that of rubber, at least in the

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front runner cities. The key challenges actions on mobility, on air and water quality, on energy efficiency, will involve deep economic, social and environmental effects, which would affect an improvement in urban and regional quality parameters, in particular concerning the territorial competition and improvement of employment. The Consortium has a strong portfolio concerning the ambition; Ciclica and Caldes de Montbui received two european grants regarding urban gardens; Herleen won the European Geothermal Innovation Award in 2015; Viterbo has developed recently a rationalization of thermal spring sources commissioned by Lazio region and almost all involved academies has a strong relationship with municipalities and sme with the aim to develop thermal resources. All the actions will be evaluated through the Lycfe Cycle Assessment (LCA) that will evaluate the enviromental impact of the supposed actions. So the ambition is to produce a better quality in environment and in social life. Through dissemination of results, which is realized through the implementation of DEDiP platform and the drawing up of the Dissemination Plan, the benefits of the experimentation carried out will help to create a "community of practice" based on efficiency of policies and governance and an interactive decision making process. The tested and implemented actions inside pilot projects (and supported by the project partners, especially by followers, strenghten the achieved benefits and, through comparison of the case studies and the obtained results (analyzed by appropriate quality and performance indicators), will emphasize the role of transformations and nature-based innovations as key role for the enhancement and urban and regional regeneration. It is also planned the implementation of Community policies such as the "EU Water Framework Directive", the "EU Biodiversity Strategy to 2020", the "EU Climate Change Adaptation Strategy", "The Blueprint to safeguard Europe's water" and the "Communication on Green Infrastructures ". The expected results are to bring the cities together, not only at the level of experts and the entire project of a city, but also down to the level of stakeholders and elaboration of specific ideas, to facilitate the cities’ experience exchange throughout the entire process in different digital and physical participation and co-design steps and to link the innovations that are taken from other cities from the start with what the citizens experience as needs, challenges and opportunities in the city who wants to adopt those ideas (not just copying, but smart adoption, taking all aspects into account).

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AUTHOR'S PROFILE

Francesca Moraci is Full Professor of Urban Planning at Mediterranea University of Reggio Calabria. PhD in Urban Planning. Master of Science in Economic Policy and Planning (UNBoston), Fulbright ('84-85 and 85-86) at Northeastern University and American institutions (MIT, Coastal Zone MP). She Coordinates various researches in urban, territorial and environmental planning. She is senior Consultant for prestigious institutions, and She is now Member of Administrative Board of FS (Italian **National Railways).**

Celestina Fazia, Architect, Ph.D. in Territorial Planning. Conducts research at the Università Mediterranea di Reggio Calabria, in LABSTUTeP. She is consultant for Companies and Organizations in planning, territorial and environmental assessment (Component EIA, SEA, IPPC, Calabria region). National Enabling for Associate Professor in Urban Planning.

Maurizio Francesco Errigo, Researcher and Assistant Professor in Urbanism at the Faculty of Engineering and Architecture, University of Enna Kore. National Enabling for Associate Professor. PhD in Urban Planning (2007). Advanced Training Course in Design of the coastal landscape (2004) Master in Management of Local Authorities (2010). From 2007 to 2011 He is Professor at Mediterranean University of Reggio Calabria. From 2011 to 2013 Post Doc researcher at Delft University of Technology, where He is Professor at MsC in Urbanism (2012-2013).

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A NETWORK APPROACH FOR STUDYING MULTILAYER PLANNING OF URBAN GREEN AREAS: A CASE STUDY FROM THE TOWN OF SASSARI (SARDINIA, ITALY)

***MARIA ELENA PALUMBO[a]**
SALVATORE MANCA[b], SONIA PALUMBO[b]

[a] Department of Chemistry and Pharmacy
University of Sassari, Italy
e-mail: m.palumbo@studenti.uniss.it

[b] Civil - Environmental Engineer, freelancee
e-mail: sonia.palumbo@ingpec.eu
ing.salvatore.manca@ingpec.eu

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ABSTRACT

Urban development determines some of the largest local biodiversity extinction rates (McKinney, 2009), mainly by means of habitat fragmentation (Kong, 2010).The Theory of Island Biogeography (TIB) of MacArthur and Wilson (1967) applied to biological conservation suggests the need to project widespread ecological network seven in urban environments (Massa, 2002). The adoption of a network approaching the urban green areas (UGAs) planning is fundamental to make cities more permeable to the biological components; however, to do this it is important that the pieces of the planned landscape do not become sink-type areas (negative biological traps). Applying the principles of landscape ecology, in this work flora and structure of UGAs of the town of Sassari (NW Sardinia, Italy)were studied in order to identify the main structural drivers that determine the observed plant biodiversity and create a scientific base on which to root an UGAs planningimplemented at the landscape level. Preliminary results suggest that native plant diversity is conditioned more by green patches configuration than spatial arrangement of patches within the urban matrix.The main application of our data is the re-development of each area, that from monovalent becomes polyvalent, thanks to the multilayer overlapping of single layers, each focused as a key issue for city life, as inspired by the network approach.

KEYWORDS
Source-sink dynamics; Urban flora; Urban sustainability

* The other author is: Emmanuele Farris

1 INTRODUCTION

Normal levels of biodiversity contribute to the maintenance of ecosystems' resilience, therefore able to adapt to climate change (Mant et al., 2014). In this sense, biological diversity is a guarantee of stability and functionality of the biosphere and ensures adaptation to environmental changes (Primack, 2003). Loss of biodiversity and degradation of ecosystems undermine the supply of ecosystem services essential for human well-being and adaptation to extreme events (De Groot, 2002), increasing the vulnerability of ecosystems (Mant, 2014). It is therefore essential to implement actions that create resilience by increasing the natural ability to recover ecosystem services (Mooney, 2009).

However, adaptation strategies tend to focus on technological, structural, social, and economic developments, and linkages between biodiversity and adaptation are often missed (Campbell, 2009). This is worrying, as the issues of climate change and biodiversity are interconnected in a one-to-one manner (CBD, 2009).

Among the various factors that contribute to undermining biodiversity, urban development is the process that determines some of the largest local extinction rates, often eliminating most native species (McKinney, 2009).

During urbanization, large areas of natural habitat have been converted into impervious surfaces, causing habitat loss (Liu et al., 2016). Fragmentation and loss of habitats threaten biodiversity and are among the primary causes of the current extinction crisis (Primack & Carotenuto, 2003). Urban growth often replaces native species that are lost with non-native species. This constitutes the process of biotic homogenization that threatens to reduce the biological uniqueness of local ecosystems (Blair, 2001). Urban-gradient studies show that, for many plant taxa, the number of non-native species increases toward centers of urbanization, while the number of native species decreases; that the lowest species diversities along the urban–rural gradient occur in the intensively "built" environments of the urban core, and the much of the reduction in richness is obviously caused by the loss of vegetation (McKinney, 2009). The number of species of animal taxa tends to correlate with the number of plants in an area. Also, area covered by vegetation is a good predictor of species numbers for many taxa (McKinney, 2009). In Italy, the settlement model that was imposed from the 1970s onwards is dispersive, and has caused an expansion of artificial areas, especially at the expense of the soils closest to the pre-existing settlements, easily accessible and with morphologies more favorable to construction, affecting this especially in agro-ecosystems (Romano & Zullo, 2010).

The proportion of the world's population living in cities is expected to surpass 65% by 2025, and dramatic population increases have been accompanied by intensified urban development

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(Kong, 2010). The general trend due to urbanization tends to increase habitat fragmentation over time and to decrease mean patch size, total core area, and cohesion of habitats (Liu et al., 2016). From 2010 to 2050 the built-up area will increase by 3 times (Liu et al., 2016). Because urban areas may contain a rich flora that contributes significantly to biodiversity, urban biodiversity conservation should receive more attention (Kong, 2010). Urban planners should find ways to preserve biodiversity as cities expand outward by changing the natural habitat (McKinney, 2009).

The need to create ecological networks in which protected areas connected by "corridors" or stepping stones with other natural resources (Phillips, 2003) is becoming more and more urgent, and the consequent decline of the traditional concept of conservation by park-islands is accompanied by the affirmation of the need to project widespread ecological networks also in urban environments (Massa, 2002). This network approach in cities can also leave the strictly biological field to assume different meanings: connection networks can not only enhance biological processes between habitats, but also assume a more complex meaning integrating nature with cultural and historical aspects (Talia & Sargolini, 2013). From a landscape ecology perspective, areas with significant amounts of vegetation called Urban Green Areas (UGAs) are "patches" (remaining fragments of the original habitat) within an anthropogenic matrix (Farina, 2001).

Therefore, in UGAs planning processes it is important to pursue the network approach not just to conserve habitats consumed by sprawl, but also to make cities more permeable to biological processes.

To do this, it is in fact important that the pieces of the planned landscape do not become, due to isolation and fragmentation, areas of the sink type (negative biological traps in terms of contribution to the dispersion of species). This means that the planning of an ecological network that aims to connect green areas must be implemented at the landscape level.Also, spatial configuration of UGAs (natural and semi-natural) within the urban (anthropogenic) matrix is of utmost importance, because large patches can accommodate a greater variety of habitats (Smith & Smith, 2009) and guarantee many functions, but small cards provide other types of benefits (Forman, 1995). To this end, an optimal landscape model should have small tesserae dispersed in the matrix in addition to large patches that guarantee the most important functions (Massa, 2002).

In this study we explored the richness and diversity of native vascular plants in a variety of UGAsin the urban matrix of the town of Sassari (NW Sardinia, Italy), with the aim to determine if plant diversity is conditioned by patches size, location in the matrix, or configuration of each patch. The goalis to obtain objective data useful for the development of UGA's planning based on the principles of urban sustainability.

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2 METHODOLOGY

The city of Sassari (40°43’36”N, 8°33’33”E) is located in the NW of Sardinia (Italy), lies at 225 m a.s.l. in the limestone outcrops of Miocene deposits, and belongs to the lower sub-humid mesomediterranean phytoclimatic belt of the Pluvi seasonal Oceanic Mediterranean bioclimate (Canu et al., 2015). Urban structure,established since Middle Age as a fortified town with 36 towers, isasymmetrical and surrounded by a olive grove strip. Sassari has an extension of 546 km^2 with a 2017 population of 127.533 witha quite stable demographic trend since 2013.

The study area (Fig. 1) consists of the oldesturban fabric of Sassari (Sardinia, Italy) bordered to north by the Rosello and EbaGiara valleys, and its most recent expansions towards other directions, up to where the widespread urban settlements give way to the surrounding areas with a lower urban density.

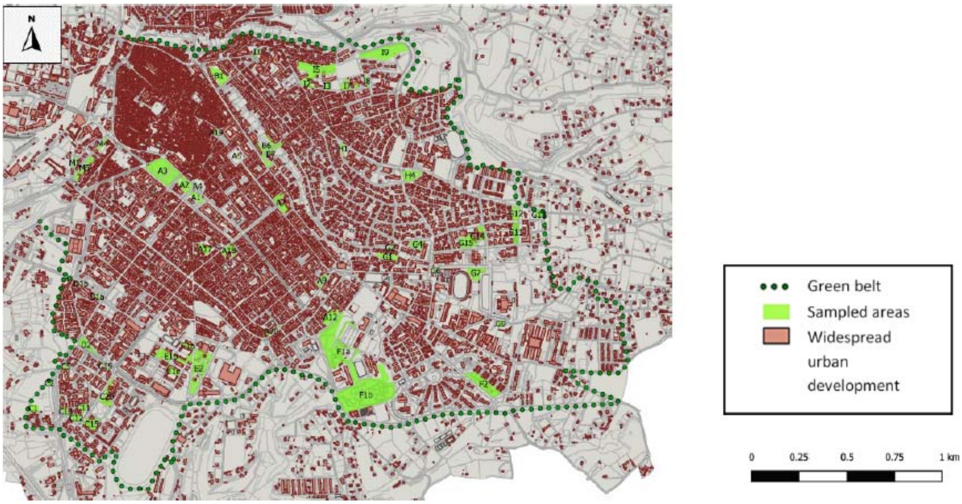

Fig. 1 Map of the study area containing the sampled UGAs, classified by an alphanumeric code

In order to have an overview of the UGAs in the city, for each sampled site the following features have been defined:

- area
- perimeter;
- perimeter / area ratio;
- distance from the edge (greenbelt);
- distance from the nearest UGA;
- type of management;

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- accessibility;
- number of native plant taxa;
- density of native plant taxa;
- number of exclusive native plant taxa (plant taxa only recovered in one UGA);
- % of exclusive taxa on total native plant taxa recovered in each UGA.

Maps of the studied area were realized and implemented in GIS and Google Earth software. Other relevant information was obtained from the municipal urban plan of Sassari (P.U.C.) and inspections in order to verify contrasts between the use reported on P.U.C. and the effective status.

UGAs with a surface area of less than 100 m^2 and/or linked to the road network (traffic islands, road edges) with a markedly linear shape were excluded from sampling.

Native vascular plants were sampled from May 2018 to May2019. They concerned spontaneous herbaceous, shrub and vine species. Artificially planted (ornamental) and alien (casual or invasive) species were excluded from sampling and determination. The samples taken were stored after drying and subsequently determined using the Flora d'Italia (Pignatti, 1982, 2018) dichotomous keys.

This sampled UGAs became the object of connectivity analysis in integrated planning. The integrated urban planning process used QGIS and AutoCAD software, and was divided into 3 phases. Preliminary phase, that is a study on the state of art of:

- The current planning instruments (supra-municipal, municipal and sectorial) and the planning in force;
- The peculiar and distinctive features of the city: uniqueness and potentiality (features that can bring benefits at different levels)) and shortcomings for various planning spheres.

In this phase are highlighted: typical characters, genius loci and potential values that characterize UGAs, but also waste of space, inefficiencies and distribution inhomogeneities, in order to have a comparison parameter with which in the final phase evaluate benefits brought by the intervention designed.

Second phase: contamination of the urban planning criteria with the ecological ones. Among those UGAs which require ecological connections (small and with a stretched shape UGAs), three sub-groups of them has been selected, one for every thematise detected in the preliminary phase. The aim is to optimize spaces and create new strategic connections between different areas of territory. Third phase: the city masterplan. A proposal for a UGAs and related urban services plan, strengthening and completing local social and urban service needs, is suggested. The plan redesigns the urban green texture, creating a balanced

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uniformity that reconnects the UGAs, assigning them according to their own intrinsic features and to existing road connections.

3 RESULTS

The total sampled UGAs were 56, for a total sampled area of 26.08 ha, of which 56.47% is freely accessible (Tab. 1).

TYPE OF UGAS	TOTAL AREA (ha)	% AREA	#UGAs	%UGAs	ACCESSIBILITY
Parks and gardens	8.44	32.36	19	33.92	Yes
Military	8.27	31.71	2	3.57	No
Private gardens/parks	3.08	11.82	8	14.28	No
Abandoned	1.69	6.50	2	3.57	Yes
Parking areas	1.36	5.23	5	8.92	Yes
Sanitary	0.95	3.63	3	5.35	Yes
School	0.88	3.36	5	8.92	Yes
Public flowerbeds	0.58	2.24	10	17.85	Yes
Sport	0.51	1.95	1	1.78	Yes
Archaeological	0.31	1.20	1	1.78	Yes
Total	26.07	100.00	56	100.00	

Tab. 1 Classification of the sampledUGAsaccording to type of management

The average area of the sampled sitesis 0.47 ha, with a maximum area of 4.51 ha and a minimumarea of 0.02 ha. Only 12.07% of the sampled sites exceed one hectare of extension. Out of 236 total species sampled, the average number of sampled species detected in each UGAwas 30.11, with a maximum of 85 species at site I9 (1.586 ha), and a minimum of 6 species at site C5 (0.046 ha). To quantify the effect of UGA's shape on species richness and density, the ratio between perimeter and area was analyzed. On average the studied UGAs showed a perimeter/area ratio of 1,741.93 m / ha with a maximum value calculated of 5,754.45 m / ha, while the minimum was 200.97 m / ha. 70.90% of the sites have a perimeter / area ratio > 1000 m / ha. The 29.31% of sampled UGAs had a distance from the greenbelt > 500 m, whereas the remaining 70.68% of the sites had a distance from the greenbelt <500 m. To investigate the structural connection of UGAs, the distance from the nearest UGA was calculated in terms of minimum distance between the relative perimeters. The 32.72% of sampled sites have a distance from the nearest patch< 100 m.
A significant relationship appears from the data between area and species richness ($R= 0.65$; $N=56$; $P<0.001$; Fig. 2A), whereas a negative relationship was found between species

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richness and perimeter/area ratio (R=-0.57; N=56;P<0.001; Fig. 2B).Furthermore, significant negative correlation was found between species density and area (R=-0.88; N=56; P<0.001; Fig. 2C), whereas a positive correlation was found between species density and perimeter/area ratio (R=0.72; N=56; P<0.001; Fig. 2D). No significant correlation was found between species richness, species density and other parameters (distance from green belt; distance from nearest UGA).

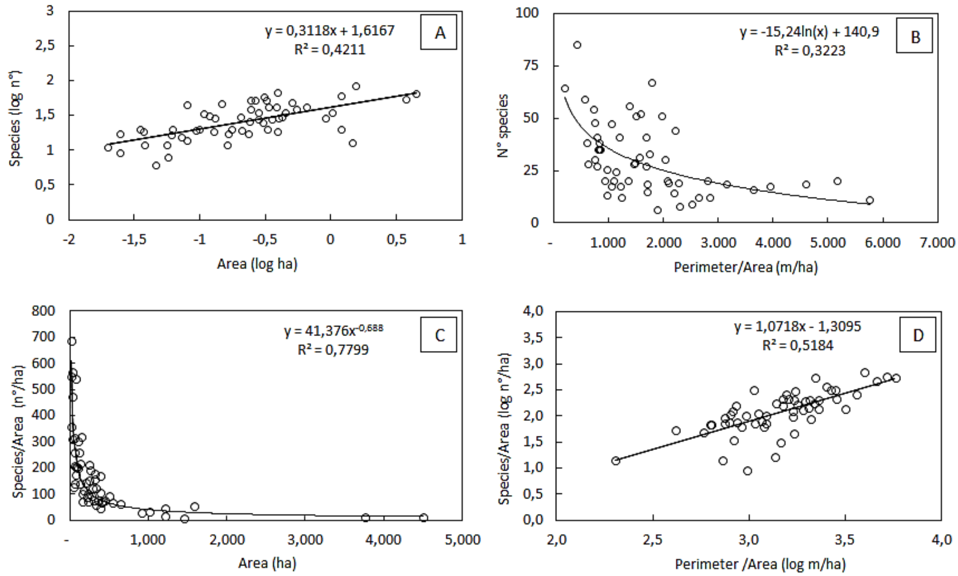

Fig. 2 A Linear trend between area and species richness; B: correlation between shape (perimeter / area ratio) and species richness; C: negative exponential trend of species density (no.species / area ratio) as the area grows; D: linear trend of the ratio no.species / area to the increase of the perimeter / area ratio (N=56 in all graphs)

Preliminary results suggest that native plant diversity is conditioned more by green patches configuration than spatial arrangement of patches within the urban matrix. In particular, maximum values of specific richness are in large and compact areas. This species-area relationship can be explained by the Theory of Island Biogeography (TIB) of MacArthur and Wilson (1967), according to which larger habitats (geographical or ecological islands) tend to accommodate more species than smaller ones.

Most UGAs in city are small (almost 88% of UGAs are less than 1 hectare), and most have a shape not very compact (70.90% of the sites have a perimeter / area ratio > 1000 m / ha).

Because it is almost impossible to increase the areas size, in order to support biodiversity in the city, green corridors between UGAs can be designed. The creation of ecological corridors

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and "steppingstones" involves the habitat extension of many species and facilitates the genetic exchange between native plant species (Farina, 2001).
In order to increase the ecological connectivity between UGAs, three design layers have been developed by connecting small and poor of species UGAs with larger and with high biodiversity levels UGAs. At the same time, a thematic criterion was applied. The layers created can be read severally and simultaneously at an integrated level (Fig. 3):

- A - Educational green,
- B - The sporting city,
- C - The widespread park.

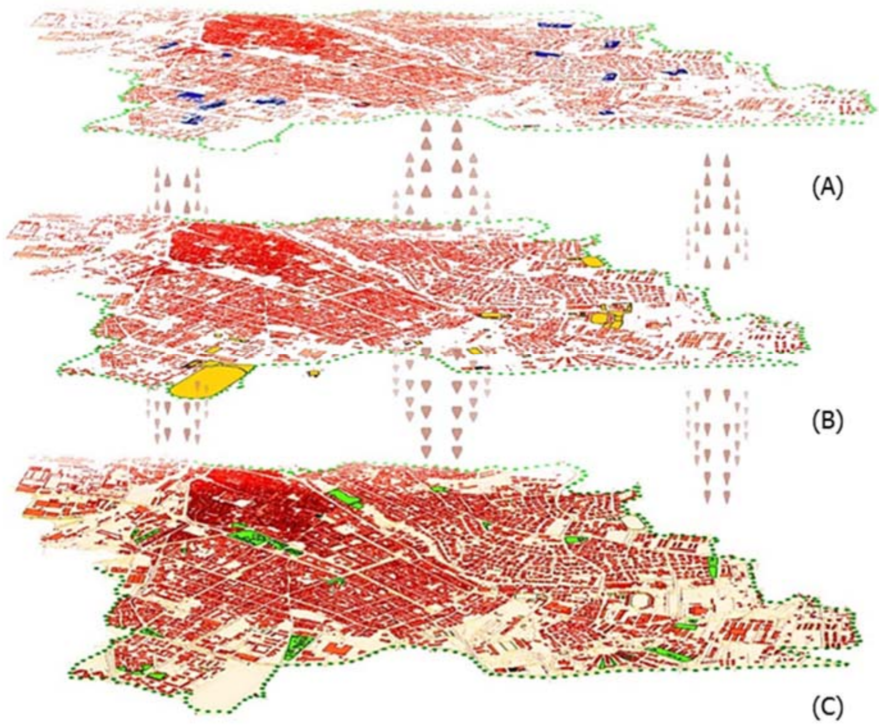

Fig. 3 Conceptualschemeofthe "multilayer" overlappingof selectedthematism: A =educational green; B = thesporting city; C = the widespread park.

The level A triesto create organicitybetween sports areas already present by creating green linkages, by creating new ones through the re-thinkingof un-used areas and by adding sports featuresto UGAs suitable for developing this thematism. For this level, the creation of a*urban sport circuit* spread all over the cityis proposed, in order to promotea healthy and more livable

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urban mobility. The level B tries to create organicity between UGAs ofvarious didactic structures, including schools of different order, universities and cultural institutionssuch as museums. For this level, the creation of a *widespreadcircuit of knowledge*is proposed, aimed at offering the opportunity for a great variety of users to be able to learn naturalistic and cultural notions. The level C proposesto uniform and enhance recreational UGAs, which includes areas likeparks or gardens,by reconnecting them with a*green network of recreational paths*. The masterplan proposal of UGAsobtained by the overlapping of the three layers, as a result,proposes a detailed UGAs and related urban services plan in which the individual green areas, currently equipped with only one or none type of use, become multifunctional. The resulting projectis a multilayer planningin which each thematic level is coherent and strengthened on its own, but receivesadditional values by the overall masterplan, of which it is an integral part.

4 CONCLUSIONS

The analysis of the vegetation and thegreen areas study through basic parameters has allowed acquiringan overall picture of the current connection and state of the green areas in the city of Sassari. The most significant parameters related to the biodiversity studied in terms of vascular plant richness appear those related to species-area relationships and area-perimeter relationship. The report, which could be further studied by increasing the number of surveys and investigating the impact of other factors and their different effects on biodiversity, could have an important meaning in UGAs planning. Small and stretched areas, which correspond to the majority of UGAs in the city, are more exposed to biodiversity loss. However, they show the highest specific density levels. The remaining large areas can serve as a source area. Each type of area, in a connected green system, cangenerate specific functionality at the ecosystem level. In order to improve the current connectivity of the system, in the present project a sector-based approach has been replaced by an approach based on complementary synergies between the ecological and anthropic fields.This multidisciplinary approach allowed us to obtain, as a synthesis, a planning proposal consisting of a detailed plan of services and UGAs functional from the point of view of ecological and urban sustainability. On the one hand the ecological gaps between green areas and potential or exploitable ecological connection elements are identified, on the other hand the potential improvement of urban quality obtained based on ecological principles is underlined.The result is a "diffused park" that offers a strategic mending of different city's portions that have a potential urbanistic value, and that also preserves urban ecosystem's resilience by linking areas that host native vegetation and exploiting their strategical position for enhancing urban biodiversity.This case shows how a multidisciplinary UGAs planning can suggest new

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functional approaches and can offer better solutions because more complete from a holistic point of view that ultimately includes the importance of quality of life in cities.

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AUTHOR'S PROFILE

Maria Elena Palumbo, Graduated in Natural Sciencesat the University of Cagliari, ispursuing a Master Degree in Environmental Management at the University of Sassari. Hermaster thesis deals with the urban ecologyof the city of Sassari. Her main interest is thestudy of ecological roles played by interaction between plants and birdsin ecosystems.

Salvatore Manca, Civil engeneer graduated with a Master Degree at the University of Cagliariin Building Engeneeringand Architecture, with a thesis in city planningentitled "The historic urban landscape of Cagliari: lines for protection and enhancement". Co-founderofSOSAstudio design, he works in design, planning, and constructionsupervision.

Sonia Palumbo Civil engeneer graduated with a Master Degreeat the Universityof Cagliari in Building Engeneeringand Architecture, with the thesis "Strategic lines for the planning of a widespread urban park of the knowledge of the historic center of Cagliari", which won firstprize for best thesisin the"Premio CEI" award, established by the OIC (OrdinedegliIngegneri di Cagliari) in 2014.Co-founder of SOSAstudio design. She is a civilengineer, planner and interior designer.

Emmanuele Farris, Associate professor of Botany at the University of Sassari, his main research interest is related to the study of plant biodiversity at both the species, population, and landscape levels. He teaches Plant Ecology for Natural Sciences and Landscape Ecology for Environmental Management courses.

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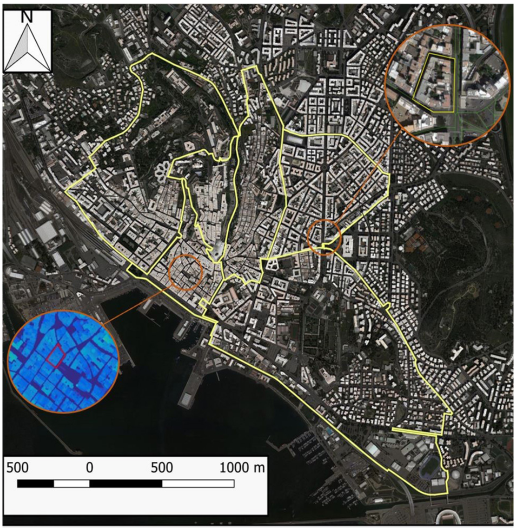

URBAN AREAS MORPHO-METRIC PARAMETERS AND THEIR SENSITIVITY ON THE COMPUTATION METHOD

***LUCA SALVADORI, MARIA GRAZIA BADAS**
MICHELA GARAU

Department of Civil, Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: luca.salvadori@unica.it

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ABSTRACT

This work aims to underline the relevance of a site-specific characterization of urban sites, needed both for Computational Fluid Dynamics (CFD) simulations (e.g. for micro-climate or local air quality studies) and urban larger scale air quality studies. We consider the Italian town Cagliari as a case study, which presents heterogeneous urban texture, as many of European historical towns, quite different from large, regular sized texture of American cities, that are generally considered in literature. Starting from the computation of the main morphometric and fluid dynamics parameters from Digital Elevation Models (DEM),it is possible to identify some possible caveats on using gridded DEM analysis for the site statistics detection. Finally, results show how site-specific analysis is necessary to provide better and more representative parametrizations compared to those obtained by literature results, which cannot be transposed to other urban contexts. Morphometric site-specific analysis represents a key issue in urban numerical simulations, since the application of non-representative morphometric input data may dramatically affect their results.

KEYWORDS
Morphometric Parameters; Urban Aerodynamic Roughness; Urban Canopy Model

* The other authors are: Giorgio Querzoli, Simone Ferrari.

1 INTRODUCTION

Interaction between air flows and built environment is essential when performing numerical simulations, and it has to be described appropriately, whatever it is the target application and for whatever involved spatial scale. Actually, using mesoscale models for weather forecasting and air quality prediction on large areas, the parametrization of the average effect of the small-scale atmospheric processes is needed. The latter is highly complex, due to the nonlinear processes involved as well as to land heterogeneities, especially in urban context (Arnfield, 2003; Pelliccioni et al., 2016). Eventually, the positive effect of an adequate characterization has been widely demonstrated (Chen et al., 2011; Salamanca et al., 2010). This kind of characterisation (Chen et al. 2011) of the urban areas is fundamental for microscale models too, which require more detailed descriptions of the urban morphology, as required by mesoscale models, in order to represent the average effect of the physical process. Moreover, at neighbourhood or building scale simulated by means of Computational Fluid Dynamics (CFD) models, the proper description of the urban surrounding is still necessary for setting the urban roughness length in the regions surrounding the target area, which are not explicitly modelled although included in the simulation domain, as well as to define appropriate approaching wind boundary condition (Blocken, 2015; Pelliccioni et al., 2015). Urban canopy parameterization and fluid dynamic parameters are generally developed on the basis of simple urban configurations. Considering the urban canyon as fundamental unit, and the broad division of urban canopy models used in large scale numerical simulations into single-layer (e.g., Masson, 2000) and multi-layer (e.g. Martilli et al., 2002) models, studies performed on simple configurations, including two-dimensional urban canyons are valuable (Badas et al., 2017; Garau et al., 2018).

In his pioneering work, Oke (1988) highlighted how canyon flow characteristics depend on the Canyon Aspect Ratio (AR_c), defined by the ratio between the canyon width (w_c) and the mean building height ($\overline{z_H}$) (Fig. 1a).

$$AR_c = \frac{w_c}{\overline{z_H}} \qquad (1)$$

Other authors, e.g. Hang and Li (2011), showed the influence of the Building Aspect Ratio (AR_b), i.e. the ratio between the building width (w_b) and the building height ($\overline{z_H}$):

$$AR_b = \frac{w_b}{\overline{z_H}} \qquad (2)$$

Canyon morphology affects the street canyon ventilation (Badas et al. 2017; Bernardino et al., 2015; Garau et al., 2018b), in particular, when thermal effects are considered or when the urban morphology interacts with different atmospheric conditions.

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The main method to estimate aerodynamic parameters was proposed by Grimmond and Oke (1999). In their approach, the morphometric characterisation leads to the empirical determination of the aerodynamic parameters. They schematically described building shapes and proportions, referring to an elementary unit on which the morphometric study is based. Basic measurements involved in the elementary unit description are sketched in Fig. 1b. Apart from the yet cited $\overline{z_H}$, the other parameters are the building planar area A_P, the building frontal area, along a specific direction, A_F, and the total planar area of the element (considering the building pertinent area, as defined by the chosen urban area partition) A_T. Two morphometric parameters, namely Plan Area Index (λ_p) and Frontal Area Index (λ_f) can be defined:

$$\lambda_p = \frac{A_P}{A_T} \tag{3}$$

$$\lambda_f = \frac{A_F}{A_T} \tag{4}$$

When two-dimensional canyons are considered, and the direction is the same as the longitudinal development of the canyon, the relationship between the two set of parameters becomes:

$$\lambda_p = \frac{w_b}{w_b + w_c} \; ; \quad \lambda_f = \frac{\overline{z_H}}{w_b + w_c} \tag{5}$$

Today, morphological analysis is well aided by geospatial data availability. Recently, the urban boundary layer parameterization project, NUDAPT (National Urban Database and Access Portal Tool), was created to provide accurate and homogeneous urban dataset on more than 40 American cities (Ching et al., 2009). Other initiatives have been developed in this field; however most studies are performed in American cities, whilst European and, in particular, Italian urban areas have received less attention. Without a specific and accurate morphometric parameter dataset, the input model parameters related to urban structure must be derived from available datasets and reference values. However, these ones not necessarily correspond to the specific analysed condition, and this may have not negligible effects on the simulation outcomes. Moreover, another aspect must be considered: generally morphometric studies are performed on gridded data on a regular grid (Burian et al., 2002; Ratti et al., 2006). Results can be significantly affected by element selection, and the choice of the most appropriate methodology should be investigated. Concluding this introduction, a fact deserves attention. Until air quality simulation models continue to be used relying on a simplified built environment representation, poor information can be obtained about the link between urban morphology and air quality in cities. Indeed, only a deep knowledge of the first one can help managing this task, and high-resolution data is required, to support urban planning process. Based on it, the whole simulation process may lead to a larger dataset to analyse, which cannot always

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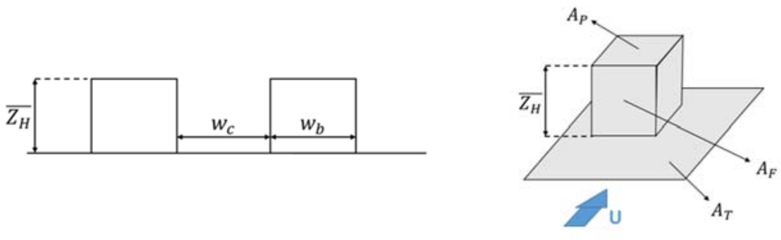
be reached using only in field measured data. This work presents a morphologic analysis of Cagliari, an Italian town, quite representative of many historical European towns, with the aim to discuss the outcomes of a regular or irregular grid choice.



(a) (b)

Fig. 1 Basic parameters to define (a) urban canyon aspectratios ($AR_c = W_C/\overline{Z_H}$, $AR_b = W_b/\overline{Z_H}$); (b) planar ($\lambda_P = A_P/A_T$) and frontal ($\lambda_F = A_F/A_T$)area indexes.

2 METHODS

The procedure here implemented is based on a Digital Surface Model (DSM) and a Digital Terrain Model (DTM), both at 1 m resolution. These datasets were retrieved for our case study, Cagliari, thanks to the open access guaranteed by the local dataset "Sardegna Geoportale". The computation of λ_p and λ_f parameters has been useful to derive Zero Plane Displacement Length (z_d) and Roughness Length (z_0) values. These fluid dynamics parameters are used in CFD models to define the incident wind profile:

$$u(z) = \frac{u_*}{k}\ln\left(\frac{z - z_d}{z_0}\right) \quad (6)$$

where u is the flow speed at height z, u_* is the friction velocity and k is the von Karman constant.Several methods have been developed and tested in order to get z_d and z_0 values (Grimmond and Oke, 1999). In the following, we present the results obtained applying the MacDonald method, among the proposed in the study, because of its more suitable experimental derivation to an urban context:

$$\frac{z_d}{\overline{z_H}} = 1 + \alpha^{-\lambda_p}(\lambda_p - 1) \quad (7)$$

$$\frac{z_0}{\overline{z_H}} = \left(1 - \frac{z_d}{\overline{z_H}}\right)\exp\left\{-\left[0.5\beta\frac{C_D}{k^2}\left(1 - \frac{z_d}{\overline{z_H}}\right)\lambda_f\right]^{-0.5}\right\} \quad (8)$$

where α and β are empirical coefficients and C_D is the drag coefficient. The authors suggested using $\alpha = 4.43$, $\beta = 1.0$, $C_D = 1.2$, and we adopted the same values. In order to compare the outcome of the analysis performed on regular square grids and irregular elements, assessments were carried out by means of three different settings: an irregular grid whose

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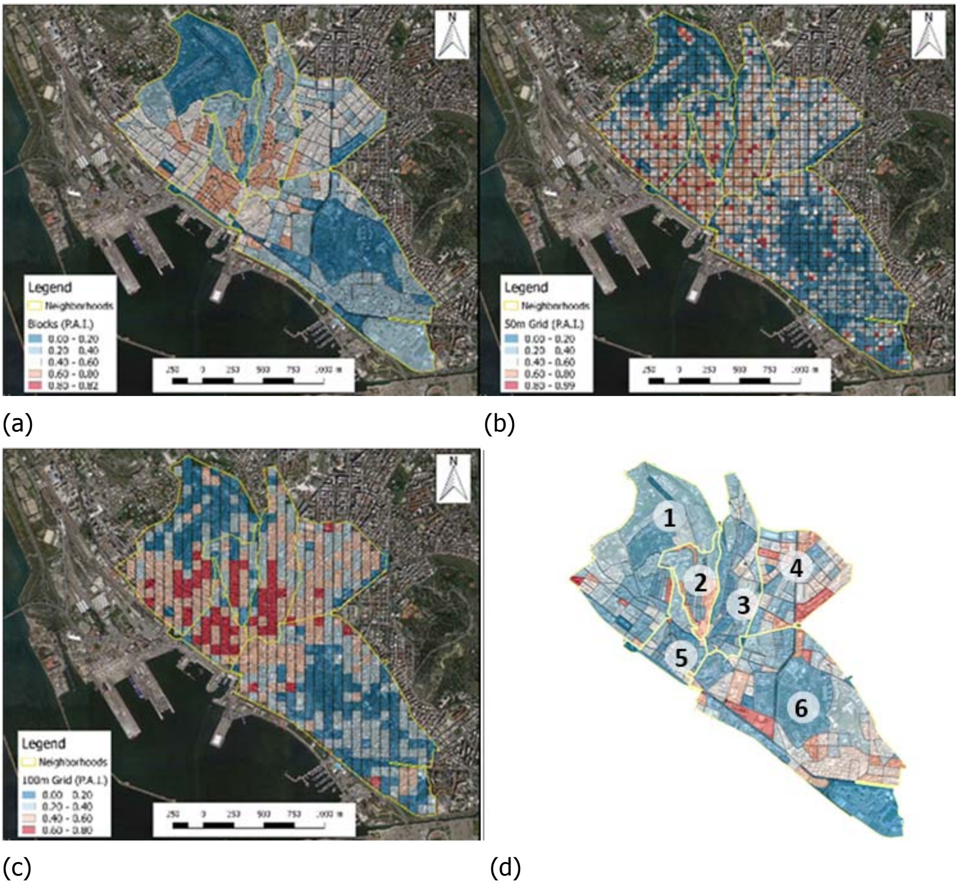
elements are defined on the street graph, hence following the shape of the building blocks (Fig. 2a), a 50 m × 50 m gridded map (Fig. 2b), a 100 m × 100 m gridded map (Fig. 2c). Actually, different grid scales were employed for morphometric analyses (Burian et al., 2002; Ratti et al., 2006;) and a consensus on defining a standard methodology has not been achieved by the scientific community yet (Fernando et al., 2010). Here, small scale grids were chosen to compare regular and irregular grid outcomes at similar resolutions as well as to investigate the town heterogeneity.



(a) (b)

(c) (d)

Fig. 2 λ_p colormap distribution on Cagliari urban area computed from subdivision in irregular blocks (a, top left), gridded elements at 50 m (b, top right) and 100 m (c, bottom left). Yellow lines highlight neighbourhoodsubdivision: Stampace (1), Castello (2), Villanova (3), San Benedetto (4), Marina (5),Bonaria (6), asdisplayed in plot (d, bottom right)

Indeed, the morphometric analysis was applied to Cagliari central area (Bonaria, Marina, Castello, Villanova, San Benedetto and Stampace – displayed in Fig. 2d), which have a

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different historical development that is reflected in their morphometric features. The obtained data were statistically analyzed at each neighborhood scale as well as considering the whole gridsrepresenting central Cagliari mean parameters.

3 RESULTS

Fig. 2 shows colour maps of λ_p over the analysed urban area, computed on the three adopted grids. All the maps display a heterogeneous λ_p distribution, with notable difference from one neighbourhood to another one, whilst less variation is shown within each district. We also analysed the λ_f directional value, to better evaluate anisotropies of urban texture. Results obtained for three of the analysed districts are displayed, as an example, inpolar plots of Fig. 3a. A remarkable difference is apparent: while data obtained from a regular grid show maximum values on the diagonal direction irrespective of the district analysed, λ_f polar plots computed on irregular element grids are notably different from each other.

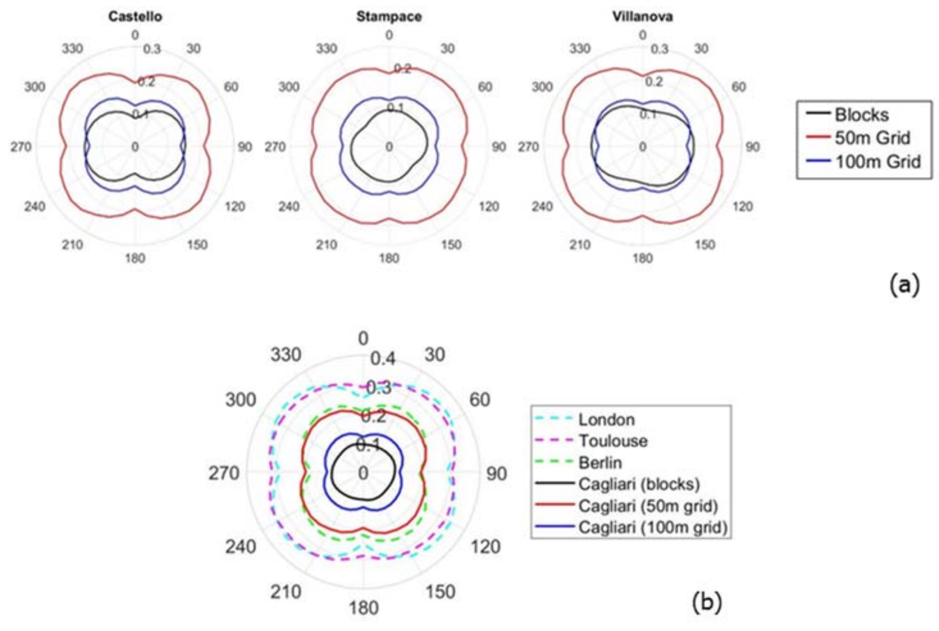

Fig. 3 (a)λ_f polar plots computed for the corresponding wind direction for three Cagliari neighbourhoods, using subdivision in irregular blocks (black line), regular gridded elements at 50 m (red line) and 100 m (blue line).(b)$\lambda_f$polar plots for the whole Cagliari area usingsubdivision in irregularblocks (black line), regularelementsat 50 mside (red line) and 100 m side (blue line) compared with other study casesperformed on regular grids (dotted lines)

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The behaviour observed for the regular grids is prevalently driven by its geometrical properties, more than being a result of the specific urban layout. The same outcome is apparent from the λ_f polar plots obtained for whole Cagliari area and displayed in Fig. 3b. Cagliari λ_f values for the regular grids resemble those obtained by Ratti et al. (2002) for other cities (London, Tolouse, Berlin) using regular 100 m grids: they all have maxima around 45° directions, with Cagliari 100 m grid data almost overlapping Toulouse ones. Conversely, Cagliari irregular block results display an isotropic λ_f distribution, since the effect of the anisotropies highlighted in some neighbourhoods (and discussed above) are lost when averaging data at larger scales. Actually, we compared mean morphometric values since it is a common practise to use them as a reference in this context (Pelliccioni et al., 2016).

The heterogeneous distribution of λ_p and $\lambda_f$values is reflected into the heterogeneous spatial distribution of the roughness length z_0, computed according to MacDonald formula. In absence of such detailed studies, when urban roughness length $z_0$or zero displacement length z_d are needed, it could be possible to choose the appropriate values following the urban area classification by Grimmond and Oke (1999), whose reference values are displayed in Tab. 2. According to the description given by these authors, Cagliari should be classified as a C urban area (i.e. residential-closely spaced < six-story row and block buildings or major facilities like factories, university, etc., town centre). However, comparing Tab. 1 and 2, whilez_d falls within the proposed range,$z_0$from the morphometric analysis is quite different from those obtained by Grimmond and Oke (1999). Moreover, $z_0$distribution is highly heterogeneous; hence its mean value may not be representative. This confirms that using parameterizations obtained in other regions can be misleading, providing different mean parameters.

4 CONCLUSIONS

Getting information about relations between cities air quality and urban morphology, reliable as base to shape well breathing new urban zones, requires an aerodynamic analysis. The latter, in turn, requires input parameters, which are supposed to synthetically represent the complex interactions between the boundary layer and the built environment (Amicarelli et al., 2012).Simulation results can be heavily influenced by these urban context parametrisations, both in case of air quality models (Di Bernardino et al., 2018) or in CFD context (Ferrari et al., 2016). Considering the analysis performed on Cagliari and here presented, some general conclusions can be extrapolated. As main result, it must be noted that caution is necessary when using literature data obtained in different urban contexts. Secondly, the complex town historical development leads to a heterogeneous distribution of morphometric parameters.

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SITE	$z_H\ (m)$	$\lambda_p(-)$	$\lambda_f\ (-)$	$z_d\ (m)$	$z_0\ (m)$
Cagliari	21	0.33	0.10	10.7	0.47
Berlino	20	0.35	0.23	12.1	1.18
Tolosa	16	0.40	0.32	10.9	0.92
Londra	15	0.55	0.32	11.9	0.30

Tab. 1 Comparison between aerodynamic properties obtained for Cagliari and available literature data for some other European cities

CLASS	$z_H\ (m)$	$z_d(m)$	$z_0\ (m)$	URBAN SURFACE FORM
A	5-8	2-4	0.3-0.8	Low height and density
B	7-14	3.5-8	0.7-1.5	Medium height and density
C	11-20	7-15	0.8-1.5	Tall and heightdensity
D	>20	>12	>2.0	High-rise

Tab. 2 Aerodynamic parameters for the four urban area classes defined by Grimmond and Oke, (1999), ordered by height and density

Hence, their mean values computed over the whole urban area may not be meaningful and, in some cases morphometric parameters should be first assessed at a homogeneous neighbourhood level. Then, their bulk effect should be estimated, by focussing on the upwind fetch area. Moreover, the comparison of λ_f computation for grid dataset showed misleading results that can be conveniently overcome using irregular elements extracted from the street graph.

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WEB SITES

"SardegnaGeoportale"

http://www.sardegnageoportale.it/

AUTHOR'S PROFILE

Luca Salvadori is a Ph.D. student in Civil Engineering and Architecture. His main research topics are about pollutant dispersion in environmental flows, especially related to problem solutions like urban sites characterization methods.

Maria Grazia Badas has been an Aggregate Professor in Hydraulics II at the University of Cagliari (Italy), since 2006. She received her Ph.D. in Territorial Engineering from the University of Cagliari in 2005. Her research topics include turbulence and mixing in civil, environmental and biological flows.

Michela Garau received her Ph.D. in Civil Engineering and Architecture from the University of Cagliari in 2019. Her main research interests include atmospheric boundary layer, numerical modelling of urban canopies and dispersion models.

Giorgio Querzoli has been a Full Professor in Fluid Mechanics at the University of Cagliari, Italy since 2006. He received his Ph.D. in Environmental Monitoring at the University of Florence, Italy in 1996. He teaches 'Hydraulics' and 'Environmental Hydraulics'. His research topics are turbulence and dispersion in biologic and environmental flows, such as atmospheric boundary layer and ocean outfalls.

Simone Ferrari has been an Aggregate Professor in FluidMechanicsat the University of Cagliari (Italy), since 2011. He receivedhis PhD in Territorial Engineering from the University of Cagliari, in collaboration with the Imperial College London (UK) in 2007. His researchinterests include turbulence and mixing in civil, environmental, industrial and biological flows.

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PRESERVATION AND VALORISATION OF SMALL HISTORICAL CENTRES AT RISK

MARIA ANGELA BEDINI
FABIO BRONZINI, GIOVANNI MARINELLI

Department Simau
Polytechnic University of Marche, Italy
e-mail: m.a.bedini@staff.univpm.it
f.bronzini@staff.univpm.it
g.marinelli@staff.univpm.it

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ABSTRACT

The fragility of the territories in Italy represents a problem of enormous dimensions, which seems extraneous to the priority choices of the political agenda. It manifests itself with the acceleration of abandonment, in large territories, of hundreds of small widespread historical centres. Abandonment generated by a rapid reduction in the possibilities of work and livability, which has led to the removal of young residents and the natural disappearance of the older population. To this widespread phenomenon the absence of strategies able to improve the level of safety and protection from hydro-geo-morphological and seismic risks is superimposed. The aim of this paper is to evaluate possible strategies to slow down the escape from fragile areas, favoring the return of the population. Particular attention will be paid to the weak rehabilitation processes implemented in some post-earthquake experiences in Italy.

KEYWORDS
Risk Protection; Historical Centres; Rebirth; Fragile Territories

1 INTRODUCTION

Today, the many scattered settlements in the territory of the Apennines and high hillsides, that are at the mercy of rain, snow storms and earthquakes, or will be left alone to their fate or will have to be protected by a inclusive and technological network at local level and at vast area level.

This could be done with initiatives planned and agreed with residents, that ensure effective relations between the different social and economic components, and may be concretized through integrated operational actions, carried out rapidly, at different levels of intervention: from the municipal district level to the Vast Area level (Gambino, 2008). As Campos Venuti has said, «it is necessary to invest, through post-earthquake interventions, not only in the affected area, but in the territorial system as a whole», taking the Vast Area as reference for preventive programming, given the possibility of future earthquakes.

A system should therefore be planned, on a detailed scale, to define the relationship between the urban fabric and free areas, the spaces used for public buildings and emergency structures and roadways, far from risks caused by falling masonry or landslides, that guarantee, even in the case of natural disasters, internal and external access, and network systems that in any case ensure the continuation of services.

In this settlement network of small centres scattered throughout the territory, a system of "functional hubs", should also be planned as strategic protection outposts to defend the territory, equipped with landing spaces for rescue helicopters. Such territorial nodes should constitute "terminals" of a network of protected roads, along which buildings, electricity poles or columns of data of any kind should not be constructed, whose collapse during a natural catastrophe could obstruct the streets. These protected access and escape routes could lead to what were once called "pomerium areas", namely a tract of land denoting the formal, "sacral" ambit of ancient cities. A space where only super-equipped wooden structures may be constructed: a safe shelter, similar to wartime shelters, with a certain degree of privacy for citizens who find themselves having to sleep in these shelters. As well as protected feeding troughs, for the animals. Shelters that may be reached from the ring roads of the small centres, where elderly people and children may find a place to stay for short periods of time if necessary.

Small municipalities should be fully equipped with generators, turbine snow sweepers and any other equipment that may be needed to deal with emergencies. And if these micro-municipalities, that are very often kept as administration districts only for electoral reasons, are not able to protect the lives of citizens, they will simply have to be grouped with larger communities.

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According to the database of the Civil Protection Department (updated on 26 May 2017), 1,141 Municipalities do not yet have a protocol for dealing with natural disasters, such as earthquakes or floods (Department of Civil Protection, 2017). Many of these are in seismic zone 1, which corresponds to the highest level of danger.

The Municipalities in the "earthquake damaged area" of Central Italy are all required to have plans in place to deal with hydro-geological disasters or earthquake, as set forth by a law dating to 2012. What this means though is that these Civil Protection plans, as such, are useless.

In order to keep the few remaining residents and the facilitate the return of those temporarily transferred, it is necessary to draw up and implement a plan to ensure that former residents can return in complete safety, even in the event of new shocks or other natural disasters such as landslides or hydrogeological events, in the coming years. It should not be forgotten that on 18 January 2017 in the locality of Rigopiano, Abruzzo in the municipality of Farindola (Pescara), an enormous block of ice, earth and mud broke away from the mountain, during earthquake shocks, and fell into the valley, destroying the large hotel complex of Rigopiano, built on the confluence of a detrital valley at very high risk of landslides.

Viewers who from abroad watched the live TV coverage of the tragedy of the great Rigopiano Hotel, where a column of cars and rescue vehicles travelling in a 3-meter tunnel of snow, stopped desperately behind a turbine sweeper that were unable to reach, after many hours, the people who were dying, they must have thought that Italy was an extremely backward Country.

And viewers watching the very few heroes who faced the snowstorm simply on skis, walking the last seven miles, must have wondered at this generous but backward society, where not even the simplest form of planning was present.

It was noted, at a very high cost in terms of human lives, that buildings can not be built on streams, creeks or small rivers channeled into great pipes, covered with earth, on precarious natural or artificial balconies, on lands at risk of landslides or hydrogeological disasters, or on areas that are unstable from a geotechnical point of view.

2 PRIORITY SOCIO-ECONOMIC OBJECTIVE FOR THE REBIRTH OF FRAGILE TERRITORIES

To keep the population in the foothills settlement of the interland, it is not enough to build houses, but it is necessary to bring back not only the original citizens, since their sense of attachment is part of its *genius loci*, but also new members of the community.

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In order to encourage these residents to return (Alexander, 2013), it should be remembered that reconstruction is closely linked to the financial situation of citizens and businesses before the disaster, given that it is citizens with more money who are better equipped to face a disaster. And as researchers have observed, reconstruction may lead to a "boom-and-bust" economy, where the reconstruction process fuels a temporary economic growth, at the expense however of the long-term sustainability of the local economy.

That is why it is so important to choose which economy to support.

For example, the decision may be made to support the so-called "Production Landscape" (Abbasi, 2017; Bedini & Marinelli, 2017), with a programme of strategic incentives.

The investment in rural settlements of landscape and environmental value may therefore be a driving force for development, for a new growth model based on the social and production reconversion of the countryside and the environmental and cultural revaluation of the network of widespread settlements, typical of central Italy.

An investment made, for example, with the substantial funds allocated by Marche Region to the so-called "Advanced Cultural District" (Regional Law 4/2010, involving 13 regional projects, 3.05 million Euro; 4 regional initiative projects, 1.75 million Euro), based on the concept that financing cultural and creative projects in areas of historical, architectural and environmental value, may attract businesses and people to the area.

Numerous studies have made it easier to understand the mechanisms and interrelations between policies, the landscape and social-economic and benefits (Zasada et al., 2017).

In some Italian regions, above all in Central Italy, there are new potentialities for this type of development, based on the rural dimension and a new production-settlement model, such as that proposed by the rural policy of the CAP, the approach of Urban Agriculture (Fleury, 2005; Torquati et al., 2015; Poulot, 2007) and the new Agropolitan forms (Donadieu, 2005; Droz & Forney, 2006), Agrourbanism (Fleury & Vidal, 2010), the Food Plans applied in Europe and the USA, or the urban horticulture projects (Daly, 2015) which appeared, in the late 90s, as a way to reorganise Irish agriculture.

In order to reconvert the agro-zootechnical industry, in line with food and production requirements, and social, tourist and cultural needs, agricultural planning should include the introduction of Vast Area Plans in Associated Municipalities Districts.

This is confirmed by the successful experience of small groups of associated municipalities in Marche Region (in the hinterland of Pesaro) and other towns in Emilia Romagna, where it has been demonstrated that small Municipalities are unable to plan new and existing farming activities, that can only be done at district level.

An economic-territorial policy is therefore required with diversified operational tools: urban plans, farm park plans (Giacchè, 2014), agro-urban programmes (SDRIF) (agro-urban

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programmes to protect farming areas and encourage the active participation of farmers in territorial planning choices) (Bernard & Dufour, 2005), *agriurbanism* projects (Maraccini et al., 2013; Vidal & Fleury, 2009), Integrated Territorial Projects (PIT), (PSN, 2006), and tools to implement the structural funds of the European Union.

Consequently, in this moment of instability caused by the global and local crisis in Central Italy, and the difficult resurgence of lands devastated by the earthquake, the settlement filaments, the urbanised countryside and the hundreds of historic-rural buildings may represent an opportunity to reconsider values, in order to relaunch local values and lifestyles in areas of high environmental-landscape value with small populations.

The multi-scale strategy suggested hinges on the desires and involvement of residents (Buttarelli & Ortu, 2008), who are determined to return to the places where they born. The identity of these contexts should therefore be strengthened and supported more carefully. Plans for the hinterland areas, the intermediate hillside areas and coastal areas should be reconsidered as a whole, in order to create a new pact between city and countryside, an understanding of reciprocal usefulness, in order to overcome the current deadlock, and relaunch the development and integration of resources which are, on one hand, widespread and underused, and on the other hand centralised and consolidated (Bedini & Bronzini, 2016; Bronzini & Bedini, 2015).

The pact for an integrated strategy between city and countryside becomes a coherent pact between the coastal and hinterland areas, the areas of the capital and neighbouring territories, putting aside one-sided development of competing Municipalities, in order to develop common territorial services (water supplies, maintenance of sewerage systems, waste disposal sites, waste recycling, distribution of zero-mile foods, health facilities and schools for several Municipalities, supra-municipal public transport systems for the hinterland areas, cooperatives of city-countryside consumers, etc.)

In the territories of Central Italy, the city-country dualism, that has been studied in great detail in other contexts (Clementi, 2008; Secchi & Viganò, 2011), has different and peculiar aspects. And these environments are perfect to regenerate a close relationship between consolidated systems and the rural environment, securely linked to the cultural, food and wine system, environmental and tourist networks and the network of over one thousand small historical-artistic "treasure troves", to which the "advanced cultural districts" (in which cultural and creative projects create new production activities) are connected.

But an effective strategy must be adjusted according to the endogenous potential of places, involving different levels of operators:

- local government authorities (responsible for protecting farm lands and functionality);

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- groups of agricultural entrepreneurs (Milone & Ventura, 2009) (whose responsibility is to increase the quality of products and offer recreational, educational and social-environmental services);
- tourist or food and wine entrepreneurial groups (who also supply sports, social services, environmental recreation);
- cultural groups (in order to insert the historical rural and natural heritage in the economic network);
- artisanal businesses (with typical products);
- old and new local residents (with whom the preservation and functionality of places should be agreed).

This leads to a new planning approach of public spaces in the extensive territory, suggesting elements of recognisability, identification, the boundaries of the settlements and environmental qualification.

This approach was examined in great detail in the book published by Paolo Colarossi (Colarossi & Latini, 2008) and in the Urban Plans developed by the same author in Cisterna Municipality (Rome).

It should also be considered that "modifying an economic policy variable may produce different responses in different territories, in other words, modifications of this kind may have different local values rather than a single global value" (Pecci & Sassi, 2007). It is therefore necessary to «evaluate and develop the endogenous potential of rural areas [...] with differentiated typologies» (Mennella, 2006) and to plan interventions according to the different relationships between the rural areas and linear settlements of the territory.

Despite these strategic approaches however, there is a gap in the governance of the regional territory, at Vast Area level, and a total lack of programming-management for these scattered settlements.

Given the shortcomings of the public bodies, that are evident in the governance of these territories with scattered high-risk settlements, the Productive Landscape approach and the new city-countryside relationship offers a new and unrepeatable opportunity for the economic and social development of production landscapes. It suggests a policy, which is perhaps the only possible option, to relaunch local values and lifestyles in more balanced man-environment settings. Planning should be holistic, given that it is not only a question of substituting damaged assets and infrastructures, but also a question of reconstructing communities, to ensure equity, access to resources and equal opportunities for disadvantaged persons. Only in this way will it be possible to reduce the community's vulnerability to risks.

In a precarious economic and social scenario, the *intellighenzia* of urban-territorial knowledge is called to take a stand against the deplorable shortcomings of risk protection and prevention,

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combating the abandonment of the hinterland, while focusing on a culture to safeguard the territory and regenerate the products of the landscape-environmental system. Without a regulatory front of this kind, the academic world will end up being an accomplice of the deplorable choices of political power.

3 FRAGILE TERRITORIES AFFECTED BY SEISMIC EVENTS

The experience in Emilia Romagna, 2012, represents a milestone in the approach to dealing with the aftermath of earthquakes. For the first time in Italy, this was an earthquake that struck an enormous area with a dynamic industrial, urban and agro-industrial fabric. An experience that was developed with a laborious bottom-up process.

The Reconstruction Plan (Law No. 16/2012) for Emilia-Romagna (Nerozzi & Romani, 2014), the 2015 Special Area Programmes for 24 Municipalities (Regional Law no. 30/1996) (Franz, 2016) and the Plans for the historical centres, all reconfirmed the fundamental importance of the established fabrics, while the Operational Plan (OP) defined an innovative urban plan associated with economic and financial programmes for the social and economic regeneration of the urban historical centres (Isola & Zanelli, 2015).

In other words, this was a shared and planned urban planning strategy, which was part of a vision whose aim was to strategically relaunch a very large territory, that risks abandonment, by introducing preventive measures of earthquake planning. The plan focuses on supporting the population, by reprogramming new production and tourist-cultural functions for the tiny historical centres scattered throughout the territory.

The experience of Emilia-Romagna (where reconstruction was carried out under a new Regional Law and Urban Plan), including the new Special Area Plan, is an example of effective concerted urban planning (in compliance with Regional Law 30/1996), that ensured cross-functional collaboration between municipal and private administrations. The 2012 experience, involving the smaller centres of the Ferrara district, whose infrastructures dated to the Romanesque period and the early Middle Ages and later, the Renaissance period, revealed, with very few exceptions, the degradation and abandonment of the historical centres. These settlements were mostly occupied by low-income immigrant families, who were unable to carry out maintenance or renovate buildings.

In the case of Umbria (1979; 1984; 1997) on the occasion of the earthquake dating to September 1997 (Nigro & Razzio, 2007), the choice of “light” reconstruction made it possible for residents to return to the district within a reasonable period of time, when it was possible to repair the damages incurred with anti-seismic technical solutions. In this case, seismic microzonation made it possible to identify areas with different geological and geomorphological characteristics, over and above the seismic aspect.

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Pursuant to Regional Decree no. 64 dated 8 February 2010, the Region approved the guidelines to define the Minimal Urban Structure for the Reduction of Seismic Risks, pursuant to article 3.3.d of Regional Law no. 11 dated 22.02.2005. And with Regional Law no. 1 dated 21.01.2015, the SUM was structurally included in Urban Planning, in order to identify approaches, spaces, urban functions and strategic buildings to ensure an urban response to earthquakes during the emergency, and maintain and resume urban, economic, social and relational activities, after the earthquake.
The SUM includes the *lifelines*, the main railway communication routes and nodes, the escape routes, the secure open and closed spaces, key centres, collection points for the population. The SUMs include the critical elements: historical urban gateways, steep or very narrow sections of roads, sharp bends, hydrogeological hazards, buildings close to the road, etc.
Far from the media spotlight (and with a logic opposite to the abnormal one of the historical centre of L'Aquila), in Abruzzo (57 municipalities in 3 provinces) the model of negative recovery in progress in the historical centre of L'Aquila was not followed. In contrast, a completely different regeneration model for small Municipalities was being developed and proposed by university groups 9 uniform Areas were identified, where the scope was to ensure coordinated administrative management and pooling of services between different Municipalities. Forms of *governance* involving several municipalities, interrelated at Vast Area level, were also introduced the Reconstruction Plan also acts as a Strategic Plan. The Reconstruction Plan, that involves other building aspects, also acts as a Strategic Plan, namely for social-economic and territorial planning. The Minimal Urban Structure (SUM) was again used, at an urban and territorial level. The possible locations and conditions of collapse of the Minimal Urban Structure were also identified. The places, with the highest level of protection and urban connecting areas, were on the other hand identified. It was in this way possible to integrate the historical centre and the rest of the urban area. And these locations will moreover be safe and beautiful, becoming not only functional elements of the SUM but also areas of cultural, environmental and social value with which the local community can identify itself.

4 OPERATIONAL STRATEGIES

This paper can only limit itself to proposing simple and clear procedural and planning suggestions, that could be used as a Road Map for public initiatives.
Examining the experiences of previous difficult post-earthquake situations, it is apparent that there has been a general difficulty to capture the right opportunity to rethink sustainable settlement models: population, activities, urban and rural homes, historical-artistic artefacts and environments, services scattered over enormous territories that are inadequately protected in the case of natural disasters and have no technological rescue networks, super-

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equipped urban shelters, or a constantly accessible network of central structures, located in strategic hubs at the service of the territory.

An earthquake breaks the existing fragile balance of the territory and makes it necessary to rethink the lifestyle model in these places, based on:

- a territorial urban risk protection system;
- a system of Smart land projects, that improve the services to the community and businesses in the territory;
- a system of new functional relationships between small urban centres in earthquake damaged areas and urban centres outside earthquake damaged areas (transport, cooperatives, itinerant services for production activities etc.) and intangible relationships that strengthen the new ties between residents in mountain, hillside and coastal areas (historic-cultural memory, visual perception, identifying oneself with the emotional enjoyment of beautiful environmental areas, awareness of the quality natural and anthropized areas, etc.).

The experiences in the past have produced successful (Emilia Romagna, Umbria, Marche), but also negative (historical centre of L'Aquila) results. The lack of a permanent guidance center in the prevention, emergency, and post-earthquake rebirth phases is a particularly negative aspect, given that all these phases should be addressed simultaneously and not successively: there should be no emergency Plan without preventive Plans for protection against risks. There should be no emergency Plans with temporary settlements and building reconstruction as a separate and distinct phase, prior to the planning-management of resurgence. The management protocols should impose, in the case of an earthquake, the simultaneous implementation of emergency plans and social-economic regeneration plans.

The post-earthquake environmental situation makes it necessary deal with the phase of social, economic and urban-territorial regeneration, very attentively. A phase, that focuses on the absolute priority of repopulating the territories, that is even more important than reconstruction alone.

This objective should be coded by law and become a cultural, social and economic choice, even though a different allocation of resources to reconstruction and territorial regeneration planning strategies.

The latter should, moreover be based on detailed urban planning projects (SUM Minimal Urban Structures) prepared by experienced urban planners, with concerted urban planning practices and without forcing private individuals to become members of expensive consortia.

The use of these valid urban planning tools (SUM) ensures greater safety in earthquake damaged areas, encouraging citizens to return to the area to take up their business activities and services.

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This practice is applied in Umbria where, with Umbria Regional Law 11 dated 22.02.2005 called "Law for Governance of the Territory", the SUM is included in Territorial and Urban Planning. This practice is currently examined and tested at the weekly workshops of the national University Master (2017-2018) "City and Territory. Innovative tools and strategies for protection against risks for territories in difficulty", in which 40 Universities and Research Centers participate.

As already confirmed by experimentation carried out in Lazio, different planning tools must be integrated, given that the territory regeneration system entails a more complex security, protection and maintenance system of the territory:

- SUM, Minimum Urban Structure to reduce urban seismic vulnerability.
- QSV Strategic Valorisation Framework of Historical Centres.
- Civil Protection Plan.
- PAI, Hydrogeological Structure Plan.
- Seismic microzonation and risk maps.

The resurgence of fragile territories could be based on the economic and social model of the so-called "productive landscape". In other words, an investment in the human capital entrenched in these places, in the historical rural settlements, the environmental values and products of excellence, and on a new relationship of solidarity between abandoned areas, hillside areas and coastal areas.

This solidarity already exists in some environments, and consists of introducing common social, health and emergency services including assistance to businesses, producer-consumer associations, etc.

An integrated economic and settlement system that may become a driving force for a new lifestyle model: social and production reconversion of the countryside and protected regeneration of the extensive settlement system, with its historical and cultural values.

A model where services to agro-zootechnical companies in the territories, as in the case of Valnerina (Umbria), will once again become, itinerant: the itinerant Teaching Post of AgriCulture (Giacchè, 2017), the itinerant butcher and many other "door-to-door" activities, including advisory services for production, access to credit, cooperation.

The above-mentioned Marche Region funding of 16 strategic operational projects uses a different approach, but in any case aims at supporting the driving force of the production Landscape. Projects for employment development based on the knowledge of local entrepreneurs of excellence, driven by cultural and environmental excellence, that are the true unalienable resources of the territory.

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AUTHOR'S PROFILE

Maria Angela Bedini, Associate Professor of the Technical and Urban Planning sector, Department Simau, Faculty of Engineering, Polytechnic University of Marche. Responsible for editing coordination of the International Journal Mterritorio, Journal of Planning, Socio-economic and Cultural Testimony and of the parallel online magazine Mterritorio (www.mterritorio.univpm.it). She has written over one hundred and sixty publications on urban planning and techniques, the city and its emotional and sensorial implications. Books and papers published in the last years: M.A. Bedini, F. Bronzini, The post-earthquake experience in Italy. Difficulties and the possibility of planning the resurgence of the territories affected by earthquakes, in Land Use Policy, Elsevier, 2018; F. Bronzini, M.A. Bedini, The City-countryside embrace, Franco Angeli, Milano, 2015; F. Bronzini, M.A. Bedini, P.N. Imbesi, Elementi di qualità in vecchie e nuove forme di piano, in Territorio, n. 74, Franco Angeli, Milano, 2015M.A. Bedini, F. Bronzini, G. Marinelli, Il respiro italiano. Expo 2015 – The Italian breath. Expo 2015 – El respiro italiano. Expo 2015 – Der italienische Atem. Expo 2015 – 2015年世界博览会——意大利马尔凯大区精神气息, Gangemi Editore International Publishing, Roma, 2015; F. Bronzini, M.A. Bedini et alii, The Measurement of the Plan. Tools and strategies, vol. 2, Gangemi Editore, Roma, 2014.

Fabio Bronzini, Full Professor of the Technical and Urban Planning sector, Department Simau, Faculty of Engineering, Polytechnic University of Marche. Scientific Coordinator of II level master "City and Territory. Strategies and Innovative Tools for the Protection of Risk in Areas in Crisis" (2017-2018 and 2018-2019). Director of the Giovanni Astengo Urban and Territorial Planning Laboratory. Director of the new international magazine Mterritorio, Ancona University Press. Director of the parallel online magazine Mterritorio (www.mterritorio.univpm.it). Books and papers published in the last years: M.A. Bedini, F. Bronzini, P.N. Imbesi, Italian Urban Plans. Diversified Approach Methods to Quality, in Planning Practice & Research, Taylor & Francis; M.A. Bedini, F. Bronzini, Old and new paradigms in pre-earthquake prevention and post-earthquake regeneration of territories in crisis, in Archivio di Studi Urbani e Regionali, Franco Angeli, Milano, in press; M.A. Bedini, F. Bronzini, The New Territories of Urban Planning. The Issue of the Fringe Areas and Settlements, in Land Use Policy, Elsevier, 2016.

Giovanni Marinelli, Researcher of the Technical and Urban Planning sector, PhD, Department Simau, Faculty of Engineering, Polytechnic University of Marche. He obtained the qualification for associate professor. He coordinated study sessions and presented research products at important international conferences promoted by INU, SIU, AISRe and is the author of numerous articles on urban and territorial planning.

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MATERIAL AND IMMATERIAL CULTURAL HERITAGE: IDENTIFICATION, DOCUMENTATION, PROMOTION AND VALORIZATION

THE COURTYARDS AND HALLWAYS OF MERIT IN THE MURATTIANO DISTRICT OF BARI

ANTONIA VALERIA DILAURO
REMO PAVONE, FRANCESCO SEVERINO

Department ICAR, Polytechnic of Bari, Italy
e-mail: dilaurovaleria@hotmail.it
remo.pavone.88@gmail.com
fra.severino@gmail.com

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ABSTRACT

The contribution intends to bring out the possibility of creating an iconographic atlas that can provide an example, therefore an instrument, of investigation of the territory, identifying, cataloging and preserving cultural heritage assets. Then, what is the role assumed by the design as a conceptual and interpretative tool, as a practical and critical act, as a means of documentation and communication in the context of conservation and enhancement of architectural and cultural heritage? Taking inspiration from the research activity of the professors Valentina Castagnolo and Anna Christiana Maiorana of the Department ICAR of the Polytechnic of Bari, conveyed in the proposal of a visual archive on the city of Bari (BDA - Bari Drawing Architecture), the contribution intends to implement their cataloging work, thickening the network of data already present, identifying and cataloging, in order to enhance and promote its use, the courtyards, gardens and hallways of the Murattiano district of Bari. Drawing, through survey and archival research, takes on the role of linguistic system, of taxonomic cataloging, which, depending on the scale of representation, makes recognizable different information about the city. The conservation and enhancement of the architectural and cultural heritage, be it on the urban scale or on the individual building, moves parallel to the themes of design and architectural survey, and the contribution intends to underline this aspect, trying to answer the questions: 'What to draw? How to draw?'.

KEYWORDS
Relief; drawing; cultural heritage; atlas; taxonomy

1 MATERIAL AND IMMATERIAL CULTURAL HERITAGE

The definition of the term *cultural heritage* is rather recent and is the culmination and synthesis of a laborious legal-legislative itinerary.

The term *heritage* also alludes to the economic value of the asset to which reference is made, but also it is intended to indicate the existence of a reference regulation that regulates and protects the assets themselves.

Essentially the cultural heritage is an *open system*, a *dynamic reality*, constantly changing and expanding, containing all those historical, artistic, landscape-environmental and/or archaeological testimonies belonging to the community, subject to protection and enhancement in order to avoid a mnemocide.

The assets that become part of this *open system of cataloging* become bearers of unrepeatable and irreproducible *values*, of formal characters, but also aesthetic and symbolic, such as to render the asset a *unicum*, belonging to the society that produced them, whose replication cannot exist.

An asset, be it movable or immovable, material or immaterial[1], so that it can be protected, enhanced and, for example in case of architectural assets, made available for knowledge, visibility or possible re-functionalization of places, requires a fundamental operation of cataloging, closely correlated with the preliminary phase of *identification* of the assets themselves, meaning by cataloging an operation that becomes a *cognitive tool*, therefore an *ordering principle*.

This operation of a purely practical nature is accompanied by an important phase of *historical-interpretative analysis* and only the sum of these operations allows on the one hand to establish and organize the set of peculiar and valuable assets, object of protection, and, on the other hand, it also becomes a *time of investigation and study* of the territory within which they are inserted. This is why the Rogers slogan of 1952 takes on substance also in the context of the protection of cultural heritage: *from the spoon to the city*, or rather from the single artifact or from the single experience steeped in tradition, to the territoriality, to the historical-geographical identity relegated to the urban scale. The interrelation between cultural and natural capitals, between human and natural activities, between material and immaterial

[1] From the site of the Italian National Commission for UNESCO: "Cultural heritage is not only monuments and collections of objects but also all the living traditions transmitted by our ancestors: oral expressions, including language, performing arts, social practices, rituals and parties, knowledge and practices concerning nature and the universe. traditional craftsmanship. This intangible cultural heritage is fundamental in maintaining cultural diversity in the face of globalization and its understanding helps intercultural dialogue and encourages mutual respect for different ways of living."

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heritage, is thus made to emerge through this *taxonomic cataloging*, made by an open and continuously evolving system that, in its development, aims to define a linguistic system whose *design* becomes a means of communication and knowledge, but also a useful tool for documentation passing through the survey.
But if, as claimed by Umberto Eco *without memory no future is planned*, it is therefore good to preserve the traces of the past, knowing and analyzing the experiences of antiquity to create a *network of development*, whether they belong to a recent past rather than to a past more distant from our time.
After all, *the reality of the present is also historical*, as a further fundamental element for what we could call '*temporal stratigraphy*'.
If already Marc-Antoine Laugier in the frontispiece of his *Essai sur l'Architecture* (1753) represents the close relationship that must be established between the contemporary work and the work of antiquity, depicting architecture as a cultured woman lying on the rubble of history and indicating with the right arm the intertwining of the branches of a tree, which are identified with the primitive hut, then what can be the relationship between antiquity and actuality today, passing through the protection of these same assets of antiquity, a mirror of past traditions and cultures?
The intervention aims to bring out the possibility of creating an *iconographic atlas*, whose ultimate, but fundamental, purpose is a census useful for the protection, enhancement and fruition of assets, thus making a possible methodology suitable for recognition and cataloging. taxonomy of realities and artifacts. An example to refer to and from which to draw a valid starting point, as well as the start of the research to be carried out, is represented by the *BDA archive*, the result of the research work of professors Valentina Castagnolo and Anna Christiana Maiorano of the ICAR Department of the Polytechnic of Bari[2], whose investigation in the Bari area has given rise to a "*visual archive of the city, in which the design of the architectures, represented through the graphic reference model, is connected to the other visual data, both material and immaterial, acquired through the investigation still in progress*". (Castagnolo & Maiorano, 2018).

2 CONSERVATION AND ENHANCEMENT OF ARCHITECTURAL HERITAGE: THE ROLE ASSUMED BY THE DRAWING

If therefore it is not possible to protect what is not known and if the *census of assets* is the only means by which it is possible to pursue policies of protection and enhancement, not only

[2] Please, refer to the consultation of the text BDA - Bari Disegno Architetture by Valentina Castagnolo and Anna Christiana Maiorano, within the URBAN SURVEY series published by Aesi Editore.

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of goods as materials, but also of goods in the landscape sense or immaterial cultural, what in this context can the role assumed by design as a conceptual and interpretative tool, as a practical and critical act, as a means of documentation and communication in the context of conservation and enhancement of architectural and cultural heritage, be?

"*Drawing «is the true view of the architect». The work of recomposition [...] goes through this look. And «since the architect must know the physical world in order to intervene on it, and the physical world is composed of objects, their in-depth and repeated analysis becomes essential for understanding living in its various articulations*.»" (Castagnolo & Maiorano, 2018)

In this sense, drawing becomes a *conceptual and interpretative tool*, a *practical act*, but at the same time critical, a means of documentation of existing reality, but also of communication, a method of knowledge and analysis that allows the asset to move into a theoretical-perceptive dimension.

In a sort of conceptualization process, drawing becomes an instrument of investigation and expression, and the underlying geometry becomes an instrument for investigating the form: as claimed by Purini *drawing is idea, thought, communication and memory*, but "*the drawing is important for many reasons, the drawing today has become electronic, a design that keeps away from that material exercise that was once the design*" (Anselmi, 2013), but despite the change in the means of representation, the evocative and communicative aspect of visual techniques remains unchanged.

3 FOR AN ICONOGRAPHIC ATLAS: IDENTIFICATION, DOCUMENTATION, PROMOTION AND VALORISATION OF ARCHITECTURAL HERITAGE

In 1751 Denis Diderot, flanked by Jean-Baptiste Le Rond D'Alembert, in an attempt to propose a unitary and universal knowledge, in the context of that revolution that was taking place in the spread of culture and thought in Europe, elaborated the cyclopean work of *Encyclopédie*, a work of dissemination, a reference point for the illuminist and progressive culture of the time.

But *what and how to draw*? What is the *design* useful for the codification of a univocal but open *system of representation of reality*, meaning drawing as a datum of the present, therefore as restitution and documentation, passing through the *survey*, understood as a mirror of the past?

How it is possible to tell a reality through images? Or again, how can the kaleidoscopic and changing image of the city be made legible?

What is wanted to represent through the drawing is the faithful interpreter of what is being analyzed or a filtered instrument according to arbitrary logic of 'censorship'?

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The intent is to answer these questions, so that the conservation and enhancement of the architectural and cultural heritage, be it on the urban scale or on the scale of the single building, can move parallel to the themes of design and architectural survey, through cataloging actions that, depending on the case, identify categories of representation and therefore of investigation, but also to restore centrality to the disciplines of design and relief, within the interpretative context of urban dynamics.
But why is Diderot's work so revolutionary, but also exhaustive in its heterogeneity? The answer is probably to be found in the classification table with the original tree of the *figurative system of human knowledge* (Fig.1), proposed as an introduction to the work, which, taking up the Baconian classification system and therefore inspired by the principles of English philosophy, organizes human knowledge according to the generic categories of *memory*, *reason* and *imagination*, including every human activity, from the most abstract philosophical speculation, up to the most concrete artisanal and industrial techniques.

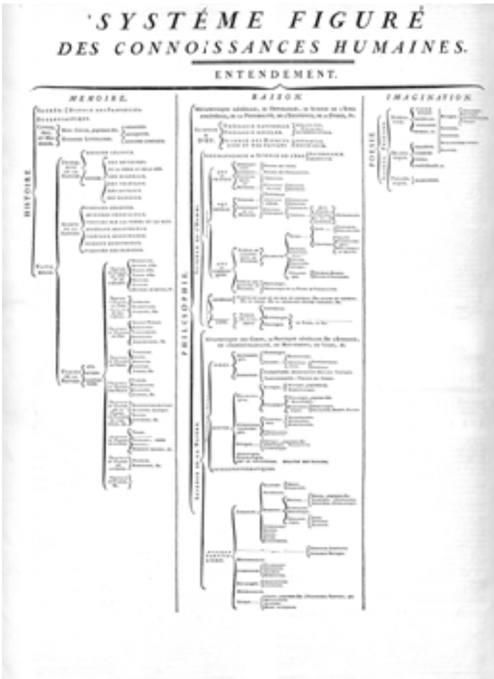

Fig.1 The figurative system of human knowledge

As observed by Barthes in the essay *L'Univers de l'Encyclopédie* (1964 - later published in the Einaudi edition of *Il Grado zero della scrittura*), starting an interpretation of the iconography accompanying the *Encyclopédie* and underlining its poetic nature beyond the merely didactic

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one, the plates included in the *Encyclopédie* seem to start a real philosophy of the object; the encyclopedic object is in fact captured by the image along three different *levels of vision*: an *analog level*, where it appears isolated from any external context; the *anecdotal* one, where it is instead reproduced within a living scenario (we are in front of an object inserted in its productive context); and finally what Barthes himself defines a *genetic level*, that is when the image shows its path from *raw material to the finished object*. In this way, the tables reveal different dimensions and aspects of the same object: they fragment, dissect, work metaphorical shifts, enlarge and shrink.

Then the reciprocal arrangement of the images gives life to a narration to which it is possible to ascribe a reading at multiple levels, according to a double trend: reading the table from the bottom upwards the *epic* path of the object is revived, or rather we go *from nature to society*; instead, if we read the image from above downwards, *we progressively descend to the causes, the materials, the first elements*, to the materiality of the object itself.

We could juxtapose what we could define *degrees of vision* to those identified by Alois Riegl in his *Historical Grammar of the Visual Arts* (1897): Riegl in fact speaks of *normal*, *close* and *distance vision*, referring to three different *moments of perception* dictated by the distance between the eye and the object, which allows a three-dimensional or two-dimensional reading of the object, but also a material and sensorial reading of the same, depending on whether the object is viewed as a whole or that only one detail is observed. What might seem to be an ineffective excursus compared to what was said, could instead represent an important starting point for reflection, a *procedural system* valid for the identification and cataloging of assets for protection and enhancement. Imagining a univocal and homogeneous cataloging procedure is unthinkable, but the creation of a database capable of collecting information that is so inhomogeneous and discontinuous, recreating a recognizable image, transcription of the real, restitution of the true form, is necessary for protection, becoming a tool of research and knowledge, but also a guiding tool, in fact through the consultation it would be possible to identify and document any interventions or transformations, dictated by the needs of the artifact or by the various processes taking place within the urban and cultural sphere.

Returning to the reference example identified in the *BDA archive*, "*the city is conceived as a complex system, a network [...] on which data is distributed (to know, analyze, study, interpret, represent) linked by relationships [...], different in meaning and size, establishing rules* " (Castagnolo & Maiorano, 2018), but being a system that is also open, flexible and implementable, in an attempt to create cross-readings that offer new reflections and interpretative keys, how could the example of the tree of the figurative system of human knowledge of Diderot refine the cataloging system? Certain, it would be possible, taking up the introductory outline proposed by the *Encyclopédie*, to think of working and cataloging,

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analyzing and intervening on every asset, whatever its nature, according to three moments that can be parallel to those of Diderot: Survey | Drawing | Interventions, like Memory | Reason | Imagination, closely related to each other. But if the three *faculties* of Diderot give rise to a synthesis of knowledge that, starting from the cataloging of experiences (connected to memory), passing through a reflection on them (connected to reason), finally reaches the original reworking (connected to the imagination), then the survey (*documentation phase*), passing through the critical design (*classification and cataloging phase*) of what is intended to be cataloged, can identify the critical points of the asset itself, becoming a guiding system, whose ultimate goal is the possibility of intervening (*preservation and conservation phase*) on the asset, for the purpose protection and enhancement, but also of fruition.

But "*to try to reactivate and revitalize an iconographic culture [...] it is important to try to explore the visual universe*" (Rossi et al.,2009) therefore the proposed system is configured as a method of investigation and reading, of restitution and historical reading, a method of codification, which, implemented with information on the state of degradation and / or abandonment, in the perspective of reading the artefact within its context (*anecdotal level*), but also in its being as such, also on a material-constructive level (*analogue level and genetic level*), allows to establish the possible interventions to be performed, for the purpose of exploitation and possible use. Recognized the value of the existing through taxonomic cataloging, then the proposal becomes part of a wider research and will, which involves all the assets, for example of the same surrounding area, bringing out its value, whose direct consequence is their knowledge and fruition, not only of local citizenship, but of a much wider public, also triggering a tourism system around the innumerable assets of the city. The intent is to propose a fruition of valuable assets through a network of *public open spaces*, also *privately owned*, scattered around the city, signaled through appropriate *guides* provided to the users, thus connecting together *fragments of the city* worthy of note, within which we can also foresee the possibility of organizing events.[3]

4 CASE STUDY: COURTYARDS AND HALLWAYS OF MERIT IN THE MURATTIANO DISTRICT OF BARI

On the basis of what has been said, the intervention tries to fit into the research started with the *BDA archive*, in particular it aims to offer new insights on the city of Bari, new categories

[3] In this regard, see the guide 'Secrets of San Francisco - A guide to San Francisco's privately-owned public open spaces' by SPUR: a series of interesting buildings in the city have been made accessible as if they were public spaces, while maintaining their own private nature; the spaces are accessible at certain times of the day, or with specific modalities.

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of analysis and investigation of the Borgo Murattiano (and not only) , with the intention of implementing the documentation already archived, but above all with the aim of shedding light on all those places that, although of architectural merit, are too often not made accessible and usable.

"*The visual space of the Borgo, despite its apparent unitary nature of the plant, is characterized by a multiplicity of architectural languages*" (Castagnolo, Franchini, & Maiorano, 2014), despite the fact that the Murattian Statutes almost imposed very specific building regulations, together with administrative regulations to be applied to building areas that the municipality was yielding to private individuals. Among these rules, in particular, article 7 defined specific guidelines about the constraints related to the use of lots, establishing a minimum mandatory portion of the lot surface to be used for the use of the *courtyard* or *garden*: from this, the desire to *identify*, *classify* and *analyze* the aforementioned courtyards and gardens, including the valuable entrance halls of the same buildings.

In his book '*Bari, il borgo Murattiano*', Marcello Petrignani unravels the development of the village by analyzing some of the blocks that, articulated along the orthogonal grid, have given light to the plan of 1813 for the development of the city: it is evident that each block is inevitably characterized by the presence of a *courtyard*, but why not map the aforementioned courtyards and gardens and make them *public spaces of private ownership*, in order to make the spaces usable, also annexing the possibility of revaluing the value of the building, hierarchizing the spaces according to systems of mileage and/or collective sharing areas?

After all, the buildings that are to be considered, constitute an important trace in the intramoenia and extramoenia architectural panorama, therefore the proposal aims at the re-evaluation of the spaces and the return of these to the community.

The mapping of spaces (Fig. 2) shows the articular complexity of the Murattiano district, but at the same time, it makes clear the image of a possible use of space, following the example proposed by the guide 'Secrets of San Francisco' drawn up by SPUR.

The individuation phase is followed by the survey and restitution by means of the drawing, which becomes a filter between the real urban space and the cataloged one.

The hope is to be able to give life to a new database that implements the already existing one of the BDA archive, defining a real iconographic atlas of the city of Bari, on whose example other realities can move.

- From the site of the Italian National Commission for UNESCO: *"Cultural heritage is not only monuments and collections of objects but also all the living traditions transmitted by our ancestors: oral expressions, including language, performing arts, social practices, rituals and parties, knowledge and practices concerning nature and the universe. traditional craftsmanship. This intangible cultural heritage is fundamental in maintaining*

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cultural diversity in the face of globalization and its understanding helps intercultural dialogue and encourages mutual respect for different ways of living."

Fig. 2 Mapping of the courtyards and gardens of the Murattian district of Bari: public buildings in red, privately owned buildings in white

— Please, refer to the consultation of the text BDA - *Bari Disegno Architetture* by Valentina Castagnolo and Anna Christiana Maiorano, within the URBAN SURVEY series published by Aesi Editore.

— In this regard, see the guide 'Secrets of San Francisco - *A guide to San Francisco's privately-owned public open spaces'* by SPUR: a series of interesting buildings in the city have been made accessible as if they were public spaces, while maintaining their own private nature; the spaces are accessible at certain times of the day, or with specific modalities.

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AUTHOR'S PROFILE

Antonia Valeria Dilauro, Graduate in Architecture at the Polytechnic of Bari in January 2018, professionally qualified in January 2019, currently engaged in historical-manual research, investigating the theoretical aspects concerning the relationship between form and structure in architectural composition, drawing on the disciplines of design and survey, urban planning, but also of interiors and design. Several contacts with the academic world, with which the collaborations are continuous; among the latter, the participation as tutor to the II Seminario Internacional de Levantamiento del patrimonio Arquitectonico in Cartaghena de la Indias and Monteria (Colombia). Some publications and participation in conferences are in progress. Recently winner of the second prize of the Gli Androni più Belli di Bari competition.

Remo Pavone, Architect, graduated at the Polytechnic of Bari with an experimental thesis in anti-seismic design, interested in territorial and urban planning investigations, with particular regard to disused Apulian architectures or those in a state of abandonment. In this context, the participation in the "Italo Balkan Urban Design Workshop 2018" organized by the Polytechnic of Bari. Recent participation as tutor in the II Seminario Internacional de Levantamiento del patrimonio Arquitectonico held in Colombia, organized by the UPB and the Universidad San Buenaventura. Winner of the second prize of the competition of ideas Gli Androni più Belli di Bari and participant in call, including recently Rileggere Samonà of the University of Roma Tre, and at several conferences.

Francesco Severino, graduated in Architecture at the Polytechnic of Bari on 06/27/2018 with the thesis "Shape, Structure, Place", which shows the urban study of the city of Fuzhou for the subsequent construction of two large squares and a river park of over 12kmq. I participated in the Summer School in Structural Morphology at Fuzhou University in China in 2018, and at the II Seminario Internacional de Levantamiento del patrimonio Arquitectonico as a tutor at UBC and UPB in Colombia in 2019, where I made academic relationships with professors of several Italian and Colombian universities.

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PLANNING OF HISTORIC CENTERS IN SARDINIA REGION

CONSERVATION VERSUS VALORIZATION OF ARCHITECTURAL AND CULTURAL HERITAGE

FEDERICA ISOLA, FEDERICA LEONE
CHETI PIRA

Department of Civil, Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: federica.isola@unica.it
federicaleone@unica.it, federicaleone@unica.it

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ABSTRACT

Planning of historic centers has acquired a great importance within national, regional and local regulatory framework. The concept of historic center has been characterized by different interpretations and changes due to, on the one hand, the conservation conception, according to which city center is an identity asset, and on the other hand, to the strategic vision where city center is a source of cultural and economic development at the local level. The normative framework concerning city center planning has been characterized by several phases that have influenced and oriented its development. The European Convention on the Landscape and its implementation within the Italian legislation through the Law enacted by Decree no. 42/2004 "Code of cultural and landscape assets" includes historic center planning within the landscape planning. In relation to the case study of the Sardinian Region, after the approval of the Regional Landscape Plan (RLP) the implementation plans of the historic centers (IPHCs) have to comply with the RLP's Planning implementation code. Moreover, within this process, landscape component and the co-planning approach between regional administration and local municipalities represent two key elements that should address and orient the development of city centers. From this theoretical perspective, this study analyzes the elaboration processes of twenty IPHCs in compliance with the RLP in order to identify the key elements of this process. In particular, the study aims at defining a descriptive and normative framework, based on the key elements identified in the comparative analysis.

KEYWORDS
Historic centers; Conservation and Valorization; Local Plans; Regional Landscape Plan

1 INTRODUCTION

Since the beginning of the XX century, the issue of preservation and rehabilitation of architectural heritage has acquired increasingly importance within the European context, representing a reaction to the "chaos" of the post-industrial era. Although from the 1960s the protection of architectural heritage has been a hotly debated issue, only in 1975 it was formalized in the European Charter of the Architectural Heritage, a document adopted by the Council of Europe (Gabellini, 2011).

In Italy, several laws were enacted in order to preserve the architectural and cultural heritage. The first law on the landscape protection was enacted in 1922 by Benedetto Croce in order to defend and safeguard the most significant natural and artistic Italian beauties. On the other hand, this law focused on historical and cultural heritage and on monumental buildings at the expense of the environmental context in which they were allocated. The Law no. 1089/39 "Protection of historical and artistic heritage", duly noted as "Bottai Law" and the Law no. 1497/39 "Protection of natural beauties" focused on the protection of cultural and historical heritage and they introduced some innovative aspects within the Italian normative framework. On the other hand, once again, the concept of protection was conceived as a "passive protection" that safeguarded the single building without analyzing the environmental context in which it was allocated.

The Law no. 1150/1942, duly noted as the "urban development Law" represented the first planning tool that focused on the entire municipal territory through a land use classification. In the first post-World War II decades, the population growth and the rapid development of urban areas required the use of new planning tools, reinterpreting the spatial plans defined by the Bottai Law. Moreover, during the post-World War II reconstruction the relationship between the "New" and the "Old" acquired a significant importance within the national debate. However, although in 1960 a declaration on the protection and rehabilitation of historic centers, duly noted as "Gubbio Charter", was approved, the concept of historic center was defined by the Law no. 765/1967, hereinafter "Ponte Law". In 1968, the Interministerial Decree no. 1444/68 classified the historic center as "A" zone type, including those urban areas characterized by historic, and artistic values. Therefore, the concept of historic center assumed a new identity, representing both a solution to housing needs and an alternative to building speculation (Cassatella, 2015). In fact, historic center was conceived as an economic asset and its rehabilitation aimed at contrasting the economic crisis by transforming cities (Capalbo, 2006). During '80s and 90's, the focus of the national debate moved from the residential needs to the necessity of areas for the tertiary sector activities, changing the analysis scale from the city center to the municipal territory. Cities have been characterized

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by the implementation of big urban projects and by programming agreements that have involved current problems that affect urban areas, such as pollution, housing degradation, uncontrolled urban sprawl with a consequent distortion of urban landscapes.
The Law no. 431/1985, duly noted as "Galasso Law", established protection restrictions on all the national territory characterized by particular landscape values, excluding "A" type zones. In 2004, the Law enacted by Decree no. 42/2004, "Code of cultural and landscape assets" identified the historic center as a landscape good. Nowadays, the historic center is conceived as a part of the city that need to be planned through an integrated approach. Indeed, the protection policies and strategies that have characterized the planning of historic centers from post-World War II period have entailed a progressive phenomenon of depopulation with a consequent abandonment of these areas. Therefore, the role of historic centers between revitalization and protection measures represents a key issue within the national planning debate and the normative framework (Valente & Gasbarra, 2004).
In this context, implementation planning may play an important role to face challenges that affect historic centers.
This study aims at analyzing the different phases of the co-planning process between Sardinian regional administration and local municipalities for the elaboration of Implementation plans of historic centers (IPHCs) in relation to two different perspectives: the Sardinian regional administration, the authority in charge for the approval of the IPHCs and the local municipalities, the authority in charge for their elaboration. In particular, the analyses aim at identifying the critical elements in the planning of historic centers, in relation to the regional administration's perspective, and the problems in the elaboration of the IPHCs from the local municipalities' perspective.
The study is articulated into four sections. The second section describes the methodological approach used and the normative aspects in planning of historic centers in Sardinia. The third section reports the results of the analyses of the two perspectives. The concluding section discusses implications, limits and suggestions for further research.

2 PLANNING OF HISTORIC CENTERS IN SARDINIA

In Sardinia, the Regional Landscape Plan (RLP) was approved in 2006 and includes the innovative aspects introduced by the Code of cultural and landscape assets that translate principles and strategies of the European Convention on the Landscape into the Italian legislation.
Innovative issues concern the concept of historic center conceived as a landscape good and the involvement of the different authorities (regional administration and local municipalities)

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in charge for its planning within a co-planning process that represents the implementation of the subsidiarity principle (Cangelli, 2012).

According to the RLP, planning of historic centers should aim at defining a new spatial organization of the city and at strengthening social cohesion (Regione Sardegna, 2006). Although the principal historic and cultural resources are identified and mapped by the RLP, their accurate identification and the definition of protection measures are the results of the co-planning process (Regione Sardegna, 2006). The planning implementation code (PIC) of the RLP defines "Areas characterized by historic settlements" (article 51), provides rules (article 52) and defines strategies (article 53) for the elaboration of IPHCs in compliance with the RLP. In particular, "Areas characterized by historic settlements" are defined as centers of antique and primary development and their identification is the result of an accurate analysis of the historical cartography. Centers of antique and primary development are those core parts of the urban settlements that have been development since 1950 and they are not conceived a single asset but as a landscape asset composed by several identity elements. The area of the centers of antique and primary development is identified through a co-planning process between the regional administration and the local municipality. Local municipalities that do not have an IPHC elaborated in compliance with the RLP may authorize only interventions concerning ordinary and extraordinary maintenance, and internal restoration without increasing volumes and surfaces or changing the external building profile. Moreover, the Sardinian regional administration elaborated several documents and guidelines, such as "Lab.Net" Project and the Handbook on restoration of working-class architecture.

This study aims at analyzing the co-planning process to elaborate and to approve IPHCs through two analyses that reflect two different perspectives. The first perspective concerns the authority in charge for the approval of the IPHCs, that is the Sardinian regional administration, and the second concerns the authority in charge for the elaboration of the IPHCs, that is the local municipalities. The analysis of the two perspectives aims at identifying the critical issues that the elaboration and the approval of an IPHCs entails.

The first analysis focuses on official documents1 that officials of the Sardinian regional administration elaborated to approve the IPHCs. These documents may include provisions that must be addressed by local municipality in order to make the IPCH consistent with national and regional strategies, policies and laws. Our study analyzes documents concerning twenty local municipalities (Fig. 1), located in the Sardinian regional territory.

[1] All documents are available online:
http://www.sardegnaterritorio.it/j/v/1293?s=191779&v=2&c=9559&t=1

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The second analysis focuses on the elaboration process of the IPCH of San Basilio, a small town located in the Southern-East part of Sardinia.

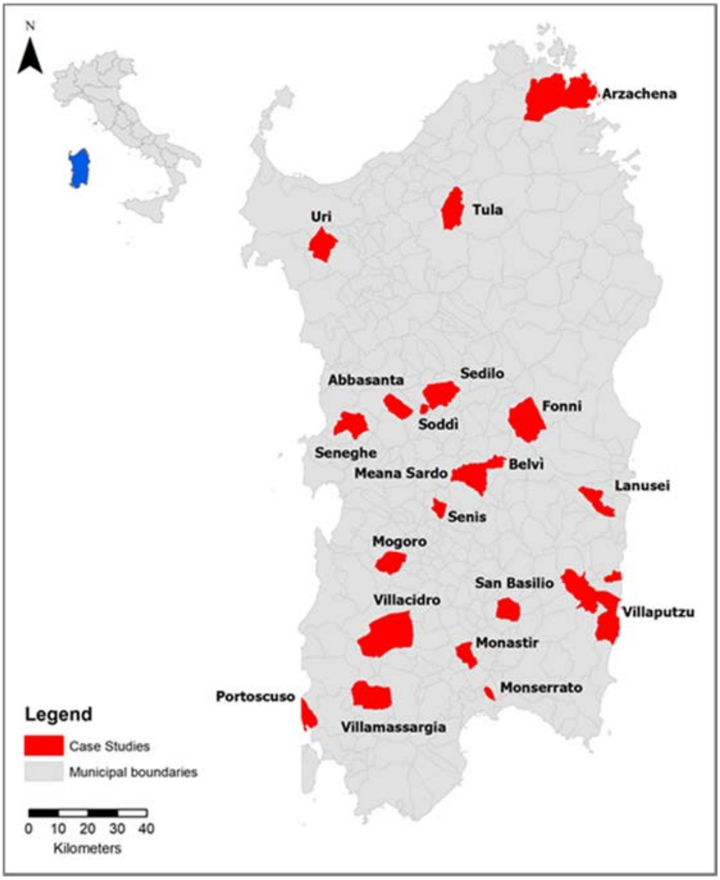

Fig. 1 Case studies

3 THE ELABORATION PROCESS OF IPHC IN RELATION TO THE REGIONAL ADMINISTRATION THE LOCAL MUNICIPALITIES PERSPECTIVES PLANNING OF HISTORIC CENTERS IN SARDINIA

In Sardinia, planning of historic centers must be consistent with objectives and rules defined by the RLP. Therefore, the elaboration processes of the IPCHs is analyzed and described, in critical terms, in relation to the normative context of the RLP. As regards the first perspective, the analysis of the Decisions of the regional government of Sardinia (DRG) in relation to the approval of the IPHCs highlights the repetition of some key issues that seem to direct plans towards the final approval. In particular, key issues concern provisions in relation to building interventions, public spaces and technological systems.

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In relation to urban systems that maintain its historical characteristics, only interventions that do not alter the external envelope of the building are allowed (Municipalities of Abbasanta, Monserrato, Fonni, Monastir, Meana Sardo, Lanusei and Mogoro). Interventions of restoration must concern all buildings within the parcel including little structures used as storage room or stall (Municipalities of Abbasanta, Lanusei, Meana Sardo and Monastir) in order to safeguard their integrity. Moreover, interventions of restoration, concerning public spaces, such as green areas, streets and squares, must be based on a specific study, aimed at harmonizing and enhancing historical characteristics of the city center (Municipalities of Lanusei and Monastir). Empty lots must be designed in relation to their landscape values (Municipality of Lanusei). In particular, if the lot is empty due to demolition of the existing buildings, this empty lot may be used as public space. New buildings within empty lots must be consistent with characteristics of city center in terms of spatial distribution of single buildings and traditional building types (Municipality of Monserrato). New constructions within lot where historical buildings are present must be consistent with the specific typological schedule defined in the IPHC in order to safeguard the historical stratification (Municipality of Mogoro). In case of newly built buildings that do not have traditional typological characteristics, interventions must concern primarily the elimination of inconsistent elements in relation to the historical context (Municipality of Seleghe).

The installation of technological systems for the production of renewable energy is forbidden in those buildings that maintain their historical and typological characteristics. On the other hand, their installation is allowed in those buildings that are not visible from the streets and from panoramic views. In relation to other cases, the installation must be preventively evaluated through photo simulations (Municipalities of Villamassargia and Portoscuso).

In relation of the second perspective, the methodological approach used for the elaboration of the IPHC of San Basilio is based on the analysis of official documents, such as the RLP, in order to understand the structure and contents that an IPHC should have, and on the considerations derived from informal meetings with officials of the Sardinian regional administration.

The key element in the elaboration of the IPHC is the definition of a model to analyze each "minimum unit of intervention", defined as the minimum lot where interventions should be based on a unified design logic in structural, architectural and urban planning terms.

Moreover, although the IPHC governs and plans the territory included within the city center, the relationship between the city center and the rest of the municipal territory represents a critical aspect. In fact, a unified design vision for these transition areas is missing in both the IPHC and the municipal masterplan.

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On the other hand, in the specific case of the municipality of San Basilio, a little town in the Southern-East Sardinia, this inconsistency between the city center and the rest of the urban settlement is not so evident as in other cases.
In addition, the elaboration and the approval process of an IPHC shows some problems due to the coexistence between different needs and expectations.
In fact, on the one hand, the elaboration of an IPHC is strongly influenced by the orientations of the regional administration in terms of methodological approach because the regional administration is the authority in charge for their approval. On the other hand, IPHCs may satisfy expectations and needs of local communities.
In conclusion, this complicated negotiation process often do not take into account some aspects that are not mandatory but that need a unified design vision.

4 DISCUSSION AND CONCLUSIONS

Within the Sardinian context, the elaboration of an IPHC represents a process, strongly influenced by the top. In fact, the methodological approach and decisions are largely guided by guidelines provided by the regional administration and by the strong conservation character of the RLP.
However, in Sardinian municipalities as well as in the majority of municipalities in Southern Italy, citizens express a strongly negative judgment on the landscape of the town where they live, sometimes due to inconsistency of policies concerning restoration and rehabilitation of city centers. In fact, according to the BES 2015 Report (ISTAT, 2015), the 2011 Census displays an almost complete preservation of the residential areas in the historic centers in some Italian regions. Sometimes, decisions of regional administrations focus on the integral preservation of the historic centers without taking into account that construction techniques, lifestyles and housing needs have changed. As a consequence, a revitalization of city centers may be achieved though a mediation between normative issues and needs of people that will invest in those areas. The elaboration process of IPHCs should be based on the protection of historic buildings without inhibiting the social and economic development of the area. In other words, regulations should be more flexible in order to promote the future development of city centers without compromising their conservation.
The analysis of the two perspectives highlights three important aspects in the elaboration process of the IPHCs. The first aspect concerns the necessity to use a methodological approach to identify the key elements that a plan should have.
The second aspect concerns the protection and the enhancement of the historic value of a building in terms of conservation and, at the same time, by adapting the existing buildings to new housing standards. In fact, although the existing socio-economic dynamics entail land-

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taking processes, the re-use of the existing buildings within the city centers may represent an opportunity. City center is not a static element of the urban settlement; it should be conceived as a dynamic part of the whole city where promoting those activities that, in coherence with conservation measures, may revitalize this part of the city in economic and social terms. The third aspect concerns two issues: the co-planning process with the regional administration and the citizens participation from the starting phases of the planning process. In particular, in relation to the elaboration process of the IPHC of San Basilio, the dialogue with local community represented an important contribution to the definition of regulations.

In conclusion, the analysis of the two perspectives emphases the significant identity value that the city center assumes for local communities and regional administration. The greater is the identity value, the higher is his landscape value (Barocchi, 2006).

On the other hand, a high landscape value entails problem concerning policies of landscape protection that, in this context, may be in contrast with policies of urban, socio-economic and cultural development. The phenomenon of depopulation represents the key of the balance of the conflict between conservation and revitalization of city centers. As suggested by Severini (2015), the city center should be characterized by residential uses rather than abandoned areas. In fact, residential uses usually entail the demand for private services and public services should be maintained and developed within city centers. Therefore, both urban restoration policies and financial interventions are necessary.

The methodological approach proposed in this study is strongly influenced by the RLP in terms of strategies and policies, thus it shows some limits due to their possible exportation in other regional contexts characterized by different normative frameworks. However, the methodology, conceived as the analysis of the perspectives of different actors involved within the planning process, is easily exportable in other national and international contexts. In fact, one of the advantages of this methodological approach is to define a normative and descriptive model that summarizes contents and themes that an IPHC should have.

Future directions of the research may concern how and to what extent the implementation of the analyzed IPHC influences the local development of city centers.

NOTES

Federica Isola, Federica Leone and Cheti Pira have made substantial contributions to the study’s conception and design, background and introduction of section 1. Cheti Pira has taken care of section 2. Federica Isola has taken care of section 3. Federica Leone has taken care of section 4.

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AUTHOR'S PROFILE

Federica Isola, Building engineer, is Research Doctor in Environmental Sciences and Engineering (Italy, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Federica Leone, Building engineer, is Research Doctor in Land Engineering (Italy, 2013), and MSc in International Planning and Development (UK, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Cheti Pira, Environmental engineer, is Research Doctor in Land Engineering (Italy, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

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APPROACH TOWARDS THE "SELF-SUSTAINABILITY" OF ANCIENT VILLAGES

FRANCESCA PIRLONE, ILENIA SPADARO

Department of Civil, Chemical and Environmental Engineering, University of Genoa, Italy
e-mail: francesca.pirlone@unige.it
ilenia.spadaro@unige.it
URL: www.unige.it

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ABSTRACT

The paper proposes a methodological approach aimed at enhancing the internal areas through the self-sustainability of the ancient villages. In this regard, the paper considers aspects fundamental for a conservation and valorisation of architectural and cultural heritage and for a sustainable Recovery / Rebirth of the villages.
The new approach starts from the DCBA methodology of the University of Delft - born for planning "ex-novo" districts in the Netherlands - and the CBA method, developed later by the DICCA of the University of Genoa, dedicated to already consolidated fabrics. In addition, a deepening of the "indicator tool" at European level has been developed. To take inspiration in the proposition of interventions, an analysis to know, mainly at Italian level, the abandonment causes and virtuous cases of villages rebirth has been carried out. In detail, an approach, called FRS "Forgotten, Reborn and Self-sustainable villages" is defined. This approach is develops in different phases and proposes actions for a sustainable rebirth of the village under study. In the first step the environmental and social sustainability, and in the second the economic sustainability of the village are analysed. This analysis is preliminary to the proposition of good practices to revive the village and make it self-sustainable. Val Borbera, and more precisely the Rivarossa village, in Piedmont Region, is the case study of the first application.

KEYWORDS
Ancient villages; Rebirth; Self-Sustainability

1 INTRODUCTION

The research presented in the paper analyses the theme of abandoned villages. These villages represent that minor heritage yet to be discovered, capable of offering environmental and cultural resources that can enrich both the tourist and the local communities. They represent the image of sustainable rural tourism that concerns the minor places, mountain or rural areas, where places and nature authentic and unspoiled landscapes are possible to be rediscovered. In this regard, the paper considers aspects fundamental for a conservation and valorisation of architectural and cultural heritage and for a sustainable Recovery / Rebirth of the villages.

In Italy, numerous internal areas, starting from the post-war period, underwent a gradual process of marginalization that led to the depopulation of the villages. These problems have been partially tackled in the "National Strategy for inland areas", which, in the framework of "Europe 2020", represent, for the Italian regions, a financial and methodological opportunity for the programming of community funds available.

The goal of this paper is precisely to find actions for the valorisation of abandoned villages that, in recent years, are increasing and becoming object of recognition by national institutions. On the merits, the Ministry of the Cultural Heritage and Activities and Tourism has proclaimed 2017 "Year of the Villages of Italy", with the aim of enhancing the artistic, cultural, natural and human heritage of these places that represent a decisive component of the country's tourist offer. Furthermore, in 2017 the Law n.158 "Salva borghi" and other initiatives, such as "Borghi Arancioni" (Touring Club) and the "Borgo Autentico Certificato" (Association of Italy Authentic Villages), have had as main objective the rebirth of abandoned villages.

The developed research highlights a new concept: the forgotten village. "This is a depopulated village, but not completely abandoned, with high potential for rebirth" (Pirlone & Spadaro, 2018). In the following paragraphs, an approach and a first application is presented, aimed at proposing actions to re-valorize the forgotten villages.

Starting from the literature, the methodology is developed through the concepts of sustainability (environmental, economic and social) and responsible tourism. The approach is structured in different phases. Initially the "status quo" of the village considered is analyzed and subsequently, through the collected background, a series of good practices to revive the village and make it self-sustainable are proposed.

Case study Rivarossa in Val Borbera, Province of Alessandria.

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2. NEW APPROACH FOR THE "SELF-SUSTAINABILITY" OF ANCIENT VILLAGES.

The research starts from the analysis in the literature of the studies related the planning of sustainability-conscious interventions. The DCBA methodology, developed by the University of Delft to create "ex-novo" eco-sustainable neighborhoods in the Netherlands, is analyzed. This approach, also called the four-variant method, proposes, according to the themes (Energy, building Materials, Water, Food and Waste) and sub-themes (such as heating, solar energy and materials for windows), different constructive solutions in ascending order of environmental friendliness. "One important feature of the design method DCBA is flexibility. The requirements for each variant are benchmarks, which are defined relative to current regulations. D stands for the normal situation and A for the highest attainable point. Having established these two reference points, logical points B and C can be set somewhere between the two" (Konishi, 2005).

Through this method, the examine and link together the urban planning themes is possible; it can be used to determine the level of "environmental ambition" of a intervention even before its design, or as a monitoring during the design and construction phase.

Starting from the DCBA method, the DICCA team of the University of Genoa, in 2005, developed the CBA approach, dedicated to fabrics already consolidated, unlike the DCBA, aimed at new-built neighborhoods.

The CBA method has three reference thresholds:

- C, the current level (referring to the current state of the investigated areas);
- B, the regulatory level (when existing, obtained by foreseeing the targets of applicable laws);
- A, the optimal sustainable goal to be achieved.

The considered issues are analyzed through the quantification of indicators, initially identified. To define a priorities scale of the indicators, the approach uses internally the Delphy method. It is an intuitive methodology, particularly used in the field of business, which through different phases of expression and evaluation of the opinions of a group of experts, or social actors, want to get the most complete and shared opinion. Through the compilation of a questionnaire by a sample of experts, the weights of the indicators, their impacts and their possible solutions are possible to determine.

The weights associated with each indicator can help determine intervention priorities to achieve greater sustainability and then move from the "minimum" C to the B or A levels, defining the actions to be implemented. This approach can be applied to the different scales of reference, from the territorial to the local, to identify the actions to achieve the desired

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levels of sustainability, verifying the effects through continuous monitoring in the medium-long term.
The paper proposes the new FRS "Forgotten, Reborn and Self- sustainable village" approach, which integrates the two previously described methods to create a specific one for the self-sustainability and rebirth of the ancient forgotten villages. The FRS method has three reference levels:

- F, the status quo of the village (which is to be defined as "Forgotten" or "abandoned");
- R, the rebirth (that is the tools and the actions to achieve this goal);
- S, the optimal target to make the village under study "Self-sustainable".

The most important aspects investigated by the new approach are the knowledge of the level of sustainability: environmental, social and economic of the village and the possible actions for one of its rebirth. The approach is divided into two steps: the first examines the two - environmental and social- dimensions of sustainability and the second the economic one. Figure 1 shows the structuring of the proposed new FRS approach.

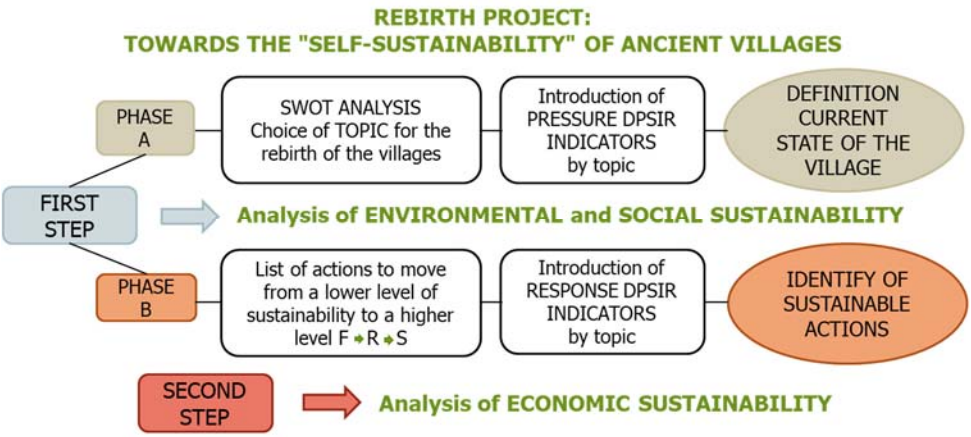

Fig. 1 Structuring of the new FRS "Forgotten, Reborn and Self-sustainable village" approach

The goal of the first step is to analyze the status quo of the village and to understand if the case in question is abandoned or forgotten, that is with good chances of rebirth.
To identify the priority topics, the now known SWOT analysis can be used. Among the possible issues that are important for a self-sustainable rebirth of the villages can be cited for example: energy, waste, tourism and environment, closely related to each other.
In this phase the village must be evaluated in level F to understand the territorial characteristics and the dynamics that interact within the system itself. "For this we need the

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use of the indicator tool that allows us to know the present and future photography of the territory through the reduction of uncertainties" (Malcevscki, 1987).

In scientific bibliography, there are many definitions of indicators, the best known and frequently used are:

- "A parameter, or a value derived from parameters, which points to, provides information about, or describes the state of a phenomenon, environment, area, with a significance extending beyond that directly associated with a parameter value" (OECD, 1993);
- "indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems" (UNCED, 1992).

The proposed approach refers to the DPSIR framework used by the European Environmental Agency: Driving forces (eg industry and transport) cause - Pressures on the environment (eg pollutant emissions) which degrade the – State of environment, which then generates - Impacts on human health and on ecosystems, causing the society - to Respond with various political measures (eg Taxes).

Then, the FRS scheme is created, referring to the current state of the village where, for each topic defined as significant, the indicators are reported. Once the F-level has been quantified, actions to move from a lower level of sustainability to a higher level (F towards R or S) are important to identify. Figure 2 shows the new FRS method, complete with a column related to the indicators and one with the sustainable actions proposed, linked to each topic taken into consideration.

		LEVEL			
TOPIC	INDICATORS	F	R	S	SUSTAINABLE ACTIONS
ENERGY	– production of electricity – electricity production plants from renewable sources – …	…	…	…	– production of electricity through renewable sources – good practices for energy saving (LED bulbs, eco-sustainable household appliances, ..) and energy efficiency – ....
WASTE	– production of waste – separate waste collection – recycling – composting – ...	…	…	…	– urban waste collection – establishment of a door-to-door collection service – composting as a good practice – ...
TOURISM	– accommodation facilities – areas of naturalistic interest – cultural historical heritage – ...	…	…	…	– extra-hotel accommodation activities; – greenway; – creation and promotion of brands; – establishment of km0 markets; – educational activities for schools – ....
LEGEND	– Presence: X – Absence: 0				

Fig. 2 The new FRS method for the sustainable rebirth of villages complete with indicators and sustainable actions

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The second step concerns the economic sustainability evaluation of the revalorisation and rebirth project of the village.

Among the basic instruments of economic evaluation, the proposed approach considers the Cost-Benefit Analysis. Indeed, this Analysis is an essential tool for estimating the economic benefits of projects. "In principle, all impacts should be assessed: financial, economic, social, environmental, etc. The objective of CBA is to identify and monetize (i.e. attach a monetary value to) all possible impacts to determine the project costs and benefits; then the results are aggregated (net benefits) and conclusions are drawn on whether the project is desirable and worth implementing" (EC, 2006). To relate the different indicators, all the necessary data must be transformed into numerical / monetary terms so that all the dimensions are homogeneous and comparable. The CBA can be considered a method of analysis and processing of indicators / indices that determine the number of disadvantages (costs) and benefits (both private and social), referring to the project or program to be implemented.

3. FIRST APPLICATION TO THE RIVAROSSA VILLAGE IN VAL BORBERA (AL)

Val Borbera is in the south-eastern area of the province of Alessandria - entirely within the Ligurian Apennines - and it is the meeting point of four regions: Piedmont, Liguria, Emilia Romagna and Lombardy. Even today the cultural and commercial ties with Liguria are strongly perceived by population.

In the Middle Ages the Valley saw the formation of the imperial fiefdoms. These administrative forms, endowed with the most complete autonomy, guaranteed considerable power to the feudal lords. Together with the impetuous orography they have contributed to the economic and cultural isolation of the Alta Val Borbera (Fig. 3).

Fig. 3 View of the Val Borbera from the fraction of Costa Merlassino and the Strette di Pertuso

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The main ways of penetrating inwards are the backbone of Antola and those of the valley bottom that lead, through further routes, directly to Genoa. These routes of communication have played an important role in the past as "salt routes" and therefore as ways of trade flows between the sea and the plain. The construction of the Strada dei Giovi has interrupting these flows, and it has destined the largest number of villages in the valley to the progressive abandonment.

Rivarossa, case study of this paper, is the highest fraction of the Borghetto di Borbera municipality, in the Province of Alessandria, in Piedmont. The village is in an exceptional panoramic position from which the view sweeps over the entire surrounding territory. The houses, now ruined and immersed in nature, still give an image of what was to be the country before its abandonment, which took place in 1956, when the last family moved (Fig. 4).

LEGEND
1) Rivarossa neighbourhood road
2) Homes
3) Hotel (chestnut dryer)
4) Cascine
5 and 8) Puddle to drink animals
6) Oven
7) Well

Fig. 4 Rivarossa: Cadastral map and view of the Village from Costone la Ripa

Turning to the application of the FRS methodology to the Rivarossa case study, as illustrated in paragraph 1, the first action is to evaluate whether the village is forgotten or abandoned.

Through surveys, analysis of the main town planning instruments and documentation related to the village, interviews and, thanks to the subsequent SWOT analysis, the strengths, the weaknesses (within the village) and the opportunities and threats (considering the large scale) of Rivarossa are analyzed (Fig. 5).

From the SWOT analysis emerge the main topics for a self-sustainable rebirth of Rivarossa: energy, waste and tourism.

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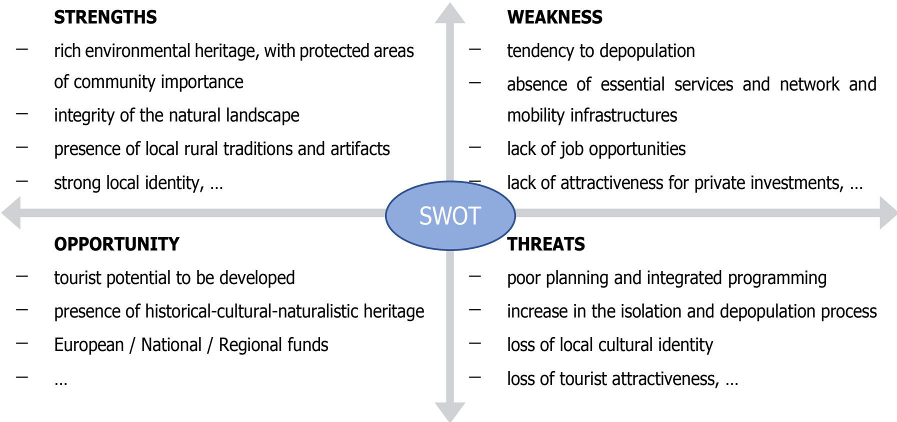

Fig. 5 SWOT analysis of Rivarossa (AL) village.

From the SWOT analysis emerge the main topics for a self-sustainable rebirth of Rivarossa: energy, waste and tourism.

With the first step of the FRS method the environmental and social sustainability of Rivarossa is analyzed. The analysis of the initial sustainability level of the village is carried out by introducing and evaluating the DPSIR indicators, divided by topic (Fig. 6). According to the new approach, Rivarossa can be considered Forgotten and therefore with a good chance of rebirth.

		LEVEL		
TOPIC	INDICATORS	F	R	S
STATUS QUO	– Population	0	/	/
	– Sewerage network	0	/	/
	– Electricity network	0	/	/
	– Natural gas network	0	/	/
	– Accommodation facilities	0	/	/
	– Meal	0	/	/
	– Transportation system	0	/	/
	– Tourist itineraries	/	/	X
ENERGY	– Renewable sources	X	/	/
	– Energy consumption	X	/	/
WASTE	– Urban waste	X	/	/
	– Separate collection	X	/	/
	– Compost	X	/	/
TOURISM	– Accommodation facilities	X	/	/
	– Tourist pressure	X	/	/
	– Naturalistic areas	/	/	X
	– Tourist attractions	X	/	/
LEGEND	– Presence: X			
	– Absence: 0			

Fig. 6 Application of the FRS method to Rivarossa village: analysis of current status

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The chosen indicators are positioned within the scheme according to the following criterion that considers the DPSIR framework:

- In the status quo, indicators that in the DPSIR model represent the Determinants (D) are reported. It photograph the current state of Rivarossa as a "forgotten" village (without electricity, sewers, residents, accommodation facilities, etc.);
- For the energy, waste and tourism topics, indicators that represent the Pressures (P) and the Responses (R) in the DPSIR model are reported. The former coincides with the pressures on the environment carried out by the village activity being reborn, the latter with the response actions that contribute to reducing the impact of pressures through a sustainable development model.

In the continuation of the application the Pressure indicators are introduced and subsequently the Response ones linked to the sustainable actions proposed for the village self-sustainability. In the next phase, to move from a Reborn to a Self-sustainable state, according to the FRS model, for each selected topic the actions for the self-sustainability of Rivarossa, and therefore the Response indicators, for each Pressure indicator, are necessary to define.

Figure 7 shows the FRS scheme for Rivarossa. The scheme is complete with topics, indicators, and this time, sustainable actions aimed at the rebirth of the village in each level, F, R and S.

		LEVEL			
TOPIC	INDICATORS	F	R	S	SUSTAINABLE ACTIONS
ENERGY	– plants to produce electricity and heat from renewable sources – energy consumption	/ /	/ /	X X	– installation in each house and commercial activities of: • photovoltaic solar panels to produce electricity self-sustainable; • solar panels to produce self-sustainable hot water and power plant heating.
WASTE	– urban waste production – separate collection – urban waste collection – compost production	/ / / /	X X X /	/ / / X	– door-to-door collection of urban waste – correct differentiation of waste in: paper, glass, plastic and undifferentiated – distribution within the village of containers for separate collection – disposal of compost inside the educational garden according to an eco-sustainable natural cycle
TOURISM	– accommodation facilities – tourist pressure – areas of naturalistic interest – tourist attractions such as events, eco-museum, etc.	/ / / /	X X / X	/ / X /	– creation of a widespread hotel as a model of sustainable hospitality – ordinary maintenance and cleaning of the local paths – organization of naturalistic visits in the surrounding faunistic and hunting areas – establishment of an eco-museum and events related to rural and local culture
LEGEND	– Presence: X – Absence: 0				

Fig. 7 Application of the FRS method to Rivarossa village: sustainable actions.

Based on the carried out analyzes, interesting touristic opportunities are planned for the area, even if there are some obstacles to overcome. The projects for the rebirth of the territory

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must be based on the valorisation of the architecture and the rural landscape through careful interventions to guarantee their reuse and allow the conservation of the historical past specificities.

Once "reborn", the village of Rivarossa, can grow by relying on the local tourist-commercial network and exploit the potential offered by the recent establishment of the Alta Val Borbera Nature Park (based in Carrega Ligure) and the proximity to the Antola Nature Park. This strategic position, between the two parks, offers important possibilities for enhancing the village. The activity chosen for the rebirth of the village are: a widespread hotel, an eco-museum and an educational garden. The widespread hotel -realized through the recovered of two rural buildings- can collaborate synergistically with the eco-museum and the educational garden, both dedicated to the discovery of the local farming culture, to the customs and traditions of the ancient inhabitants.

The second step of the new FRS methodology allows the evaluation of the economic sustainability of the Rivarossa village redevelopment project. From the economic point of view, the project would be unsustainable. Going however to consider the positive externalities: environmental protection, renewable sources use, village rebirth, paths maintenance, territory, traditions and arts of the past rediscovery and use of possible funding (for example Law No. 158/2017, Rural Development Plan of the Piedmont Region) this relationship is positive.

From this first application, the rebirth project for Rivarossa is therefore sustainable according to the three environmental, social and economic declinations (Quaglini et al., 2018).

In conclusion, the FRS method represents a new tool compared to previous researches developed by the authors on the theme of ancient villages. An innovative tool, both by conceptual setup and by related assessment techniques. This tool can be a valid Decision Support System in conservation and valorisation projects of architectural and cultural heritage capable of "measuring" (in comparative, not absolute terms) the current and expected level of sustainability. In relation to the application presented in the paper, this methodology would be interesting to apply to the different villages present in the vast area. In this way a network of self-sufficient villages could be created which, thanks to the sharing of their potentialities, could have greater guarantees and growth prospects.

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AUTHOR'S PROFILE

Francesca Pirlone, associate professor in town planning at Polytechnic School - University of Genoa, PhD, engineer. She is a teacher in three university courses of three Degree Courses. She has developed different lines of research, from requalification, natural risks, sustainability, waste, tourism, infrastructures and mobility, activities carried out in EU and national programs. Author of numerous publications and speaker at International and National Conferences.

Ilenia Spadaro, engineer, PhD and research fellow in town planning; she carries out scientific activities at Polytechnic School, University of Genoa, where she is adjunct professor in courses on Territorial Planning. Her researches are focused on ensuring safety of a territory by natural risks, requalification of historical-cultural heritage, environmental sustainability themes: waste, tourism, mobility and transport, energy. Author of several publications and speaker at International and National conferences.

ANNEX

Francesca Pirlone: the author has done the paragraph 2.

Ilenia Spadaro: the author has done paragraphs 1 and 3.

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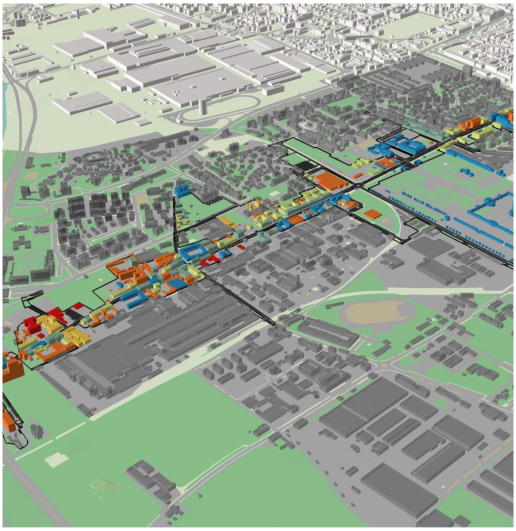

FOSTERING ARCHITECTURE EFFICIENCY THROUGH URBAN QUALITY

A PROJECT FOR VIA MILANO SITE IN BRESCIA

MICHELA TIBONI, FRANCESCO BOTTICINI

Department of Civil Engineering, Architecture
Land, Environment and Mathematic
University of Study of Brescia, Italy
e-mail: michela.tiboni@unibs.it
f.botticini002@unibs.it

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ABSTRACT

The topic of the enhancement of historical centers is taking importance in contemporary planning due of different reasons. The main ones are the will to empower the efficiency of older houses under the energetic point of view, but also, as it is shown by the recent tragic seismic facts, to increase the capability of ancient buildings to reach higher performances creating a safer place for people. The protection of historical areas of cities involved not only monuments and constrained architectures, it concerns also civil houses and open spaces because there is the will to promote historical sites ensuring the achievement of high standards of life and performances. The goal is to make historical sites resilient, to ensure the architectural heritage to respond to external stresses such as the one linked to climate change, the increase of touristic flows or seismic events. Enhancing historical parts of cities ensure to maintain the features that characterize most urban landscapes. This allows to create better places for citizens and to promote new touristic sectors. The paper considers the case study of the city of Brescia, a middle-sized city, in the north of Italy, which has been interested by an urban regeneration process involving especially a suburban neighborhood. A process that has begun in 2016 in Brescia and it is still in development, with firsts consequences on the physical and social matrix of the area.

KEYWORDS
GIS; Urban Regeneration Process; Historical Fabrics

1 INTRODUCTION

In 2016 Brescia Municipality adopted a new land use plan (PGT), with the aim of reducing free soil consumption and fostering rehabilitation of inner areas (Tiboni, 2015). The goal was to promote sustainable development of the land highlighting the importance of urban regeneration processes. To do this, it was necessary to define which were the aspects that most characterized the city, starting from the elements that could generate tourism or develop new economic sectors (Tiboni & Botticini, 2018).

These operations are also fostered by the United Nation with the Agenda 2030 for the Sustainable Development, which asks cities to become safer, more inclusive, sustainable and resilient (ONU, 2015). To reach these targets it is necessary to develop projects that must enhance open spaces (Yaro, 2009) and generate a public value that can stimulate stakeholders to start new partnership with public bodies for the refurbishment of buildings and the strengthening of existing infrastructures. Particularly, the goal 11.4 of the Agenda highlights the importance of cultural and natural heritage in the urban growth. This is due to the increase in real estate investments in urban areas and the development of infrastructures that, as Bandarin said, have altered the physical landscape of many historical cities and the impact of environmental factors on urban heritage, for example traffic, pollution, industrial wastes and acid rains, has increased significantly in recent decades (Bandarin, 2015).

1.1 GIS & HERITAGE

To foster the sustainable development of land it is mandatory to deeply analyse features of assets involved. So, the PGT started to introduce a classification of the urban fabrics considering the future destinations and the urban original role that the areas had in the past. Another important aspect that it is necessary to take in consideration is that the enhancement of open spaces is at the base of the strategy introduced in Brescia by the new PGT. Indeed, importance is given to the existing relation between monuments and squares and how it can be strengthened. All these analyses were first tested for the case study of the urban core of Brescia, in which the development of the site based on the enhancement of the ancient squares network linked to users' behavior was promoted. The analysis done for the elaboration of the PGT were developed with a GIS software, which allows to create databases in which designers can find information about assets features. This data is useful to define which is the most compatible way to operate on architectural heritage (Tiboni & Botticini, 2018).

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Another important aspect given by GIS software is the capability to upload data in online platforms called webGIS. These platforms are very important to spread data and let people to know which and where are the main aspects of the site. Thanks to the structure of the webGIS they can be used as webmaps for tourists and city users too (Tiboni & Botticini, 2018).

1.2 GIS & HERITAGE

The local urban plan characterizes urban fabrics considering when they were built. In relation to this data, a subsequent classification of buildings was done, considering if they are compatible with the stylistic language of the fabric. This kind of information is important because it allows to define which are the admissible interventions to do on assets.
One of the various historical fabrics of Brescia is the area surrounding Via Milano (Fig. 1). In the last years the Municipality decided to invest on this site, considering it strategical for the development of the city; plenty of projects have been designed to enhance the open spaces with the aim to increase the value of the land and stimulate stakeholders to invest in the urban regeneration.

Fig.1 Milano Street in Brescia: the area of interest and its relationship with the city center

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This strategy of redevelopment of a peripheral area also had the support of the national government, which is financing part of the works in progress, thanks to two different calls for financing, in which it was asked to competitors to produce projects for the regeneration of deteriorated urban areas, considering not only the physical structure but also the social matrix. The projects that won the call aim to produce urban quality and achieve the goals indicated by the United Nations through a design of open spaces deeply linked to the analysis of people that live in the area. This is an important aspect because the process of urban regeneration, called "Beyond the Street", is based on participation and fosters social inclusion and security through the creation of areas that are nice under the architectural aspect (Fig. 2).

Fig.2 A new theatre and other interventions on open spaces (Author: Brescia Municipalità)

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2 THE "VIA MILANO RECOVERY PLAN"

The project "Beyond the Street" gives attention to open spaces and facilities for people, with several targets such as to produce urban quality, creating better conditions of life for people and stimulating private stakeholders to invest on site development. But this project is not the only strategy implemented for this area. A recovery plan has been implemented, and its main goal is to foster the private owners to refurbish their own buildings to adequate them to the new standard achieved by the sit. In this way it is possible to capture and capitalize the public value generated by regeneration interventions on common areas.

Already in 2010 Municipality adopted for the area a previous recovery plan, which however did not produce the expected results. The comparison between the analysis of conservation state of buildings done in 2010 with the contemporary conservation state shows that the situation is worsen (Fig. 3)

Fig.3 The conservation state of buildings in 2010 (up) and in 2018 (down); the red-3D buildings are the ones in a worst state of conservation, the yellow buildings are the partially deteriorated and the green ones represent buildings in a good state of conservation. It is possible to see that the red buildings are increased. (Authors: Francesco Botticini, Emanuela Vizzardi)

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As already mentioned, in 2016, with the adoption of the new local urban plan, the Municipality decided to start a general variation for Via Milano recovery plan. Particularly, the PGT identifies this site as important for the development of a of sustainable mobility system that will allow to come into the urban core leaving from peripherical areas (Fig. 4-5). This system must be strengthened with a network of green infrastructures too with the aim to create ecosystem services that can increase life quality in the site and the urban quality of the area according to principles introduced by value-led development (Auzinis & Viestrus, 2017).

Fig.4 The new green network introduced by the PGT. (Author: Brescia Municipality)

Fig.5 The new mobility system introduced by the PGT. (Author: Brescia Municipality)

The recovery plan for Via Milano area is subdivided into three phases; the first one is the definition of the objectives of the plan, the second is the definition of the role of the stakeholders and the third one is the elaboration of cartographical support and the development of the project.

The goals are to achieve high quality of life through the partnership between public bodies and stakeholders, fostering social inclusion, creating new economic opportunities and refurbish the assets in an ecological way in order to ensure ecosystem services and high architectural quality of buildings.

The second phase regards how the partnership can be carried out. The plan is focused on private buildings and it can't force owners to operate. So, it is important to understand which their needs are and how stakeholders can be stimulated to invest. The first action is the discount that owners can have if they want to work on their properties. The other strategies are based on fostering participation and negotiate possible solutions directly with involved people.

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The third phase is the elaboration and it is subdivided into two steps: the first one is the creation of the database in which there are all the features that are necessary to understand the assets. Starting from these features it is possible to develop the second phase that is the project. As it is asked by national and regional laws, an urban regeneration process needs to analyse both physical and social structure of the area, so, the system of knowledge links these two different aspects.

2.1 THE CREATION OF THE SYSTEM OF KNOWLEDGE TO DEFINE THE MOST COMPATIBLE STRATEGY OF INTERVENTION

The third phase of the project was developed with GIS software that was useful to create a database that joined features from the site, from buildings and from residents too. The goal was to understand which the peculiarities of the area are to develop a sustainable strategy of intervention.

Namely, it is possible to define different topics that the analysis considers, such as, urban framework, services and infrastructures, urban evolution and buildings value, conservation state and residents' investigation.

The use of GIS software allowed to map data coming from different sources: first, a series of surveys were done. Than an historical investigation started in which ancient cadastral maps were studied, such as Napoleonic, Teresian and the one of the Italian Kingdom (Fig. 6), old pictures of the site were used too (Fig. 7).

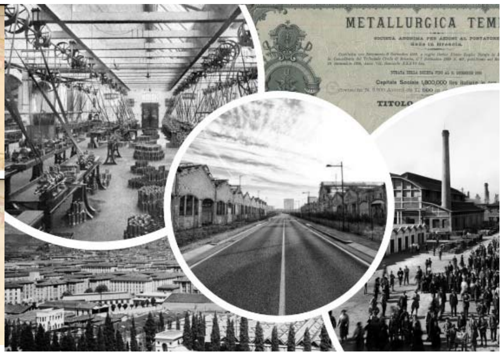

Fig.6 Ancient cadastral maps of the site.

Fig.7 Historical pictures of Via Milano factories.

These steps allowed to define some preliminary features that were mapped to obtain cartographical documents in which the evolution of the site is related to buildings characteristics.

The aim of this phase was to define which are the valuable buildings and the ones that are not compatible with the architectural language of the historical site of Via Milano. Particularly,

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it was possible to define, for every period of urban growth, which architectural typologies were built, and which features they must have. Thanks to the surveys it was possible to define the state of conservation of these components. This is a useful data because it let to define on which buildings it is prior to operate.

Another analysis is the one regarding the constrained buildings that is important to define which are the sensitive blocks along the street and, mostly, if there are buildings that could interfere with the sensitive ones. For this reason, an analysis was done in which, for every block, the incompatible volumes were checked.

With the goal to define the historical feature of the asset the use of the GIS software to relate ages and typologies was important. The same architectural typology builds in different moments can have different features and different typologies build in the same period presents different aspects too thanks to technique evolutions. The GIS software allowed to join these two aspects and obtain a third record that schematizes architectural features that buildings have.

In accordance to surveys, these features were developed in sheets in which every aspect is explained in detail.

After the analysis of valuable buildings and relevant characteristics it was feasible to start defining the guideline for intervention.

The first step in this direction is the creation of a frame of all projects that have been changing the structure of the site in the last years, such as Beyond the Street. The guideline considers the increased value of both, area and buildings, thanks to the operations done by public bodies on open spaces, infrastructures and facilities.

With the creation of new attractive poles along the street, private buildings acquire new importance and, in relation to this aspect, it is possible, to define which the operation that private are can do on their properties (Fig. 8).

This last aspect considers all the previous mapped data. Starting from the architectural value of buildings, the architectural features they have and the importance they acquire it is possible to define compatible and sustainable operations that present different degrees of freedom: the most sensitive buildings are the one on which there is the low level of freedom and the interventions are limited to restauration and conservation. On the other side, on buildings that are not compatible with the historical language of the urban fabric it is given the possibility to private owners to demolish them and replace with other one presenting a high architectural quality.

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Fig.8 3D representation of admissible interventions on private buildings. The purple buildings are the ones with a high architectural value, while the green ones are modern building that are not coherent with the language of the urban fabric. To the purple buildings are linked conservative operations while with the green ones is given the possibility to demolish and replace. (Authors: Francesco Botticini, Emanuela Vizzardi)

2.2 GIS & DIFFERENT SCALES MODELS

As it is asked by the laws, during the elaboration of a recovery plan it is necessary to stress attention on people that live in the site with the aim to highlight its social structure. Namely, in the field of socio-demographic analysis it was possible to join the social matrix of Via Milano to the structural one. The result is a series of maps relating *urbs* and *civitas* (Fig. 9).

Thanks to the GIS software it was feasible to create maps in which the distribution of people along the site is shown in connection to other data, such as the conservation state of houses or the "age" of the fabric in which they live. The other aspect is that GIS software allows to characterize information about population so, it is possible to weight them and obtain distributions related to different aspects such as nationality, gender or people different ages. The process aimed to start from the site general characteristics at urban level up to the architectural ones.

The overlay of this data is important inside the frame of the recovery plan because it let to understand if there are my relationships between different scales variables. Particularly, the data about the evolution is at urban scale, the one about the conservation is at architectural scale and the one about residents is at a lower level.

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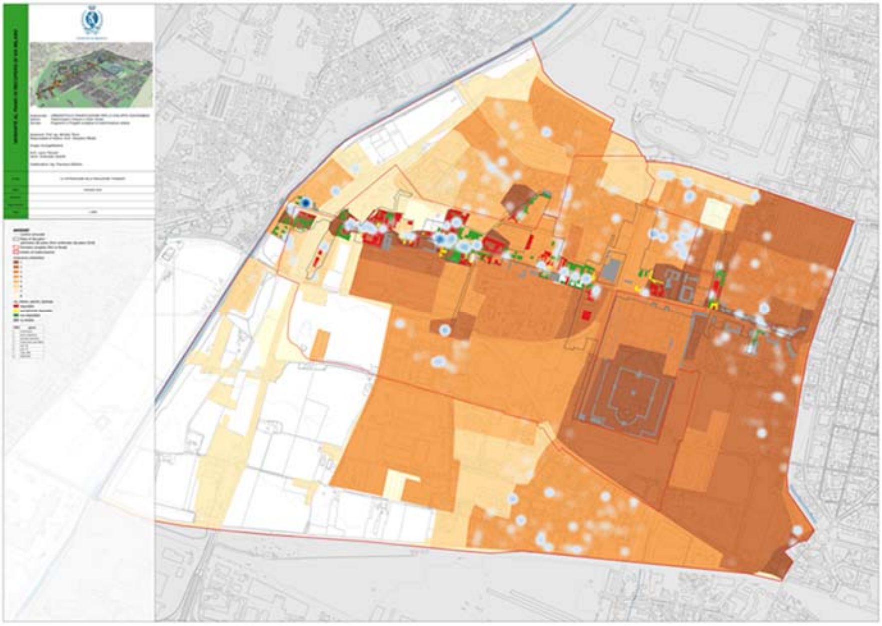

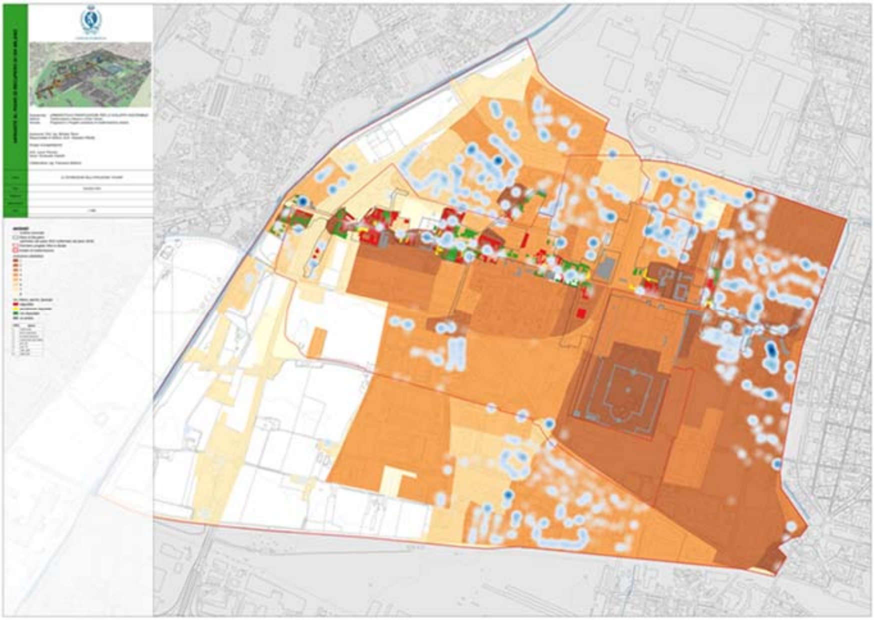

Fig.9 Comparison between the distribution of foreign (up) and Italian people (down).
The blue spots represent the concentration of people on the analysed area; high intensity of blue means high concentration of people. In this maps people are related to the urban evolution of the area and to the conservation state of buildings.
(Authors: Francesco Botticini, Emanuela Vizzardi)

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3 FIRST CONSIDERATIONS AND FUTURE DEVELOPMENTS

The article analyses the urban regeneration process that has begun in 2016 in Brescia and it is still in development. Now the first interventions have started and so, it is possible to see a little part of the firsts consequences they are having on the physical and social matrix of the examined area.

The goals of urban regeneration process are to achieve high quality of life through the partnership between public bodies and stakeholders, fostering social inclusion, creating new economic opportunities and refurbish the assets in an ecological way in order to ensure ecosystem services and high architectural quality of buildings.

The most important aspect is the relationship between public and private intervention to foster urban quality that can generate value and how this value can be captured to enhance the asset of the site.

This is an interesting point because it is linked to plenty of international researches that aims to define new strategies for the development of processes and plans of urban regeneration, with the partnership of public bodies and private stakeholders.

The other important topic of research in which this work is inserted is the one concerning how to use GIS, webGIS and 3D GIS software to enhance historical assets. This process is an example of how new technologies can be used to foster urban and architectural quality through the elaboration of holistic analysis that try to correlate how the assets are done and how they are used.

Implementation of GIS software in the heritage analysis is taking importance thanks to the possibility of creating databases that are the starting point in the assessment of the admissible strategies. Thanks to these databases it is feasible to develop statistical analysis trying to define possible correlations between the mapped features with the aim to find which are the trigger causes that can damage the heritage and the assets, such as, for example, a possible wrong use of the heritage.

Particularly, the implementation of data with the ones coming from a 3D exam can help in defining the features mapped. The use of 3D GIS allows to do more analysis that are not feasible in the 2D plan, such as the one regarding the presence of incompatible volumes inside blocks.

The last topic that this work talk about is the importance given in the contemporary urban planning to the protection and the enhancement of the historical areas of cities. Urban cores have started to have importance in the last years because it is recognized that they are at the base of the sustainable development of the land. In an optic of resilience, it is necessary to define a strategy for the growth of cities not under a quantitative point of view but under a

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qualitative one, so it is necessary to protect the elements that can generate value and a higher life quality in urban areas.

This vision allows to introduce topics inside the recovery plan such as the ones about the seismic vulnerability and the energetic efficiency that have the aim to protect the heritage and pose the base to its maintenance through the ages. This is because it is necessary to maintain the features that are at the base of the development of the land making it sustainable in accordance to the goals given by the Agenda 2030.

All these topics can be developed in future analysis; starting from the definition of a strategy to capture public value, through the implementation of 3D GIS in the definition of the data, coming to the studies of the vulnerability and of the energetic behavior.

Especially these last topics can be analysed with the goal of setting a process that investigate how to use 3D GIS to develop studies on buildings behavior that can help in defining strengths and weaknesses that plans must focus on.

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AUTHOR’S PROFILE

Michela Tiboni, Since 2005 Associate Professor of Town planning at the University of Brescia (Italy), graduated in Civil Engineering, she obtained a PhD in Town planning at the Polytechnic of Milan (2003). Author of books, papers and other publications, her main fields of research are Land-use dynamics and environmental hazards, Evaluation of plan previews for a safe and sustainable town, Urban policies and techniques towards a safer town. She took part in many projects about Mobility safety as a management objective of urban transformation and Developing Urban Management and Safety, particularly working on the application of Geographic Information System (GIS), with attention to the monitoring of the effects of planning and traffic safety measures. Since 2013 she is Councillor for urban planning in the Municipality of Brescia

Francesco Botticini, Graduated in 2017 in Building Engineering and Architecture at University of Study of Brescia with a thesis about the enhancement and the protection of cultural heritage of Brescia urban core. From 2015 he has collaborated with the Urban Planning Sector of Brescia Municipality. He is PhD student since November 2017 and his researches concern new ways for urban regeneration of cities with strong historical vocation, namely he studies how to use GIS to create functional databases to enhance the heritage and to assess the sustainability of urban regeneration processes.

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THE ROLE OF COMMUNITY ENTERPRISES IN SPATIAL PLANNING FOR LOW DENSITY TERRITORIES

CRISTIAN CANNAOS, GIUSEPPE ONNI

Department of Architecture, Design and Urban Planning, University of Sassari, Italy
e-mail: cannaos@uniss.it, gonni@uniss.it

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ABSTRACT

The article investigates the problem of aging and depopulation to which low-density areas are subjected. The problem is dealt with by illustrating the generality of the issues affecting the whole of Europe, to then deepen the case of Sardinia. In the second part a strategy is proposed which, through the implementation of some health services, intervenes on urban regeneration. The idea is to restart from the elderly population, designing services that are adequate for low density, which can trigger virtuous processes capable of producing an improvement in the quality of life of the entire resident population. The article illustrates how local communities should be placed at the center of the process by proposing Community Enterprises (CEs) as socio-territorial figures for managing services. The research aims to make small communities more resilient, as an example the Municipality of Sennariolo is cited, guaranteeing access to some services, currently the prerogative only of those who live in or near the city, recovering the sense of community.

KEYWORDS
Community enterprise; Urban regeneration; Local community needs

1 DEPOPULATION AND THE LOW DENSITY QUESTION

According to the United Nations 2017 report (UN, 2017), Europe is the only continent of the world that is losing population and this trend will continue throughout this century. Moreover the process of depopulation, in the last years is interesting a large part of European cities. A line of research on "Shrinking Cities" is started, investigating the consequences of a strong and prolonged loss of population (Kabisch & Haase, 2011; Oswalt, 2005).

The depopulation become problematic especially in the urban space, where the built environment has a very large inertia and the useful life and resilience of the buildings go beyond that of their inhabitants. Moreover, in these shrinking cities, the building activity slowed but never stopped (European Environmental Agency, 2009), producing an uncontrolled growth of suburbs and sprawl and a constant abandonment of large parts of the existing districts.

Nevertheless shrinking cities represent just a part of the problem.

Europe has been interested for two centuries by a massive concentration of population in the major cities. It has been mainly the result of the emigration of millions of people from the countryside. This phenomenon affected most of the rural areas, often characterized by a constellation of small towns and villages, with vast and difficult territories. These places, starting from a situation of low density of population, had seen further decreased the number of their inhabitants, first due to the massive emigration, and in the last fifty years for the continuous decrease of births.

These changes have influenced the number of inhabitants and their composition. Starting from a population characterized by the presence of children and young people, currently these places are inhabited mainly by elderly people. It means, in the long run, an inability of these settlements to renew and sustain themselves.

But low density of people does not means low density of buildings. Even in the totality of shrinking towns, the construction of new buildings never stopped. It means that currently most of the resident population lives in the new suburbs, while the historical parts of the center are quite empties and are still losing inhabitants.

Moreover, the management of basic services such as water supply, purification plants, waste collection, post offices, banks, kindergartens, schools, become complex and expensive in this scenario, leading to the disappearance of many of them.

The loss of basic services represents another incentive to emigration, further feeding the vicious circle of abandonment.

This continuous depopulation is "producing" a plenitude of uncultivated, abandoned spaces, empty houses, disused industrial areas, closed stations, ruins and demolished sites.

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It is then necessary to found new strategies to provide services, capable to sustain, revitalize and give a resilience to support the daily effort necessary to inhabit these places.

2 DEPOPULATION AND SERVICE CRISIS IN SARDINIA

A large part of the municipalities of the inner land[1] of Sardinia represent an example of territory heavily affected by this type of crisis.

Sardinia on 2011 accounted 1,639,362 inhabitants. It is composed of 377 municipalities of which only 29 exceed 10,000 inhabitants. Among these, only Olbia and Quartu S. Elena exceed 50,000 inhabitants and only Cagliari and Sassari exceed 100,000.

The Sardinian urban texture is formed by a network of small municipalities, which preside a very low-density areas (42 inhabitants / kmq, ISTAT, 2011). In 2011 the totality of the 296 inner municipalities accounted 660,000 inhabitants and just 8 of them registered a population of over 10,000 inhabitants.

From the sixties these settlements are recording, and will record, a real demographic collapse (Cannaos, 2013; Cannaos & Onni, 2017).

According to the ISTAT 2066 median forecasts[2], Sardinia will lose others 510,000 inhabitants over the next fifty years. Currently it is losing over 5,000 inhabitants per year, practically all distributed among the inner municipalities. There is the real risk that many settlements will be completely abandoned in the next future.

Moreover, depopulation is closely linked to aging. According to 2018[3] ISTAT data, 381,849 Sardinians (a share of 23.2%) are over 65 years old. Only in the last seventeen years this quota has increased by 7.1 percentage points.

The provision of public and private services is increasingly based on number of users and on economies of scale, so their costs are totally unsustainable in the territories with low density of population. This has led to a slow, gradual and progressive erosion of local services and the inhabitants have to journey toward the main centers even for the most trivial and everyday things.

If young people can deal with these movements, they often become very difficult for the elderly population. The greater current life expectancy translates into a greater need for daily

[1] Internal areas are defined as those municipalities without coastal territory, with the exception of those belonging to the Cagliari metropolitan area.

[2] http://demo.istat.it/previsioni2017/index.php?lingua=ita (visited on March 27, 2019).

[3] Data available on the site http://demo.istat.it/pop2016/index.html

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healthcare services, and if they are not easily accessible and available it can also become a reason for emigrating.

In general if can be acceptable a reduction of services provided by the private sector, the reduction of public services becomes, in some way, a diminution of the citizenship of who lives in small towns. Their rights seem to be weakened by the situation of low density of population that they live. At the same time it is impossible for the collectivity to pay for scattered services with few users.

If it is important and fundamental to maintain a human presence in all these places (and it is so), then there is the need to find new strategies to provide services.

A paradigm shift is needed, which can allow low-density locations to have some basic services provided locally, without an exceptional increase in their cost.

A strategy can be to provide locally some services, passing from the logical of the inhabitant-user to the one of the inhabitant-producer.

A potential tool to allow this shift can be represented by the Community Enterprises (CEs).

3 COMMUNITY ENTERPRISES AND THEIR ROLE IN LOW DENSITY TERRITORIES

A reaction to the lack of services is often represented by the emergence of social cooperation that seek to give collective answers to the inhabitants' needs. A particular form of this cooperation is represented by CEs.

CEs are a widely used mechanism in addressing problems associated with socio-economic decline in rural areas all over the Europe (Bailey, 2012; Vestrum et al., 2017). These enterprises are extremely interesting due their ability to involve local populations, create social wealth and focus on the "economic, societal, health, and environmental aspects of human welfare" (Zahra et al., 2008).

In every nation and place CEs are built in different ways and organization, and in Italy there is not a national law that clearly define and recognize CEs. Nevertheless, many Regions[4] have approved (in different ways and forms) specific laws or rules to allow their legal recognition. The world of cooperativism is increasingly involved by this phenomenon, has developed some competences, and is promoting and supporting these type of initiatives. It is the reason why we adopted the definition of IRECOOP (2016):

"We are facing a community enterprise when: in the presence of a territory in a vulnerable state and of a specific need, capable of generating an entrepreneurial opportunity, expressed

[4] Puglia,Liguria, Emilia Romagna, Basilicata, Abruzzo, Calabria, Lombardia, Toscana e Sardegna.

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by a real community (not a virtual community); an economic activity is developed aimed at pursuing community development and maximizing the collective well-being (not only of the members) and not at maximizing profit."

Then CEs are characterized by the production of advantages in favor of the local community. The community enterprises may include work activities, user social or mixed activities. The activities they carry out may be directed to commercial management; social assistance and public utility services, environmental protection; agricultural, forestry and breeding activities; recovery of trades and productions linked to tradition; tourism services and management; renewable energy production; communication services.

Among the existing experiences, it is possible to identify recurring traits, as the fact that all cooperatives arise in vulnerable rural and peripheral contexts (Johnstone & Lionais, 2004), generally not characterized by concentration of public or private investments capable of enhancing their economic and social potential.

The identifying characteristics show that they act as strategic actors for local development, responding to the specific needs of the community and enhancing unused or under-utilized resources (Haugh, 2007).

Very often the CEs are promoted by highly motivated groups of young people able to involve the rest of the population, which generally feel themselves excluded or discriminated in the ordinary labour market (Sacconi & Ottone, 2015).

The community is not only the context in which the CEs operate, but it plays a key role in the building of a need and in the initiation and development of a CE, which acts in search of the common good (Daskalaki et al., 2015; Peredo & Chrisman, 2006). Thus every CE pursue its objectives through the production of goods and services in order to have stable impacts on fundamental aspects of the social and economic life of places. Obviously, nothing prevents the fact that the territory and, consequently, the concerned population can be expanded, also varying the articulations of the activities

The social capital of a territory therefore becomes an indispensable element for setting up both organizational and management models that are able to manage themselves.

The members can be both user and/or working members. User members are those who use and benefit from the services provided by the cooperative; the working members, on the other hand, are those that are directly involved in the activities and services provided by the CE and whose professional and working skills are functional and coherent with the objectives of the CE.

The support of local institutions is necessary and fundamental because they can provide, in a more or less direct way, administrative facilities and know-how (Barca, Casavola & Lucatelli, 2014).

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Economically, CEs often act by diversifying the sectors of intervention, focusing attention on economies of scope rather than on growth of scale, finding economic resources also from outside the community of reference (eg supply of services, tourism activities, etc.) (Battistoni & Zandonai, 2017).

However, the typology of community enterprise and the type of activities carried out are not particularly important, but rather the purpose of improving the general conditions and giving value to the community of reference, also promoting cooperative job opportunities especially for young people. The benefits produced are not exclusive to the members of the cooperative but a fundamental characteristic is the ability to develop externalities and offer services that benefit the entire community (IRECOOP, 2016).

There are no substantial differences, both in organizational terms and in terms of governance, between community enterprises and traditional cooperatives, since the small size of the communities that generate them guarantees a strong representation in the cooperative's social base (IRECOOP, 2016).

Even the critical points present recurrent elements.

Surely the most important obstacle to overcome for a CE is the moment of their foundation and start-up. It requires a great effort of the founding members, that have to set aside their personal interests by thinking first of the community's welfare. All of this in a moment where they are personally engaged, both for the time and work to be dedicated to the CE, and for the financial commitment that it requires.

Another problem is the generational shift, because often the promoter group finds it difficult to identify new members or managers for the EC.

Last, but not the least, the access to credit is a strong problem. Even when it is granted, its conditions are often penalizing, affecting the overall economic capacity and, consequently, the possibility of implementing investments of the CEs.

Nevertheless, the CEs are an important and very effective tool when they are successfully implemented within the community.

This is why a small community of Sardinia is trying to set up one of them, to overcome the difficulties it is experiencing.

4 THE START-UP OF A COMMUNITY ENTERPRISE IN SENNARIOLO

It has already been pointed out that one of the consequences of depopulation is the overall aging of the population, which implies a continuous reduction of services to the person that, in a recursive way, affects the concrete possibility of living in a place, especially in the small municipalities.

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The Municipality of Sennariolo, a town of about 180 inhabitants in the province of Oristano in Sardinia, is working to set up a CE, in an attempt to counter this process by guaranteeing the elderly population the presence of a basic medical support while they remaining at their own home.
The idea to start from the needs of elderly people represent a specific urgency (one third of the population is over 65 years old and the demand of daily medical assistance is increasing), but, at the same time it can constitute a starting point to revitalize all the town. The project is thought like a process that starting from the medical assistance, step by step, could be expanded to other sectors its activity, serving all the population and creating new jobs, giving in this way a substantial contribute to the improvement of the general social well-being.
At the same time, this activity also aims to intervene on the homes of the elderly population, adapting them to their needs, or to restructure public and semi-public spaces to adapt them to support functions.
This means adapting, when necessary, the internal spaces and installations of the buildings to make them welcoming according to the type of pathology, starting from those inhabited by the elderly, and involving immediately the houses that are easy to recover or adapt. The basic idea is to identify clusters of houses to also give an input to the recovery of the historic center, working for neighborhood spaces.
At the moment, the establishment of the CE is in the start-up phase but it seems that there are good premises for its success. In fact, the municipality have a good social capital. Despite the little number of inhabitants there are three cultural and religious associations, and the level of quality in solidarity relations is very high.
It is particularly important to point out that the actual Mayor of Sennariolo, Gianbattista Ledda, has been committed to ensure that Sardinia Region approved a law on CEs, and he is working inside himself community to promote this initiative[5]. Moreover, in the last few years the municipality promoted different projects to arrive to the constitution of a CE.
The local health services have enjoyed the additional presence of a nurse, defined as "a community nurse", increasing the level of assistance service, not only for the elderly but for the whole population. At the same time has been started a conversion of some buildings that have to become a reference center for all the questions regarding sanitary and assistance services. They actually host the doctor, the pharmacist, the nurse and will host a center for the medical first aid.
For two years the Municipality has started a collaboration with the Department of Architecture, Design and Urban Planning of the University of Sassari which has produced a feasibility study

[5] Legge Regionale 02/08/2018, n. 35. Azioni generali a sostegno delle cooperative di comunità.

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for the activation of the CE. In addition, a residential workshop[6] held in November 2018 has carried out surveys and interviews from which to extract ideas and models for the definition of a project that could support the activities of the cooperative.

About 40 interviews were conducted, spread over a total of 91 family units. The interviews were always aimed at the elderly and, where present, at least one other cohabiting relative, to better understand the real needs of the population. Some privileged actors were interviewed (pastor, social worker, general practitioner, members of the municipal council, some representatives of the associations), to get feedback on what emerged from the general survey and to identify people who might have interest, skills and abilities to start the cooperative.

The path has begun and the activities of the cooperative will start during 2019, with the declared objective of making it multifunctional, investing in addition to social activities also on agriculture and tourism.

Thanks to the work carried out in recent years, the Municipality of Sennariolo is starting to access funding for the launch of the CEs, especially those coming from Territorial Programming[7].

This shift from users to producers of services seems to be a necessary paradigmatic change to guarantee a good access to services and the improvement of quality of life in depopulated and in crisis contests. The CEs cannot be the instruments of salvation for any context in crisis, in many cases they have failed, but certainly they represent an option, a good attempt to be implemented on the path of local research to counter depopulation and the marginalization of some territories.

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[7] Development tool included in the 2014-2019 Regional Development Program of the Sardinia Region.

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AUTHOR'S PROFILE

Cristian Cannaos, graduated in Civil Engineering, Thesis in territorial planning. Doctorate at the Faculty of Architecture of Alghero, Thesis "The territorial policies for tourism". For the Faculty of Architecture he coordinated from 2005 to 2014 the Tourism Observatory in Alghero and in the Province of Sassari. It has always conducted research on the tourist field and on the relationship between territory and inhabitants. It also operates in the field of environmental assessment, especially on EIA and SEA..

Giuseppe Onni, engineer, he is a PhD in Space Environmental Planning. Since 2004 he has carried out research and teaching activities at the Department of Architecture, Design and Urban Planning of the University of Sassari, based in Alghero, where he was a lecturer in Urban Management and a research fellow. His research has often turned to the effects that tourism policies have on plans, urban spaces and the resulting transformations, especially in low-density areas.

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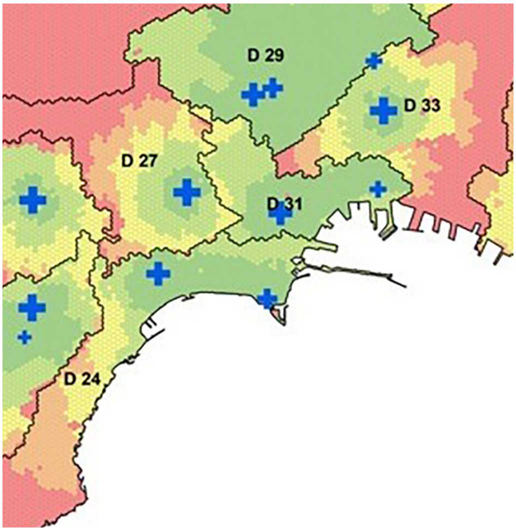

MEASURING MULTIMODAL ACCESSIBILITY TO URBAN SERVICES FOR THE ELDERLY

AN APPLICATION AT PRIMARY HEALTH SERVICES IN THE CITY OF NAPLES

GERARDO CARPENTIERI[a], CARMEN GUIDA[a]
HOUSHMAND MASOUMI[b]

[a] Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Italy
e-mail: gerardo.carpentieri@unina.it
carmen.guida@unina.it

[b] Center for Technology and Society of Technische Universität Berlin, Germany
e-mail: masoumi@ztg.tu-berlin.de

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ABSTRACT

In Europe, the share of people aged 65 years and over is expected to increase exponentially, and for the first time in human history, in 2050, the number of older people will be greater than the number of children under 15 years old. At the same time, aging is associated to an increased vulnerability and dependence on medical care services. An ageing population poses various challenges to a society and improvements in the medical and transportation systems are needed to maintain and to improve the quality of life of the elderly population. From the perspective of social equity, everyone should have the opportunity to access such services equally, but because of economic and geographical issues, it is a challenge to achieve such level of equity. The aim of this study is to fill the gap between scientific and real practices through an accessibility measure able to evaluate urban accessibility to primary healthcare services and to support decision-makers to better allocate resources, in local welfare policies restructuring. The accessibility measure was designed considering both the land-use and the transportation components, taking into account the local healthcare supply system and a multimodal transportation network. The methodology was applied for the city of Naples, considering Local Health Agency (ASL) healthcare services to elderly population. The supply consists of 17 buildings used by nearly 200,000 of old people. The outputs show that entire neighbourhoods' elderly population suffer from a very poor accessibility to primary health services, especially in the city suburbs, and that the methodology could be effective in urban palling strategies to achieve a high quality of life for elderly people.

KEYWORDS
Accessibility; Elderly; GIS

1 INTRODUCTION

Demographic ageing is an increasing phenomenon in urban areas and its economic and social consequences are comparable to the industrial revolution (ARUP, 2015). In Europe, the share of people aged 65 years and over is expected to increase from 19.4% in 2017 to 30% of the total population in 2060 and for the first time in human history, in 2050, the number of older people will be greater than the number of children under 15 years old (Eurostat, 2018). Moreover, in the European context, the demographic shift would be dramatic for Germany, Portugal, Spain and Italy, where the most aged major cities are located. The Italian Institute of Statistics (ISTAT) forecasts a significant reduction of the total population, from over 60 million people in 2018 to 46 million in 2065, and at the same time a noteworthy increase in the over-65 population (from 22.7% in 2019 to 30.5% in 2065). This means that Italy would be an even older nation.

Considering their significant increase in number and their health condition, the elderly represent an essential group of interest: due to improvements in nutrition, sanitation and medical care older people are healthier than previous generation but, at the same time, aging is also associated to an increased vulnerability and dependence on medical care services. From the perspective of social equity, everyone should have the opportunity to access such services equally, but because of economic and geographical issues, it is a challenge to achieve such level of equity (Kim et al., 2018). Local authorities should prioritise the implementation of policies to promote higher life-quality standards for this increasing portion of population and the accessibility approach can be useful to achieve this aim. It takes into account both the land-use system, consisting of the amount, quality and spatial distribution of supply and demand of activities, and the transport system, considering individual needs, abilities and opportunities (Geurs & van Wee, 2004; Papa et al., 2017). Since studies showed that mobility and accessibility trends of the elderly are a critical trial to transport systems (Aceves-González et al., 2015; Buehler & Nobis, 2010; Currie & Delbosc, 2010; Voss et al., 2016) the provision of a sustainable transport system, designed for the elderly's mobility needs, is both urgent and necessary (O'Neill, 2016). On the other hand, the activity system needs to be shaped and organized in order to gain a uniform level of access within the same city. It is crucial to provide decision support tools to local administrator to evaluate and assess the accessibility level to medical care services in urban areas (Papa et al., 2018b).

The aim of this paper is to measure the number of elderly people that suffer from a poor accessibility to public primary health care services according to the active accessibility paradigm. The procedure was applied for the public primary health services in the city of

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Naples, Italy, and it can be taken for other similar cities in case of urban size and socio-demographics.

The project is targeted to develop strategies and decision-making tools for improving the location of services for the elderly and their accessibility using public transport. The structure of the paper is organised into four different parts. Following this introduction, in section 2, a GIS-based methodology is proposed in order to compute the urban accessibility in urban areas; in section 3, we discuss the application to the city of Naples; in section 4, we analyse the results and discuss further research developments.

2 BACKGROUND

Due to the increasing political and scientific interest on the topic, several methods and approaches were produced for determining healthcare accessibility and, based on the application context, these measures vary a lot in terms of theoretical basis, operationalisation, interpretability and communicability (Geurs & Van Wee, 2004). The simplest way to assess healthcare accessibility is to use contour measures (or opportunity measures), defining catchment areas by drawing one or more travel time contours around a node and measuring the number of opportunities within each contour. This measure is easy to compute and understand but suffers of a poor theoretical basis, since different distances within the same area have no weight to evaluate accessibility. Moreover, in a metropolis where many alternatives exist the distance to the nearest primary care service does not match people demand. In order to define catchment areas by measuring travel impediment on a continuous scale, gravity measures were introduced: even though they are more accurate representations of travel resistance than contour measures, they tend to be less legible and neglect the variation across individuals living in the same area (Scheurer & Curtis, 2007). Utility-based accessibility measures are the link between infrastructure provision and perceived individual and societal benefits, assuming that people select the healthcare alternative with the highest utility. Although the strong theoretical basis (McFadden, 1975), it could be difficult to compute and interpret these measures.

In order to contribute to these debates, this paper proposes a GIS-based procedure to evaluate public primary health care accessibility, considering a multimodal transport network (walking streets, bus lines, metro lines and urban rail lines) and through the lent of social equity. The aim is to quantify elderly people that suffer from a poor accessibility to public primary health care services according to the active accessibility paradigm. The procedure was applied for the public primary health services in the city of Naples, Italy.

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3 METHODOLOGY

In this study, we develop a GIS-based procedure to evaluate the level of accessibility to elderly urban services considering the demographic characteristics of potential users, the multimodal transport service (characteristics of walking street, frequency of service and localization of urban transport stops) and characteristics of health services.

The proposed GIS-based procedure is organised in the following three steps: data collection, GIS spatial analysis and representation of results. Methodologically, our approach integrates the use of open data (spatial and alphanumerical) and organizational capability, analysis and representation of Geographic Information Systems (GIS) software. According to GIS Model Builder tool of ArcGIS Pro 2.2 software, we defined a geoprocessing workflow to execute operations that organize and analyze the alphanumeric and spatial data (Fig. 1).

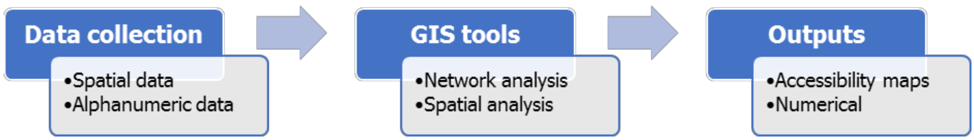

Fig. 1 The phases of GIS-based procedure to evaluate the multimodal accessibility of elderly at urban services

In the procedure first step, it is necessary to create a geodatabase using a GIS software, containing different types of data (spatial and alphanumeric). To improve the data output accuracy of the GIS-based procedure, we introduced a regular spatial grid to divide the area of analysis into small spatial units. The use of grid frames is very important for experimental and observational science, as well as providing the most common framework for spatially explicit models. The hexagonal cell, which is the minimum spatial unit in which the study area is divided, has mainly hexagonal and square shapes, which side may have dimensions previously selected by the user based on the area to be analysed (Papa et al., 2018a). In literature, the use of a hexagonal cell rather than a square one is best advised for dealing with areas that have problems related to the connectivity of different space units and the identification of shorter paths for calculating travel distances (Kibambe Lubamba et al., 2013). For this GIS-based procedure, we used as a spatial unit a regular hexagonal cell with a side length of 50m that provides greater aesthetic attraction but above all a greater accuracy in the calculation and visualization of numerical data. According to the previous studies, to assignee the census tracks socio-economic data to hexagonal cells, it used a proportional function that considered the buildings footprint located in each cell (Papa et al., 2018b; Carpentieri & Favo, 2017).

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In the second step, geoprocessing, joint data and network analysis operations elaborate the data to evaluate the travel time and accessibility level to health services for the elderly people. In order to evaluate travel times from each hexagonal cell to the main local health buildings, we created a multimodal transport network. We considered the network as the combination of both walkable streets and local public transport lines (bus and metro) to better simulate elderly mobility habits. The ArcGIS Pro 2.2 Network Analysis tool was used to compute the OD travel matrix. We run four different analysis during morning peak-hour (9:00), for an average adult, for a 65-69-aged person, for a 70-74-aged person and for an over-75-aged person, considering four different walking speeds for each age category (Papa et al., 2018b). In the third step, maps and tables were produced to quantify, numerically and spatially, the results of the GIS-based procedure and support the planning process of decision-policy makers. The results of this procedure can be easily used also by elderly, in order to choose a more comfortable dwelling neighbourhood.
Tab. 1 provides the list of alphanumeric and spatial data (vector and raster) requests for the application of the GIS-based procedure.

DATA	CATEGORY OF DATA	TYPE OF GEOMETRY	SOURCE
Population	Alphanumeric	-	Statistics Institute
Transport schedules	Alphanumeric	-	Transport companies
Primary health services	Vector / Alphanumeric	Point	Local Health Agency
Walking street network	Vector	Polyline	Open Street Map
Transport network	Vector	Polyline	Transport companies
Census tracts	Vector	Polygon	Statistics Institute
Buildings	Vector	Polygon	Geoportal
Digital Terrain Model	Raster	-	Geoportal

Tab. 1 Data selected for the implementation the GIS-based procedure

The accessibility level was measured for each hexagonal cell, using the following formulas:

$$Acc_{j|d,i} = \frac{\sum_{k=1}^{n} S_{k|d}}{P_j * t_{travel\ j,i}} \quad (1)$$

$$Acc_{j|d} = \sum_{i=1}^{m} Acc_{j|d,i} \quad (2)$$

Equation 1 is used to compute the accessibility of each cell j to the nearest health service i, within the same district d. It is the ratio between the sum of primary health services (surgeries) offered in i, Sk, and the dwelling population in each cell j multiplied with the total travel time, in minutes, to reach the primary health building i from the barycentre of each

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hexagonal cell j. Equation 2 represents the second step of the accessibility measurement: for every hexagonal cell, we summed the accessibility of each health building within the same administrative health district. According to the literature (Bauer & Groneberg, 2016; Kim et al., 2018), we identified five different accessibility classes for this case study considering the minimum number of primary health services useful to elderly (S_k) and travel time thresholds (15, 30, 45 and 60 minutes).
According to the literature review (Bauer & Groneberg, 2016; Kim et al., 2018), we identified five different accessibility classes for this case study considering a minimum number of primary health services useful to elderly (eleven services) and travel time thresholds (15, 30, 45 and 60 minutes). These levels of accessibility have also been applied in this study.

LEVEL OF ACCESSIBILITY	TRAVEL TIME	A_J
-	[min]	-
VERY GOOD	<15	>0.73
GOOD	15-30	0.73 – 0.37
LOW	30-45	0.37 – 0.24
POOR	45-60	0.24 – 0.18
VERY POOR	>60	< 0.18

Tab. 2 Accessibility thresholds

The proposed GIS-based procedure is applied to the city of Naples to evaluate the urban accessibility at public primary health services for the elderly people. We selected this case study because it represents one of the most interesting examples of a complex southern European city with high population density, non-uniform urban structure and the absence of a specific plan to satisfy the elderly people's needs.
The city of Naples has 970,185 inhabitants (ISTAT, 2017) within 117.27 km² and is the fifth Italian city in terms of population density. In the last decade, the city was affected by a gradual increase in the elderly population: from 2008 to 2018, the elderly population of the city increased of 20,052 inhabitants (ISTAT, 2018). The Naples Local Health Agency (ASL) is responsible for the primary healthcare supply in the city boundary and it has a very complex structure due to the numerous demand (nearly one million units) and the socio-economic and health heterogeneity within the competence area. The Naples ASL has eighteen hospital institutions spread all over the city but, in order to better program and allocate resources, to monitor and manage medical care and treatments, health districts would have a significant and strategic role.

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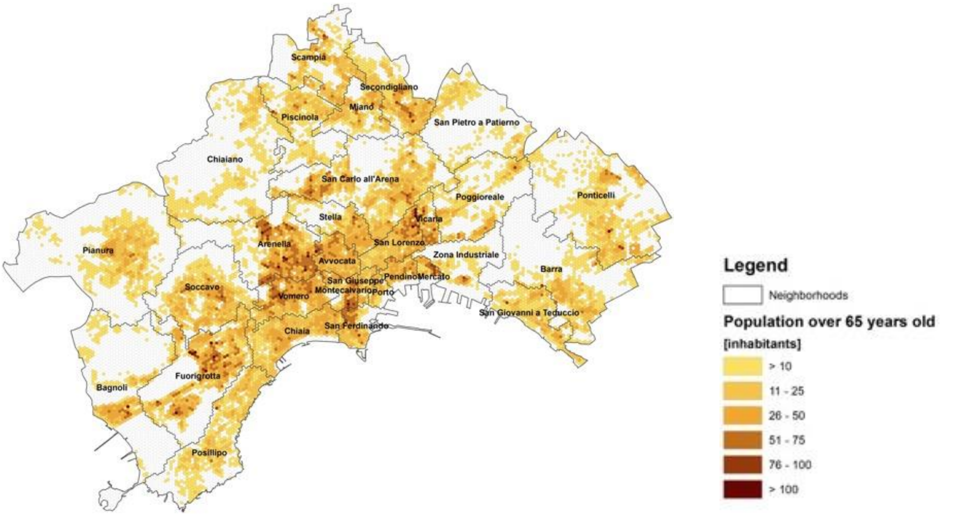

Fig. 2 The distribution of over 65-years-old population

The Italian law (D.Lgs. 229/1999 Art. 3) regulates health districts functions and identify them as territorial joints of ASL, the closest health supply for citizens. A programmatic document of health services supply at local level organizes the Districts activities and the ones belonging to upper health public levels and equivalent private services. Hence, Health Districts have a strategic role in the present welfare system whose aim is to integrate this form of assistance to more institutionalized solutions, such as physicians and voluntary organizations.

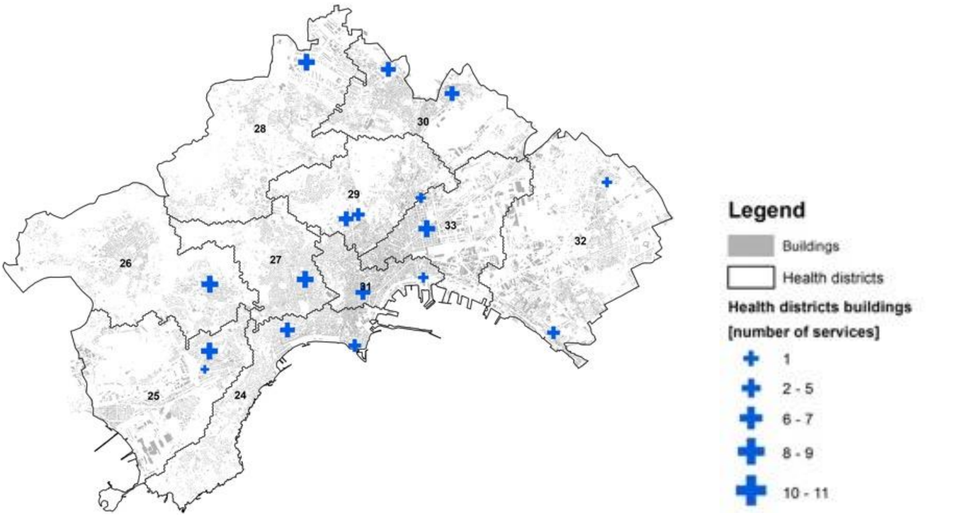

Fig. 3 The location of primary health buildings for each district

They represent a significant tool in order to limit social exclusion in urban areas.

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For the first application of this methodology, we selected local health primary services supplied by Naples ASL.

Fig. 4 The multimodal transport network

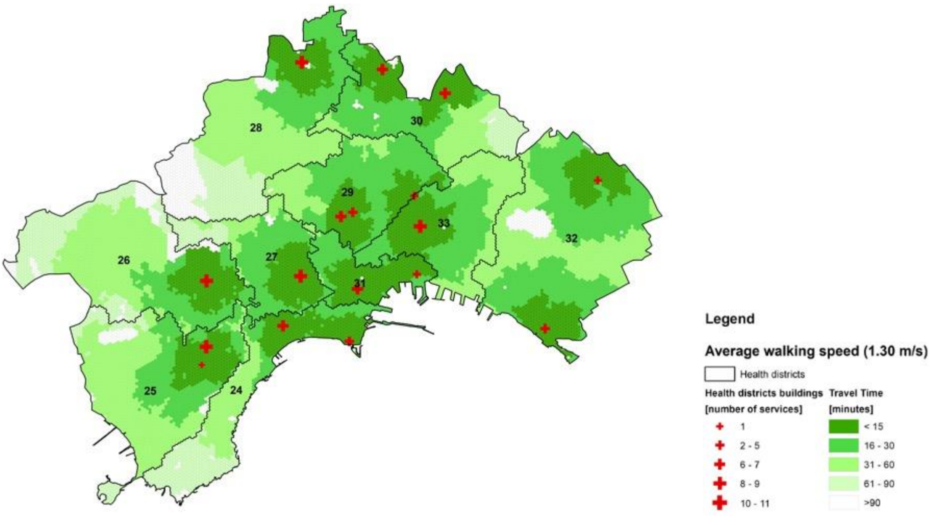

Fig. 5 The travel time to primary health centers

In particular, the municipality of Naples is divided in ten health districts, whose administrative boundaries overlap one or more neighbourhoods' borders, as reported in Tab. 2. Their structures are spread in the whole city territory and they offer the following primary services

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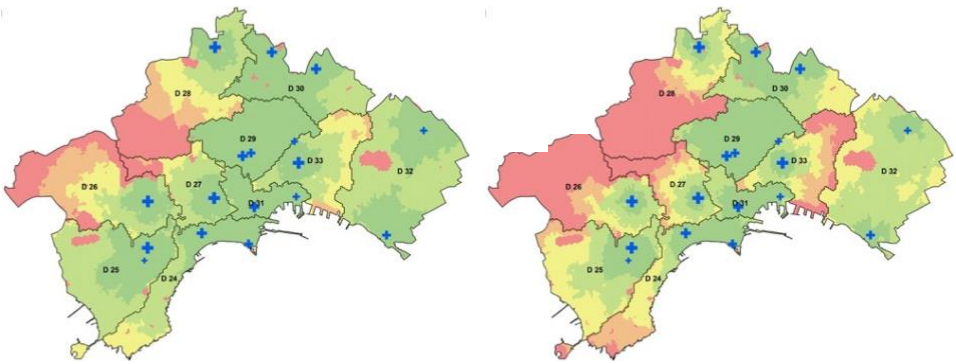
to elderly people: Cardiology, Geriatrics, Dermatology, Urology, Neurology, Pulmonology, Orthopaedics, Dentistry, Otolaryngology, Ophthalmology and Diabetology. They are managed by Campania Region and Naples ASL. A preliminary reading of the data reported in the Tab. 2 would suggest some interesting issues related to the spatial distribution of elderly and health services within the city of Naples. For instance, District 29 is the richest in health resources (building and surgeries) and its elderly inhabitants in between 65-69 years-old are the most numerous.

Moreover, District 27 (Arenella and Vomero) has the highest total and over-75-elderly (the oldest old) population, but just one health building. This initial analysis is not sufficient to investigate on social equity and it was used just as an input for the following evaluations.

According to the literature review (Bauer & Groneberg, 2016; Kim et al., 2018), we identified five different accessibility classes for this case study considering a minimum number of primary health services useful to elderly (eleven services) and travel time thresholds (15, 30, 45 and 60 minutes). In Tab. 4, 5 and 6 below, the number of elderly (65-69, 70-74 and over 75) in Naples Districts have been reported.

LEVEL OF ACCESSIBILITY	TRAVEL TIME	A_J
-	[min]	-
VERY GOOD	<15	>0.73
GOOD	15-30	0.73 – 0.37
LOW	30-45	0.37 – 0.24
POOR	45-60	0.24 – 0.18
VERY POOR	>60	< 0.18

Tab. 3 Accessibility thresholds



(a) (b)

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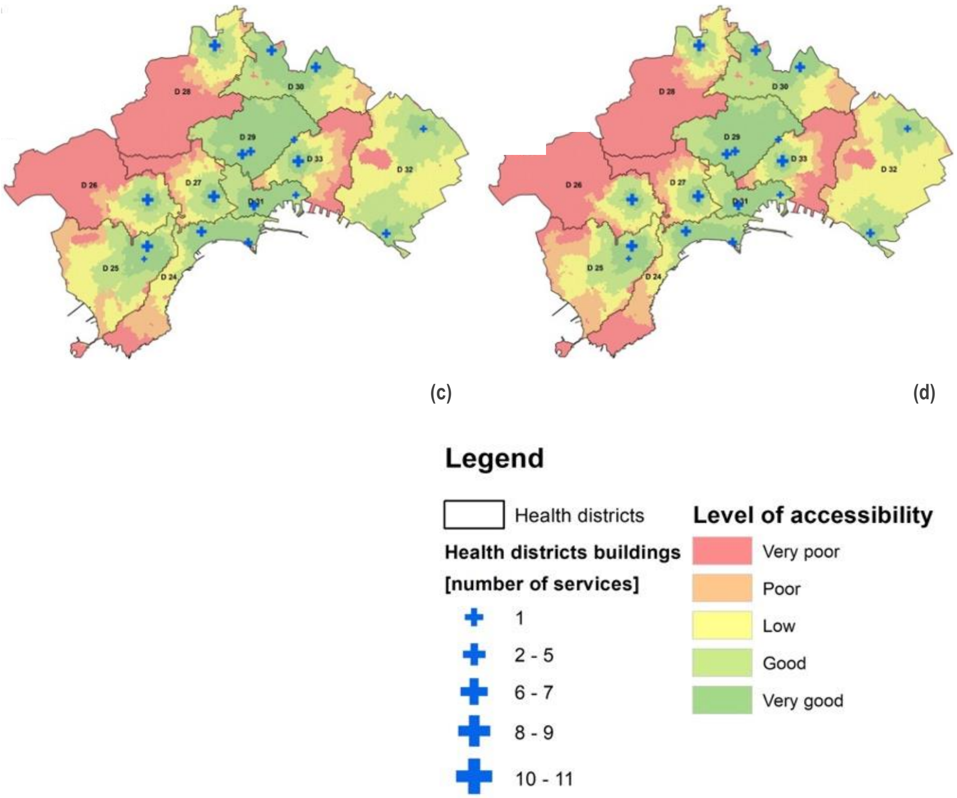

Fig. 6 Level of accessibility for an average person (a) and for the three elderly classes (b, c and d)

4 FINDINGS

For what concerns the first age range (65-69), Districts 26 (Pianura and Soccavo) and 28 (Chiaiano, Piscinola, Marianella and Scampia) need an in-depth evaluation. In District 26 about 2,000 elderly people suffer from a very poor accessibility to primary health services and this percentage increases to nearly 60% if we also consider a low, poor and a very poor level of accessibility; this means that more than half of this District dwellers access to primary health services in more than 30 minutes.

Accessibility level for District 28 is even worst since just the 8% of elderly access to primary health services within 15 minutes, while over 70% have a low, poor and very poor level of accessibility.

Indeed, 98.9% of District 29 (Colli Aminei, San Carlo all'Arena and Stella) dwellers access to primary health services within 15 minutes. This highlights the deep social and spatial inequity even for bordering neighbourhoods.

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DISTRICT	VERY GOOD	GOOD	LOW	POOR	VERY POOR
24	3,441	759	902	268	0
25	3,559	2,130	874	49	0
26	1,149	1,178	685	526	2,235
27	1,578	3,300	2,134	1,174	118
28	338	962	1,446	556	997
29	5,948	61	0	0	0
30	2,994	787	176	1	0
31	3,830	1,792	0	0	0
32	1,065	3,716	730	0	0
33	1,745	1,761	969	611	293
TOTAL	25,645	16,446	7,916	3,184	3,643

Tab. 4 65-69 aged population per district per level of accessibility

For the second age range (70-74), in District 26 and 28 more elderly people suffer from a very low accessibility level: respectively, 39.5% and 28.4% 70-74-aged people access to primary health services in more than 60 minutes. For District 27 (Arenella and Vomero), about 2.500 (more than 40%) people have a low level of accessibility, due to an access travel-time above 30 minutes. District 33 (Vicaria, San Lorenzo, Poggioreale) is not the worst in this context but it could be further investigated since nearly 40% of its 70-74-aged dwellers suffer from a low level of accessibility.

DISTRICT	VERY GOOD	GOOD	LOW	POOR	VERY POOR
24	2,286	723	692	438	23
25	2,365	1,580	882	52	0
26	641	754	622	221	1,425
27	1,205	2,571	1,667	1,024	107
28	176	574	1,049	390	778
29	4,363	143	0	0	0
30	2,009	764	69	22	0
31	2,439	1,461	42	0	0
32	758	1,924	1,100	7	0
33	986	1,273	604	436	357
TOTAL	17,228	11,767	6,726	2,589	2,690

Tab. 5 70-74 aged population per district per level of accessibility

Previous considerations are confirmed even for this last age range (over 75): districts 26 and 28 still have the highest rate of dwellers with the poorest accessibility level (respectively 37%

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and 32%). Due to the slowest walking speed considered for this elderly age rage (0.6 m/s), in every District the number of people with a low, poor and very poor levels of accessibility clearly increase.

DISTRICT	VERY GOOD	GOOD	LOW	POOR	VERY POOR
24	4,061	2,135	1,418	975	556
25	4,309	3,471	2,251	397	24
26	845	1,320	1,613	493	2,460
27	2,298	5,613	4,095	2,527	848
28	141	817	1,486	1,283	1,745
29	7,678	1,414	0	0	0
30	2,298	2,875	54	157	0
31	4,485	2,565	1,134	0	0
32	1,301	2,890	3,064	43	1
33	1,512	2,726	1,235	890	1,424
TOTAL	28,928	25,827	16,349	6,765	7,058

Tab. 6 Over 75 aged population per district per level of accessibility

5 CONCLUSION AND FUTURE DEVELOPMENTS

The growth of the elderly population in the last decades has generated a serious accessibility exclusion phenomenon. Some aspects influence the accessibility for the elderly population. The study of scientific literature on the relationship between service area extension, transport service frequency and age of users revealed the importance of considering these aspects in the evaluation of accessibility to urban services. This paper presented a quantitative method to assess accessibility to primary health services, considering a multimodal transport network and the local health system supply to elderly. In order to validate the methodology, it was applied to the city of Naples. The outputs show that entire neighbourhoods' elderly population suffers from a very poor accessibility to primary health services, especially in the city suburbs (Pianura, Soccavo, Chiaiano). In order to provide a higher accessibility level, more accurate and holistic land use planning policies are needed, also considering elderly needs and preferences. Based on the results, the methodology and the operational procedure proposed can be used as a decision support tool, in order to design new infrastructures or to optimize existing resources, in a G2B (Government to Business) point of view. In order to gain this aim, it would be useful to consider the whole primary health supply system, also considering its administrative rules and, since the main objective of our research is elderly population, a distance-decay function could be introduced to better compute their mobility availability.

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Such decision support systems are efficient tools for policy makers and urban planners, however, their contribution to knowledge production concerning the interactions of urban planning with several other social issues are usually neglected. The future work can be clarifying the knowledge-based contributions of this tool to the European and Italian knowledge of interactions of land use and urban mobility of the elderly.

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AUTHOR CONTRIBUTIONS

Paragraph 1 and 3, Gerardo Carpentieri.; Paragraph 2 and 4 Carmen Guida; Paragraph 5 Houshmand Masoumi.

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AUTHOR'S PROFILE

Gerardo Carpentieri is an Engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II and Research Fellow of Land Use Planning at the Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Carmen Guida is a Ph.D Student in Civil Systems Engineering Hydraulic and Transportation Systems Engineering at Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Houshmand Masoumi is senior researcher at Zentrum Technik und Gesellschaft (ZTG) at the Technische Universität Berlin. He holds PhD in urban planning and several years of work experience in civil engineering in industry and management section. His research interests are urban travel behaviour modelling, land use-transportation interactions, and active transportation.

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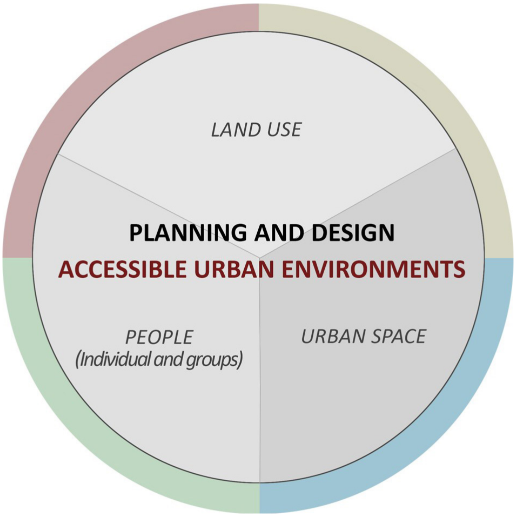

URBAN ACCESSIBILITY FOR CONNECTIVE AND INCLUSIVE LIVING ENVIRONMENTS

AN OPERATIONAL MODEL AT SUPPORT OF URBAN PLANNING AND DESIGN PRACTICE

TANJA CONGIU, ALESSANDRO PLAISANT

Department of Architecture, Design and Urban Planning, University of Sassari, Italy
e-mail:tanjacongiu@uniss.it
elisaocchini91@gmail.com, plaisant@uniss.it
URL: https://www.architettura.aho.uniss.it

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ABSTRACT

The paper explores the theme of urban accessibility in order to figure out the spatial, functional, social and environmental conditions of urban contexts to implement for extending the "accessibility capital" of inhabitants. We propose an operational method that considers accessibility as a guiding principle for planning able to orient transformative choices and plan/project action, through the different phases from goal formulation and check of actions consistency, to the assessment of interventions performance. The improvement of liveability in urban contexts requires the design of accessible environments, able to make people benefit from a wide range of urban opportunities and take part in public life, aiming at extending the "right to the city" and the capabilities of people to exercise this right. Taking into account the complexity of the accessibility concept and its multidimensional, multidisciplinary and multi-scalar character, the proposed methodological framework is composed of a project coordinates system and a process of implement-action. The first is a set of key and operational requirements and performance indicators, while the second serves as a guide for implementation through the definition of a strategy and the monitoring of implemented actions. To verify the method applicability, it was experimented in the urban regeneration project of Sant'Avendrace district, in Cagliari (Italy) – part of a national program for the renewal of urban periferies– which recognizes the accessibility for all as a fundamental prerequisite for achieving satisfaying urban and liveability conditions.

KEYWORDS
Accessibility; Connectivity; Multi-scale approach; Cross-dimensional approach; Urban regeneration processes

1 EVOLUTION OF THE URBAN ACCESSIBILITY PARADIGM

The topic of urban accessibility has been object of multiple studies within disciplines that are different from one another, proving to be a complex paradigm. On top of being multidisciplinary, the topic is also multidimensional and multiscalar. Within the scientific debate, the focus on such a concept is underlied by the growing sensibility for subjects like equal access to urban resources, social inclusion, and socio-spatial segregation. This brought the paradigm's viewpoint to extend from the sole discipline of transport to disciplines with a more anthropological dimension, such as urban and human geography and sociology.

This change finds its roots in the innovation of transport and urban planning perspective. Such a perspective drew into a crisis the mobility paradigm – sector-based and car-oriented – in favour of the urban accessibility paradigm –an integrated and comprehensive approach – oriented towards multimodality, compact land use mix, based on proximity and variety of fuctions (Handy, 2002; Litman, 2011; Litman, 2013; Litman, 2017). Litman's definition of accessibility "the ability to reach desired goods, services, activities and destinations (collectively called opportunities)" (Litman, 2011) shows an enrichment of the paradigm. Planning for accessibility means to make numerous urban opportunities effectively available for people: not only services to fulfill primary needs, but also activities to address complex needs, associated with identity, relation and participation, all essential features for the social life of individuals (Castrignanò, Colleoni & Pronello, 2012).

The aspect that, however, promoted a radical change in the approach to urban accessibility planning has been the addition of the individual dimension. Shifting the focus from the strictly material and physical dimension of built environment to people's action, the new perspective leads the individual to the centre. That is, the possibility to access to and participate in the city, in a broad sense, is not an exclusive attribute of space, but it is ascribed to people and their abilities, resources, and needs (Kauffman, Bergman, & Joye, 2004; Dijst, 2001). A person-based vision, as Dijst holds, in which the person become the real beneficiary of the city. It is not about maximizing the vehicular capacity and improving mobility as a self-standing object, but rather maximizing urban capabilities of the inhabitants (Talu, 2014) and their accessibility capital.

In this light accessibility becomes a synonym of socio-spatial inclusion and urban equity and displays its potential to extend the "right to the city" (Lefebvre, 1970) to all inhabitants. By strengthening the option value, the freedom of choice for the individuals can grow, depending on options of transport, services, social happenings, etc. Accordingly, accessibility reveals to be a relational feature, confirming both its multidimensional perspective and complexity. In fact, it attempts to relate material aspects with immaterial ones, physical aspects with

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subjective ones, as well as qualitative to quantitative aspects. It is therefore necessary to understand the relations and the dynamics that occur among the many parts of the urban system. "Accessibility invokes all the elements involved in the relation: the features of the moving subject, the way this happens, and the specifications of the territory's good or service that is being reached" (Castrignanò, Colleoni & Pronello, 2012).

The aim of this work is, therefore, to focus on what the conditions to work on in the urban context are – may they be physical, spatial, organizational, temporal, social, and environmental – and what planners and designers are to do in order to increase the accessibility capital of inhabitants, hence providing them with the optimal access conditions to the city, according to their needs and situations.

The multidimensional nature of accessibility can be considered the overlap of three spheres or dimensions: urban space, people and land use, with the action space of urban planning operating on their interdependences. Urban space represents the physical space of the city, in which opportunities are distributed; people refers to those who use the city and daily interact with the urban space, to satisfy their needs; land use (through policies, measures, but also networks of individuals who operate within the city) affects the functioning and the structure of the urban space, as well as the behaviour of individuals.

2 A NEW METHODOLOGICAL FRAMEWORK FOR URBAN ACCESSIBILITY PLANNING

On the basis of the theoretical and cultural consideration, this work aims at structuring a method to operationalize the concept of accessibility. This is crucial for moving from theory into practice and, thus, transfer the theoretical and conceptual preconditions into concrete operational procedures (actions and interventions of varied nature on physical space and policies). The proposed framework is meant to offer a methodological tool that support designers, planners, and policy makers responsible for the territory management. The framework is composed of two parts: a system of criteria/conditions to be provided for, namely project coordinates, and a section of implement-action, beneficial to a translation of the model of coordinates into planning choices strictly tailored to the specificities of the context of the intervention.

2.1 PROJECT COORDINATES MODEL

According to the three constitutive spheres of accessibility, the methodological and operational model is articulated through a framework of project coordinates structured on four levels, three for directions and the fourth for evaluation (Fig. 1).

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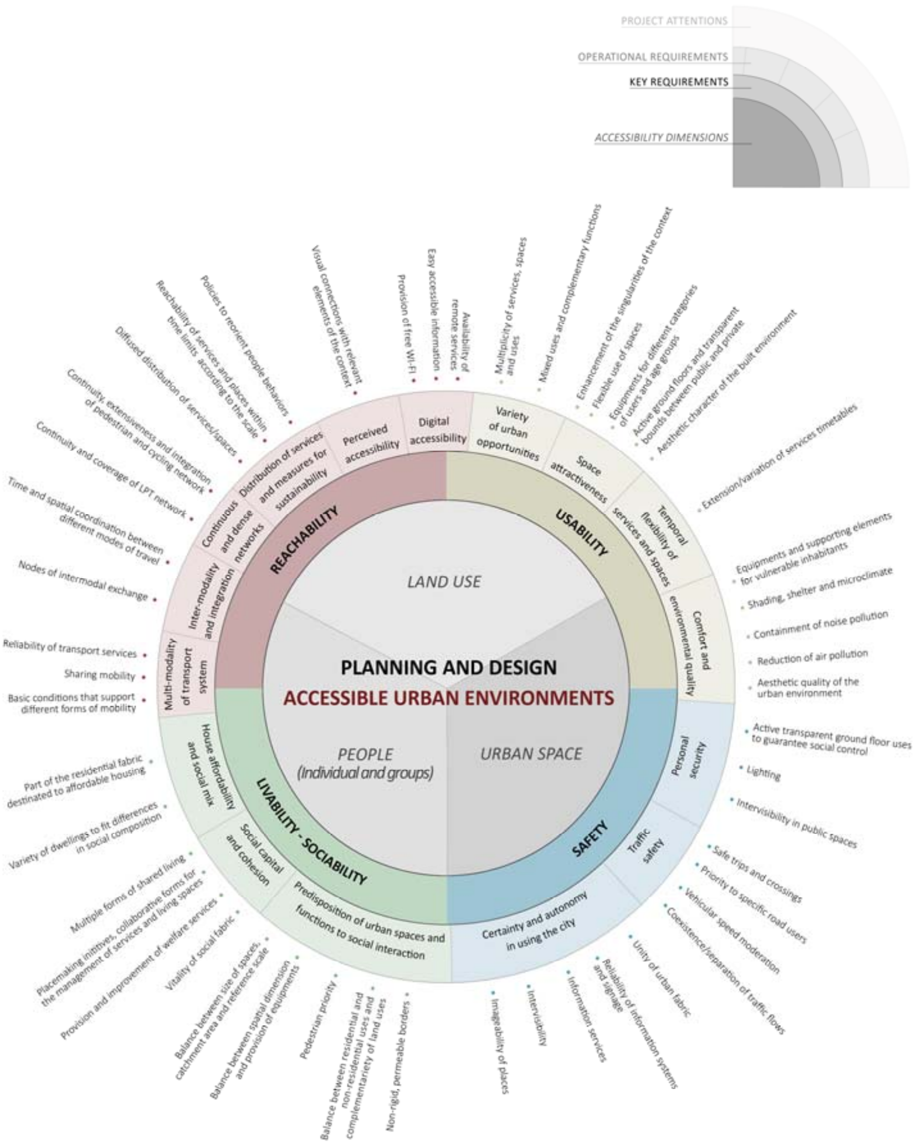

Fig. 1 Articulation of the first three levels of the project coordinates model

More precisely the model consists of:

- 4 key requirements, indispensable conditions for a context to be defined accessible and to favour accessibility to people;
- 16 operational requirements indispensable conditions to work on to see key requirements materialized;

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- 51 project attentions, a list of possible directions for action strategies, referring to each requirement;
- 60 indicators (divided into 162 sub-indicators) and related maps, to measure, assess and spatialize the degree of correspondence of an urban context to a given requirement (both ex-ante and ex-post).

In this work, due to the complex articulation of the model, we describe in detail the four key requirements: reachability, usability, safety and liveability-sociability; then the criteria for selecting the indicators will be discussed.

Reachability

To access goods, places, services, primarily it is necessary to be able to reach them. Reachability can be defined as the ease in reaching urban opportunities at different scales. It concerns the possibility of travelling through different modes (ensured by physical connections and integrated transport service networks) as well as the possibility of accessing urban facilities remotely, without need to travel (influenced by their functional organization).

Usability

Given the opportunities offered by the city (destinations, public spaces, services, social happenings) as the main trip purpose, it is essential to guarantee adequate conditions for usability in order to give people the chance to effectively take part in these opportunities. Actually, the fact that a destination can be reached does not imply that it is usable in the best conditions and by all inhabitants. So the availability, variety and quality of opportunities are important conditions to meet the needs of different categories of inhabitants.

Urban spaces attractiveness and comfort provided for example by the presence of active and permeable ground floors (Gehl, 2017) or the possibility to seat, rest and repair from sun or rain also enhance usability “giving people a reason to come to a place”[1]. Finally, the spatial and temporal flexibility of urban services (Zedda, 2009) make them easier to use.

Safety

Safety is essential because it affects any type of activity in the city (trips, open spaces frequentation, etc.) and, consequently, it can compromise the accessibility to certain contexts. Safety conditions to be provided concern three levels: personal security, partly due to social control, the so-called "eyes on the street" (Jacobs, 1969), traffic safety and a third, partly qualitative, associated to certainty and autonomy in using the city for all categories of inhdividuals. This last invokes concepts as "imageability" (Lynch, 1964), associated to the presence of recognizable places and environments, with a distinctive character, and as "urban

[1] https://www.pps.org/article/grplacefeat

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way finding" (Pilozzi, 2013), referring to information and communication systems that help people find their way around the city.

Liveability-Sociability

The fourth key requirement encompasses the set of conditions that support full participation in urban life in terms of socio-spatial interaction and re-appropriation of living environments as spaces of public life. These conditions are aimed at strengthening the potential of mutual support, which is fundamental in increasing the "accessibility capital" of individuals. They includes: the primary need of access to housing, as well as the construction of social mix and cohesion, for example through neighborhood practices that include collaborative forms of management and maintenance of collective spaces and services, or the design of spaces conducive to social interaction.

2.2 PERFORMANCE INDICATORS

The proposed model of project coordinates also identifies performance indicators related to the accessibility requirements. The selected indicators come from different fields of research, according to a multidisciplinary vision: sustainability (Ecological urbanism, Indicators for Sustainable Cities 2015), urban smartness (CITYkeys project 2015-2017), transport and land use integration (TOD Standards 2017; ITDP, 2018), urban spaces quality and practices of use (Gehl, 2017)[2]. The indicators, both quantitative and qualitative, can be of output, outcome and impact and meet the S.M.A.R.T. targets (specific, measurable, achievable, relevant and time-bound). Moreover, they make it possible to spatialize the results, thus identifying the situations of unequal distribution in access with an immediate communicability.

2.3 THE STAGE OF IMPLEMENT-ACTION

The second part of the proposed methodological framework is conceived as a guide to translate the accessibility coordinates model into context-oriented project actions. It is precisely the context that operationalise the instrument: the latter lists a series of project requirements to take into account, but it is the accessibility conditions of an urban system, with its specificities, that inform the interventions.

The phase of implement-action consists of several steps. According to the project coordinates model:

- first the accessibility of the study context is analysed with respect to the key requirements, highlighting for each dimension weaknesses and strengths;

[2] See bibliographic references.

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- second, starting from the context peculiarities, general and specific objectives are defined in the form of design attentions and operational goals;
- third, for each objective a set of actions to be implemented is defined and organised into class of actions;
- last step, a set of indicators and associated maps is identified for both analysing the initial conditions and monitoring the results achieved over time by the actions implemented.

Moreover, in order to allow the planning strategy to yearn for effective, coherent and integrated results, fully contextualized, the above mentioned four steps process needs to be complemented by population involvement and a consistency check with ongoing programmes. Population involvement is fundamental, being accessibility the joint outcome of inhabitants' capabilities compared to the characteristics of their living environment. Likewise, the agenda of programmes and policies at local and national level are important to consider as they reveal priorities and future directions as well as financing opportunities for planned interventions.
To summarise, the proposed planning model can be concurrently an analytical and a project tool at support of planners and decision makers to understand and improve the accessibility of their cities: on one hand it addresses the identification of components and factors on which to intervene depending on the problems and opportunities of the context, on the other, it ensures the planning process completeness and consistency being respected during all stages.
In the next section we report the implementation of the proposed model in the neighborhood of Sant'Avendrace in Cagliari (Italy).

3 EXPERIMENTATION OF THE METHOD IN SANT'AVENDRACE DISTRICT (CAGLIARI, ITALY)

The urban renewal project of Sant'Avendrace neighbourhood in Cagliari offered the opportunity to experiment our accessibility model. It's about an ongoing process, financed by the "Bando Periferie 2016" a national program promoted by the Italian Office of the Prime Minister, aimed at reducing the physical and social marginality of the neighborhood by reconstructing its accessibility with multiscalar integrated actions on physical connections, usability of urban space and services, safety and social dimensions.

3.1 IMPLEMENT-ACTION AND ASSESSMENT

Sant'Avendrace is a district of about 7.000 inhabitants, located at the periphery of Cagliari, characterised by socioeconomic distress, lack of public spaces and presence of several abandoned sites and neglected areas. Furthermore, a series of heavily busy transport

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infrastructures with different functionalities cross the district, providing both access and physical fragmentation. At the same time, the geographical position, the presence of metropolitan and regional level functions together with two important features of the landscape system (a Lagoon, and an archeological park on a hill) make for an interesting project area with significant potential. To give an interpretation of the context in terms of accessibility, we identified the weaknesses and strengths faced by the project, according to the four key accessibility requirements.

The district current condition suggested to focus the attention on physical and functional accessibility. With the reconfiguration of public spaces, the introduction of new land uses, services and policies, the project aims to promote a different organization and management of urban services and stimulate new relationships at multiple scales. More precisely, the project consists of three main actions: a new social housing development located in a former slaughterhouse; a new sporting and educational park in a neglected area; a redesign of the street network including (Fig. 2).

The main project actions for a radical change of the context in terms of accessibility, are argued by highlighting the urban accessibility requirements fulfilled, the specific goals and the related project attentions observed.

For example, in order to stimulate the construction of social capital, sense of community and social inclusion, the project offers new housing opportunities for diverse groups of population combining dwellings with a variety of services and spaces that support social interaction, assistance and collaborative forms of use and management of collective spaces.

The new sports-educational park converts a large marginal and partially abandoned area of the district into a multi-scale, multi-functional and flexible space, through the provision of services for sport, leisure and learning, public green areas and the reconfiguration of internal paths and external connections with special attention for transport integration.

Thanks to these characteristics, the park assumes a multidimensional value (metropolitan, urban and local) thus increasing the accessibility of citizens to urban opportunities.

The new space becomes reachable through the provision of integrated transport alternatives, which ensure the continuity of connections from within the district to the metropolitan scale.

Finally, the intervention on the connection system and travel spaces redefines physical and perceptual relationships by enhancing continuity, and directness of paths, safety and pleasantness, prioritizing non-motorised mobility, and reducing obstructing conditions such as physical obstacles, large roads, traffic volumes, parked cars.

Accordingly the main route of Sant'Avendrace was redesigned as a linear public space, incorporating public functions and services, interstitial and lateral spaces (currently unused and not directly perceivable) enhanced by the visual contact with the hill and the lagoon.

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Fig. 2 Regeneration of Sant'Avendrace neighborhood in Cagliari (Italy) - Masterplan

3.2 ASSESSMENT OF INTERVENTIONS

An assessment of the accessibility conditions of the district, oriented by project goals and actions was carried out to estimate the potential of these actions in improving current accessibility.

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Three indicators regarding the redesign of the connection system are described:

- “multimodality” - number of monomodal roads and multimodal roads, measures the increase in travel alternatives available;
- “safe crossings” - road intersections with safe crossings in all directions”, measures pedestrian and cyclists’ continuity and safety at road intersections. In Sant’Avendrace the initial poor crossing capacity due to infrastructural fragmentation, particularly in the north and west, is improved significantly;
- “public space provision” (Fig. 3) reveals the almost total absence of recreational, green and aggregating spaces and draws project attention to the construction of opportunities of collective use and social interaction.

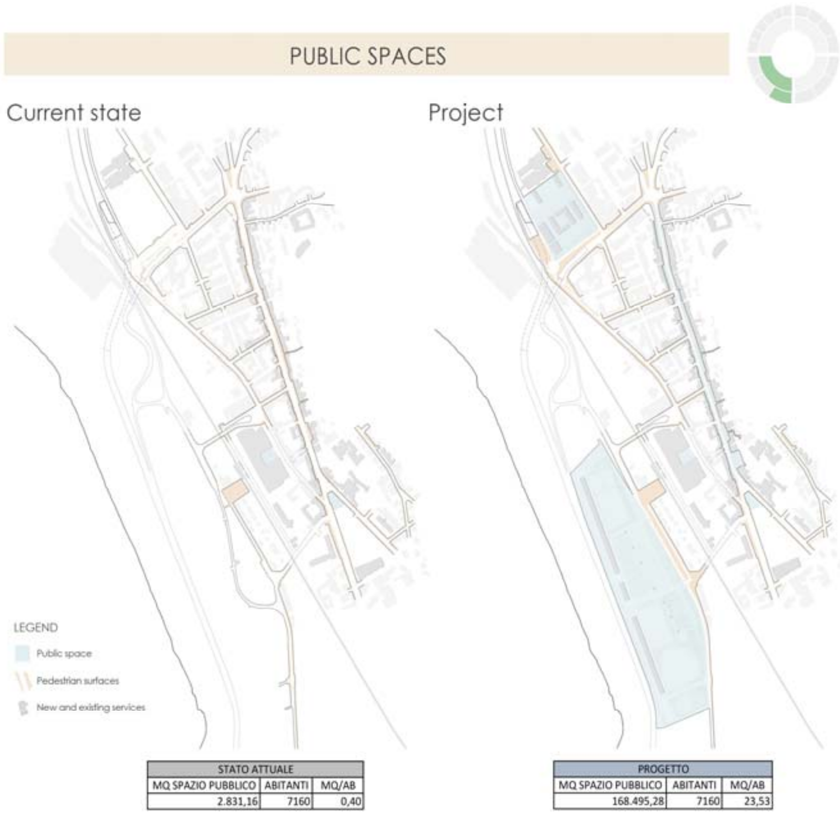

Fig. 1 Example of indicator mapping

4 CONCLUSIONS

The application to the case study of Sant'Avendrace, served to validate the proposed methodological framework and, at the same time, provided a representative example, in

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operational and practical terms, on how to enhance the accessibility capital of inhabitants of a specific context. More precisely, the case study revealed the key role of a multidimensional system of connections as indispensable and structuring element, in any project oriented to improve accessibility. In fact it contributes:

- to establish a system of relationships between constitutive elements of the context, both material/spatial and immaterial/social, necessary for integration and inclusion;
- to integrate and give coherence to class of strategic actions, frequently sectorial and separated, as in the case of "Bando periferie 2016", which instead need to be considered and processed as interdependent in order to achieve effectiveness and multiply positive impacts;
- to ensure consistency during the planning process allowing to work gradually, step-by-step, and maintaining a coherent strategic line over time.

Further advancement of the research will consist in:

- a deeper exploration and re formulation of indicators. the selection of measures has to take into account their achievability strongly influenced by available time and resources (information and operators).
- Validation of the proposed method for urban accessibility planning and evaluation in diverse real contexts and project programs in order to test the robustness, transferability and replicability of the model.

We believe the adoption of a multidimentional integrated approach can effectively innovate planning and decision making methods and tools contribute to enhance the capability of citizens to use the city anf its opportunities.

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AUTHOR'S PROFILE

Tanja Congiu, temporary Assistant Professor of Transports at the Department of Architecture, Design and Urban Planning - University of Sassari. Civil engineer and Phd in land use and transport planning, her research activity focuses on mobility and transport issues with a particular concern for the interactions between built environment configuration, sustainable transport policies and trends in travel behavior. Recent studies deal with methods and tools to measure, assess and enhance urban walkability intended as central quality in the design of urban realm. Consultant for local authorities in transport planning at different spatial levels based on sustainable mobility solutions. Latest assignments: Mobility Plan for the Municipality of Alghero (ongoing); Responsible of accessibility issues in the urban regeneration program of S.Avendrace district– Cagliari.

Elisa Occhini, european Master degree in Planning and Policies for the City, Environment and Landscape held in 2017 with a dissertation urban accessibility (final evaluation 110/110 cum laude). She currently collaborates with the Department of Architecture, Design and Urban Planning of the University of Sassari in both research and teaching activities. During her studies she undertook a 3 months Erasmus Traineeship with Proap Studio (Lisbon) and a 6 months Scolarship in Barcelona. Then, she completed her career with a postgraduate internship in the Urban Planning Office of the Municipality of Cagliari where she took part to the development of three detailed plans in the neighbouhood of S.Avendrace-Cagliari namely: redesign of the street network; new sports and educational park of S.Paolo; conversion of a former slaughterhouse into a new social housing development. Participation in international summer schools, seminars and conferences. Latest participation: Urban Transition 2018 Conference, Sitges, November 2018.

Alessandro Plaisant, associate professor of the Department of Architecture, Design and Urban Planning, the University of Sassari, where I teach Urban Planning and Analysis of urban systems. I held a Ph.D. at the University of Cagliari, after spending eight month as a fellow at the School of Anthropology, Geography and Environmental Studies, the University of Melbourne, focusing my research on decision-making processes in public policymaking, strategic planning, policies and pluralism-oriented tools. I combine my research activities with higher education, international and institutional cooperation activities, as director of the II level International Master's Program "Advanced Methods and Tools for Sustainable Planning", developed in academic cooperation with Harbin Institute of Technology and as scientific coordinator of the activities planned for the funded national call "extraordinary Program of intervention for urban redevelopment and security of the metropolitan suburbs", specifically in Sant'Avendrace district, the Municipality of Cagliari (Sardinia, Italy). Among my recent publications: Urban regeneration of peripheral areas: the critical role of the connective space in an italian city. (Aa.Vv) Urban Design Journal, 2018; Risk Prevention and Management. A Multi-actor and Knowledge-Based Approach in Low Density Territories (Aa.Vv.), Computational Science and its Applications (ICCSA 2017), in Gervasi, O., Murgante, B. et. al. (Eds.), Springer (ISBN 978-3-319-62397-9), Switzerland.

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IMPROVING ACCESSIBILITY TO URBAN SERVICES FOR OVER 65:

A GIS-SUPPORTED METHOD

***CARMELA GARGIULO, FLORIANA ZUCARO**
FEDERICA GAGLIONE

Department of Civil, Architectural and
Environmental Engineering
University of Naples Federico II, Italy
e-mail: gargiulo@unina.it
floriana.zucaro@unina.it
federica.gaglione@unina.it
URL: www.tema_lab.unina.it

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ABSTRACT

By referring to the eight domains of age-friendly cities (WHO, 2007), urban accessibility can be considered as one of the elements cutting across most of them. The relationship between the organization of the urban system (supply) and the mobility of the population over 65 (as for every city user) has prompted scientific debate on how to improve the accessibility of the over 65 to the services of their interest through the pedestrian network and the public transport network. This study is a first research segment of the broader MOBILAGE project, which aims at defining a decision support tool for public administrations to improve elders' accessibility to urban services, thus contributing to enhance their quality of life. Most studies of the literature are interested only in measuring the catchment area of health services, in order to investigate the degree of accessibility to this service, by identifying both the most disadvantaged portions of the urban area and those characterized by a balance between supply and demand. The objective of this first step of research is wider and is oriented to define the catchment area of all services for over 65 on the basis of the existing street network, the orography of the territory and the pedestrian speeds of the three age groups of the old population (65-69; 70-74; >75).

KEYWORDS
Elderly; Catchment areas; Urban accessibility; GIS

* The other author is: Luigi Faga.

1 INTRODUCTION

Advanced ageing has becoming a global phenomenon of this century, mainly due to declining fertility and improved health and longevity. In fact, in both industrialized countries and developing countries (albeit at different paces) the values of the old age index grow faster than the growth rate of the total population.

In OECD countries, the number of people aged 65 and over rose from 7.7% in 1950 to 17.8% in 2010 and it is foreseen it will reach 25% in 2050 (OECD, 2015). During the 2000s, the population share of those 65 years and above rose to 15.1%, while the rate of the total population growth was only 9.7%. Conversely, the decade between 1990 and 2000 saw a more rapid increase in the growth rate of the total population than that of the older one (respectively, 12% and 13.2%).

This unprecedented demographic shift raises some interesting (and still open) questions that involve many disciplinary fields, such as: the social sciences, concerned with the evaluation of the "social productivity" (Laslett & Cuberli, 1992) of the over 65; the economic sciences, focused on how to guarantee adequate retirement benefits without generating an unbearable pay-load for the younger age groups; the medical sciences, aimed at preventing some illnesses related to old age; the urban studies, investigating how to make an age-friendly city. In particular, a "city fit for elderly" holds services, and network infrastructure that optimize involvement, communication and interaction opportunities, in order to guarantee the independence of elders over 65, namely, their active aging in place.

By referring to the eight domains of age-friendly cities (WHO, 2007), urban accessibility can be considered as one of the elements cutting across most of them. In fact, the concept of urban accessibility generally includes the physical characteristics (mobility and open spaces networks), the functional characteristics (services and activities) and the socio-economic characteristics (lifestyles and habits) of an urban system (Papa et al., 2017; Papa, 2018). In the holistic-systemic perspective of the governance of urban transformations, the set of all these components affects the quality of life of individuals and the opportunities for their civic participation and social inclusion. Indeed, urban accessibility is increasingly recognized as the "litmus test" to quantitatively assess the social inclusion and social equity of the whole urban area or part of it, in order to ensure that all citizens benefit from equal distribution of resources, welfare and services (Van Wee & Geurs, 2011; Jones & Lucas, 2012; Lucas, 2012; Zali et al., 2016). In this regard, many studies have investigated the levels of social equity (as well as the levels of social exclusion) of some of the most vulnerable segments of population (for instance children and elderly) that are characterized by specific needs of mobility. Focusing on elderly and according to Scheiner (2006), Campbell (2015), Wang and Shepley

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(2018) “the local activity space of over 65”, that is the “geographic area of elderly daily living involvement”, declines with age. This implies rethinking and redesigning the built environment by improving connectivity, walkability and proximity of daily life facilities.
In this sense, it is useful to measure the catchment areas of the services of interest of the elderly, in order to investigate the degree of accessibility to each service, by identifying both the most disadvantaged portions of the urban area and those characterized by a balance between supply and demand of the service. In this way, it is possible to support the local public decision-maker in the development of actions aimed at guaranteeing a fair urban accessibility, with a priority focus on the most lacking areas in terms of services and transport networks.
In literature the definition of the elders’ catchment areas of the public road transport service and of the health services (especially the hospital care) are the two most consolidated lines of research with respect to this issue, as LPT can have a key role in minimizing social exclusion (Farrington & Farrington, 2005; Langford et al., 2012a; Tseng & Wu, 2018) and people over 65 strongly depend on medical facilities (Kanuganti et al., 2016; Kaur Khakh et al., 2019). Despite the abovementioned studies, few have taken into consideration further kinds of services.
Aimed towards bridging this lack in urban accessibility studies, this work focuses on measuring a sort of new catchment areas of the main services of interest based on the effective street network, the walking speeds of the three segments of the elderly population (65-69, 70-74, >75) and the orography of the city. This is a first research segment of the broader MOBILAGE project, which aims at defining a decision support tool for public administrations to improve elders’ accessibility to services, thus contributing to enhance their quality of life.
The paper is articulated as follows: the second section proposes a review of the scientific literature on the elderly accessibility issue; the third section presents a methodology to define a new kind of catchment areas of the main urban services of interest for elderly; the last section describes some first results obtained.

2 STATE OF THE ART

Demographic change raises interesting research questions in the field of urban studies, particularly on the organization of settlement systems. The localization and spatial distribution of services, the local public transport supply and the mobility networks affect the elders’ choices of movement. The duality relation between the organization of the urban system (supply) and the mobility of the population over 65 (as for every city user) has prompted scientific debate on how to improve both the elders’ accessibility to the transport and pedestrian network (Luk & Olszewski, 2003) and to the services of interest (Guagliardo 2004).

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In particular, other lines of research have examined the issue of accessibility to urban sites and services by measuring the catchment areas of the main services of interest for the elderly. An extensive scientific literature deals with the identification of the level of accessibility to reach a specific urban service, particularly focusing on the services related to health care (Chen, 2017; Luo, 2014), while other research focused on the public road transport service (Langford et al. 2012b; Lin et al., 2014).
In more detail, some of the studies developed (Ngui & Apparicio, 2011; Lou & Whippo 2012; Wan et al., 2012; Mao & Nekorchuk, 2013) have defined the catchment areas for a specific health service (i.e. the hospital care) through the measurement of some characteristics, such as the distance to be covered and the travel time to reach a certain activity (supply). Within each catchment area, the density of the elderly resident population (demand) potentially served is calculated by comparing it to the distance or time needed to reach the service. This calculation is aimed at identifying the portion of urban areas where the demand-supply balance is satisfied and how to adapt, instead, the less-served areas, in order to guarantee the same level of accessibility and, consequently, of social equity. Another research segment has adopted the same methodology for measuring accessibility to public transport (Andersen & Landex, 2008; Wells & Thill, 2012; Lin et al 2014) or other services of interest, such as green areas (Dai, 2011) or public services (Wang, 2007) without orienting such studies to only one of the age groups of the elderly population over 65.
Instead, studies that relate the demand of the elderly to the supply of various types of urban services (such as health, economic-financial, cultural and recreational services) are in a small number, also because of the urban context features.
The objective of this research work is to define a new kind of catchment areas of the main services of interest according to the street network, the orography of the territory and the pedestrian speeds of the three age groups of the elderly population (65-69; 70-74; > 75), in order to classify urban areas according to their level of accessibility to places and services and evaluate the supply-demand balance or potential gaps.

3 METHODOLOGY

As regards the objective of the work aimed at improving accessibility to urban services of interest for the elderly, this section describes the steps of the first segment of research that allowed to identify the new catchment areas for each service category, that we considered of interest for over-65-aged people, classified in three different age-range: 65-69; 70-74; >75.
In the first step, different walking speeds for each age group were defined. To this end the study of the scientific literature has allowed to consider as useful, for the purposes of this

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work, the research carried out by Weber (2016) which determined these values according to the main socio-economic characteristics of the elderly population.
Following, walking speed values are reported:

- for what concerns the first age range (65-69), the average walking speed is 0.81 m/s;
- for the second age range (70-74), the average walking speed is 0.69 m/s;
- for the third age range (over 75), the average walking speed is 0.60 m/s.

From these average walking speeds, in the second step of the methodology process, influence rays for each service category were identified; they represent the maximum pedestrian distances that a general user is willing to walk, to get to a certain service (Tab. 1). These influence rays were identified by referring to a previous work developed by the authors (Gargiulo et al., 2018), concerning the study of territory planning tools, such as the Service Plans (in particular Lodi and Bari) and Urban Sustainable Mobility Plans.
In order to define the influence area of the services used by the three segments of the elderly population, phase 3 was articulated as follows:

- calculating the average pedestrian time (for any type of user) for each influence ray (distance to walk) of the services considered;
- redefining the different influence rays of each category of service (maximum distance that can be walked), according to the different pedestrian speeds of each age group and assuming the average walking time, identified before, to be constant;
- identifying the new influence area of each service, that is, the theoretical area where the users of that service live.

However, this procedure has the limitation of considering the territory as isotropic. In fact, the influence areas thus obtained, do not represent the real areas where the users of a given service actually live, as they do not take into account the morphology of the territory and the presence of the real walkable streets.
For this reason, the slopes have been defined, as they can contribute to reduce the distance that the elderly can walk. Regarding the identification of the walkable streets, a procedure was developed in GIS environment, through the Network Analysis tool and a Digital Elevation Model, in order to define the streets that the elderly can use to access services.
Furthermore, in GIS environment, both the slope and the average pedestrian speed were associated to the street graph in order to define the set of the real walkable paths to reach each urban service.

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ID	VARIABLE	MEASURE
	FUNCTIONAL SUBSYSTEM (services of local interest)	
1	Pharmacies	Influence ray (R.i.)= 500m
2	Asl	R.i.= 500 m
3	Poly-diagnostic center	R.i.= 560 m
4	Cinema	R.i.= 516 m
5	Municipal library	R.i.= 600 m
6	Churche	R.i.= 480 m
7	Bank	R.i.= 500 m
8	Post Office	R.i.= 500 m
9	Municipal office	R.i.= 500 m
10	Union	R.i.= 500 m
11	Supermarket	R.i.= 500 m
12	Green area	R.i.= 100 m
13	Sports Center	R.i.= 1000 m
	FUNCTIONAL SUBSYSTEM (services of general interest)	
14	Hospital	R.i.= 1100 m
15	Private Clinic	R.i.= 1100 m
16	Urban park	R.i.= 1000 m
17	Museum	R.i.= 1100 m
18	Cemetery	R.i.= 1100 m
19	Stadium	R.i.= 1100 m

Tab.1 Traditional influence rays of the main urban services

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ID	POPULATION	SERVICES	TIME (MIN)	RAY INFLUENCE (M)
	FUNCTIONAL SUBSYSTEM (services of local interest)			
1	65-69 70-74 >75	Pharmacy	6	292 248 216
2	65-69 70-74 >75	Asl	6	292 248 216
3	65-69 70-74 >75	Poly-diagnostic center	7	340 290 252
4	65-69 70-74 >75	Cinema	6	292 248 216
5	65-69 70-74 >75	Library	7	340 290 252
6	65-69 70-74 >75	Church	6	292 248 216
7	65-69 70-74 >75	Bank	6	292 248 216
8	65-69 70-74 >75	Post office	6	292 248 216
9	65-69 70-74 >75	Municipal office	6	292 248 216
10	65-69 70-74 >75	Union	6	292 248 216
11	65-69 70-74 >75	Supermarket	6	292 248 216
12	65-69 70-74 >75	Green area	2	97 83 72
13	65-69 70-74 >75	Sport Center	12	583 497 432
	FUNCTIONAL SUBSYSTEM (services of general interest)			
14	65-69 70-74 >75	Hospital	13	632 538 468
15	65-69 70-74 >75	Private Clinic	13	632 538 468
16	65-69 70-74 >75	Urban park	12	583 497 432
17	65-69 70-74 >75	Museum	13	632 538 468

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18	65-69 70-74 >75	Cemetery	13	632 538 468
19	65-69 70-74 >75	Stadium	13	632 538 468

Tab. 2 New influence rays of services of interest for the three old populations segments

The catchment areas so computed, according to the localization and the distribution of each category of service of interest of over 65, allowed to define the supply map.

The supply map, compared with the demand map that classifies census tracts on the basis of over-65 population density, allows to identify urban areas characterized by a supply-demand equilibrium, as well as those where it is necessary to intervene to fill the supply-demand gap for elderly.

This research step provides some first results useful to develop a support tool for the decision maker. In fact, for instance, the identification of the urban portions characterized by a high lack of accessibility to services, defines the areas where it is a priority to intervene and allows to provide first indications useful to improve accessibility, such as the localization of new urban services for the over 65 or the identification or improvement of pedestrian paths to reach them.

4 CONCLUSIONS

This work describes a procedure for measuring a different kind of catchment areas of spaces and services of interest for people over 65, taking pedestrian speeds and urban orography into consideration.

The distribution of the demand-supply ratio of a service within an urban area allows determining the rate of the population served and identifying those urban areas where action is needed to reduce (or potentially cancel) the disadvantages caused by a scarce level of accessibility, as well as identifying the areas where the supply of many services overlap. In particular, the study of lack of accessibility for the elderly has almost exclusively concerned mobility and health care services. However, as repeatedly underlined both at scientific and institutional levels, quality of life also depends on the possibility of reaching all the services held in a given urban area. For example, the importance of ensuring access to the different urban services has been emphasized within the most recent reports of the WHO with the aim to promote cities that are willing to adapt to different age and social groups.

If the components of an age-friendly city are well defined in theory, in the governance tools of urban transformation the definition and implementation of strategies and actions for the most vulnerable social groups is not so easy. Considering the city as a whole and adopting an integrated view of user behaviors, of the services available and their accessibility, could help

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"tackle physical and social disparities and meet the needs of all groups in the community" (Plouffe et al., 2018). This holistic approach has characterized the development of the proposed methodology which, through the localization of the demand for services by the over-65s, the distribution of catchment areas, that have been ri-defined on the basis of the new criteria of the research work, and the comparison between them, allows public decision-makers to identify the urban partitions lacking of urban services.

In a subsequent phase of the research work, the location and distribution of the supply will be combined with the physical characteristics of the urban system that influence the choice of a route (for instance presence of sidewalks), to define the network of pedestrian paths suitable for senior citizens to reach the main services of interest. In fact, one of the goals of MOBILAGE project is to provide the public decision-makers with strategies and actions aimed at increasing the quality of life of the elderly by improving urban accessibility.

In this regard, the MOBILAGE research project appears to be in line with current EU policies in allowing elders to actively age in their environment by optimizing some physical and environmental characteristics, such as crosswalks, to make them easily accessible to older people but also to the whole community, which may benefit from such interventions too. Many joint initiatives, in fact, reflect a growing emphasis on participatory approaches to promoting community revitalization from the elders' point of view, thereby fostering active involvement and preventing social exclusion of seniors (Komise, 2009; EC, 2010; Walker & Maltby 2012).

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AUTHOR CONTRIBUTIONS

Paragraph 1 L.F.; Paragraph 2 F.G.; Paragraph 3 F.Z.; Paragraph 4 C.G.;

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AUTHOR'S PROFILE

Carmela Gargiulo is full professor of Urban Planning Techniques at the University of Naples Federico II. Since 1987 she has been involved in studies on the management of urban and territorial transformations. Since 2004, she has been Member of the Researcher Doctorate in Hydraulic, Transport and Territorial Systems Engineering of the University of Naples "Federico II". She has been Member of the Committee of the Civil, Architectural and Environmental Engineering Department of the University of Naples "Federico II". Her research interests focus on the processes of urban requalification, on relationships between urban transformations and mobility, on the estate exploitation produced by urban transformations, and on the complex connections between land use, energy consumption and climate change. On these subjects she has co-ordinated research teams within National Project such as Progetto Finalizzato Edilizia - Sottoprogetto "Processi e procedure" (Targeted Project on Building – Subproject "Processes and procedures), from 1992 to 1994; Progetto Strategico Aree Metropolitane e Ambiente, (Strategic Project Metropolitan Areas and Environment) from 1994 to 1995; PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market" from 2011 to 2013; Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015; Project "Mobilage" 2018-2021, financed by Cariplo Foundation. She has been editor of the Scientific Journal TeMA – Land Use, Mobility and Environment since 2007. She is author of more than 130 publications.

Floriana Zucaro is an engineer, Ph.D. in Hydraulic, Transport and Territorial Systems Engineering at the Department of Civil, Building and Environmental Engineering – University of Naples Federico II. She received a M.Sc. in Environmental and Territorial Engineering at the University of Naples Federico II with a specialization in management of urban and territorial transformations. In 2014 she won a scholarship within the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II. Her research interests are in the field of land use planning and energy saving integration in urban policies, sustainable land use and sustainable mobility.

Federica Gaglione is an engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban accessibility. The aim is to develop a decision support tool that, on an urban scale, allows to choose the most effective actions to improve urban accessibility for vulnerable users, by contributing to improve their quality of life.

Luigi Faga holds a master's degree in architectural engineering with a thesis on the topic of land use-transport integration within station areas.

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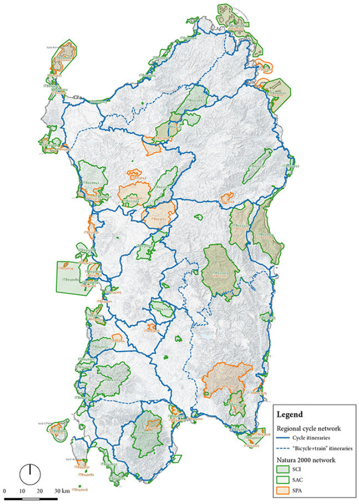

CYCLE NETWORKS IN NATURA 2000 SITES:

THE ENVIRONMENTAL ASSESSMENT OF THE REGIONAL CYCLING PLAN OF SARDINIA, ITALY

ITALO MELONI
ELISABETTA ANNA DI CESARE
CRISTIAN SABA

Centre for research on transport and mobility issues (CIREM). University of Cagliari, Italy
e-mail: imeloni@unica.it
elisabetta.dicesare@yahoo.it
cristiansaba@gmail.com
URL: www.unica.it

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ABSTRACT

Cycling is assuming a constantly increasing importance in the European society, as it provides recognised economic, environmental and health-related benefits. In the last three years, the Autonomous Region of Sardinia (Italy) identified the need to realise new cycling facilities, as part of regional strategic infrastructure, in order to promote sustainable development. Consistently, it recently approved the Regional Cycling Plan of Sardinia (RCPS), which establishes a regional network of cycle paths, with the aim to promote cycling mobility and a new type of sustainable tourism related to region's environmental and cultural peculiarities. The RCPS has been subjected to Strategic Environmental Assessment, as required by the European Directive 2001/42/EC, in order to integrate environmental considerations in decision making during the plan elaboration process. Moreover, a specific 'appropriate assessment' has been carried out, as required by the European Directive 92/43/EEC, due to the fact that the Plan affects Natura 2000 sites. This work presents the methodology defined to conduct the appropriate assessment of the RCPS, aiming to guarantee that the provisions of the Plan allow the preservation of the integrity of habitats and species of Community interest, while ensuring sustainability of human activities.

KEYWORDS
Cycling plan; Natura 2000; Environmental assessment

1 INTRODUCTION

Nowadays, the wide range of cycling benefits related to environmental sustainability, economic development and human health are largely recognised (Neun *et al.*, 2016). Thus, a great number of governments and municipalities are promoting cycling mobility at different scales. Following this trend, in 2015, the Autonomous Region of Sardinia (RAS) officially recognised cycling mobility as a key factor for regional development and identified cycling facilities among the regional priorities and the strategic infrastructure. Consequently, it allocated specific significant financial funds for their realisation. Within this framework, the Regional Cycling Plan of Sardinia (RCPS), drafted under the scientific coordination of the Centre for research on transport and mobility issues (CIREM - University of Cagliari) and officially adopted by the RAS (?) in December 2018, aims to make Sardinia accessible by bike, through the design and realisation of a regional network of cycle paths, in order both to foster cycling mobility and to encourage the development of new types of sustainable tourism related to the characteristics of the territory.

In fact, the creation of a regional network of cycle paths encourages the development of cycle tourism, which can be defined as "recreational visits, either overnight or day visits away from home, which involve leisure cycling as a fundamental and significant part of the visit" (Sustrans, 1999; p. 1), and increases the knowledge and interest in the regional cultural and natural heritage, including Natura 2000 sites.

The RCPS has been subjected to Strategic Environmental Assessment (SEA), which represents a systematic and proactive process to strengthen the role of environmental issues in the decision-making process related to plans, programmes and policies (Sadler, 2011). SEA was introduced by the European Directive 2001/42/EC and then transposed into the national legislation frameworks of the Member States. Literature highlights that important conditions for SEA to be effective are both its interaction and interdependence with the planning process at all its elaboration stages (Fundingsland Tetlow & Hanusch, 2012), and the participation of all the key actors (Fisher et al., 2006) in order to encourage inclusive decision-making processes, in accordance with democracy and transparency principles (Zoppi, 2012).

At the same time, since the RCPS is a sectorial plan likely to have a significant effect on regional Natura 2000 sites, an 'appropriate assessment' was compulsory, as indicated in article 6, paragraph (3) of the Directive 92/43/EEC (Habitats Directive), in order to evaluate whether the plan implementation could affect the integrity of sites of Community importance. According to Söderman (2008), the aim of the appropriate assessment process is to hierarchically promote: avoidance, mitigation and compensation of negative impacts on the environment. First, the avoidance of negative impacts must be reached by examining

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alternative ways of achieving the plan objectives. Whether adverse effects still occur, appropriate mitigation measures have to be identified. Lastly, where no alternative solutions exist and where adverse impacts remain, compensatory measures have to be provided (Söderman, *ibidem*). Therivel (2009) defines the appropriate assessment as a decision-making precautionary tool, because plans (or projects) that could have adverse impacts on site integrity, may not be adopted unless a series of strict requirements. The only exception for proceeding despite negative effects, concern the occurrence of imperative reasons due to overriding public interest.

In the light of the above premises, this work presents the methodology defined to conduct the appropriate assessment of the Regional Cycling Plan of Sardinia. The paper is organized as follows: the next two sections give a short overview on the most important objectives and features of the Plan and a description of the main characteristics of the Regional Natura 2000 network. The subsequent section illustrates the methodology used to carry out the environmental appropriate assessment of the Plan, while the last two sections summarise the results of the analysis and provide some concluding remarks and suggestions for further research.

2 THE REGIONAL CYCLING PLAN OF SARDINIA

The Regional Cycling Plan of Sardinia defines a set of coordinated actions, which combine hard and soft measures, in order to encourage cycling mobility.

On the one hand, hard measures consist in a wide range of cycling infrastructure types (e.g. segregated cycle paths, cycle lanes, shared roads), depending on road safety conditions related to traffic levels, and off-road available infrastructures. Cycling infrastructure is provided with a specific and recognisable signage, and integrated with adequate provisions of cycle services along the network (e.g. cycle parking, bike repair stands, information points, rest areas). Furthermore, a great emphasis is given to the promotion of intermodality, through the identification of a large number of intermodal hubs located along the network, with the aim to ensure connections with other means of transport. Intermodal exchange nodes are categorised as: (i) gates, corresponding to the most important transport accesses to the island (i.e. ports and airports), and (ii) regional hubs, corresponding to relevant train and bus stations. The network infrastructure is planned to provide both long-distance routes (100-200 km) aiming to satisfy the demand for multiple-day cycling holiday, and shorter daily sections (40-60 km). The design of cycling itineraries considers several aspects, such as the connection with the largest possible number of urban centres, cultural and archaeological attractions, parks and green areas, the reuse of existing abandoned infrastructure and buildings.

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On the other hand, soft measures are related to the social dimension and include the involvement of local communities through communication, information and education. In fact, although cycling facilities are an essential component to achieve the Plan objectives, they do not in themselves necessarily lead to an increase in cycling (Lumsdon *et al.*, 2001). In particular, the close collaboration with local cyclist organisations and the large number of public information and participation events with public authorities and local community, provided added value to the plan, contributing to its dissemination.

One of the main goals of the RCPS is to make Sardinia more appealing to cycle tourists through the diversification of the tourism product, with the consequent extension over the year of the tourism season, and the redirection of tourist flows, currently mainly concentrated along the coast, towards the regional countryside. As a result, a more general purpose consists in the development of small local business and in the reconnection between coastline and inland territories, also promoted by the Regional Landscape Plan.

The regional network of cycling paths consists of 52 itineraries for a total amount of 2.649 km, including 6 "bicycle+train" itineraries on existing railways. Moreover, the network connects more than 250 urban centres, 49 rail stations, 400 bus stops and over 700 points of interest, including historical and archaeological monuments, national and regional parks and Natura 2000 sites.

3 THE REGIONAL NATURA 2000 NETWORK

Natura 2000 is a coordinated network of core areas across the European Union's (EU) Member States, established under the provisions of the Habitats Directive, with the aim to protect biodiversity and ensure long-term survival of Europe's valuable and threatened species and habitats. Natura 2000 network includes both Sites of Community Importance (SCIs) and Special Areas of Conservation (SACs), as identified by the Habitats Directive, and Special Protection Areas (SPAs), identified under the provisions of Directive 2009/147/EC (Birds Directive). In particular, SCIs are specific circumscribed areas that significantly contribute to the maintenance or restoration of a natural habitat or of a species at a favourable conservation status, while SPAs are instituted to preserve, maintain and re-establish biotopes connected to threatened bird species. According the two EU Directives, Member States are required to both designate and manage SPAs and SCIs.

The Sardinian regional Natura 2000 network consists of 125 protected areas, for a total area of 662,769 hectares, which corresponds to about 27% of the whole regional surface. The network includes 32 Special Protection Areas, 87 Sites of Community Importance, 56 of which have been already designated as Special Areas of Conservation, and 6 sites in which the SCIs/SCIs completely coincide with SPAs (Tab. 1).

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TYPOLOGY	NUMBER	AREA (ha)
Special Protection Areas (SPA)	32	179.775,108
Sites of Community Importance (SCI) or Special Areas of Conservation (SAC)	87	364.689,299
SCI/SAC and SPA	6	118.304,938
Total	**125**	**662.769,35**

Tab. 1 Typology and number of Natura 2000 sites in Sardinia

The regional Natura 2000 network holds 61 habitats, including 14 priority habitat types, grouped according to 9 macro-groups: (i) costal and halophytic habitats, (ii) coastal sand dunes and continental dunes, (iii) freshwater habitats, (iv) temperate heath and scrub, (v) sclerophyllous scrub, (vi) natural and semi-natural grassland formations, (vii) raised bogs and mires and fens, (viii) rocky habitats and caves and (ix) forests, which represents the most extended habitat typology since it covers almost the 40% of the Regional Natura 2000 surface.

4 METHOD

The first step of the methodology consists in the identification of potential negative effects on the site's conservation needs, resulting from the implementation of the Plan. On the one hand, a direct potential negative effect is related to the development of new dedicated cycling infrastructures, which can possible cause soil consumption, damage of valuable plant formations, alteration and fragmentation of habitats of Community interest. On the other hand, it is possible to identify indirect effects related to the increase in anthropic pressure within the sites, and, as a consequence, disturbance of the animal species for which the protected areas have been designated.

Thereafter, the interceptions between the Natura 2000 sites and the regional cycling network are identified in a Geographic Information System (GIS) environment. For each intercepted site, a more detailed analysis is conducted, in order to clarify (i) the main characteristics of the specific site, (ii) the interventions provided under the Plan in its territory and (iii) an evaluation to assess whether the Plan does or does not affect the integrity of the site.

5 RESULTS AND DISCUSSION

The results of spatial analysis highlight that the regional network of cycle paths intercept 58 Natura 2000 sites (Fig. 1a). In 11 sites the cycle ways are located along their perimeter, whereas in 47 sites they intersect the area of the site.

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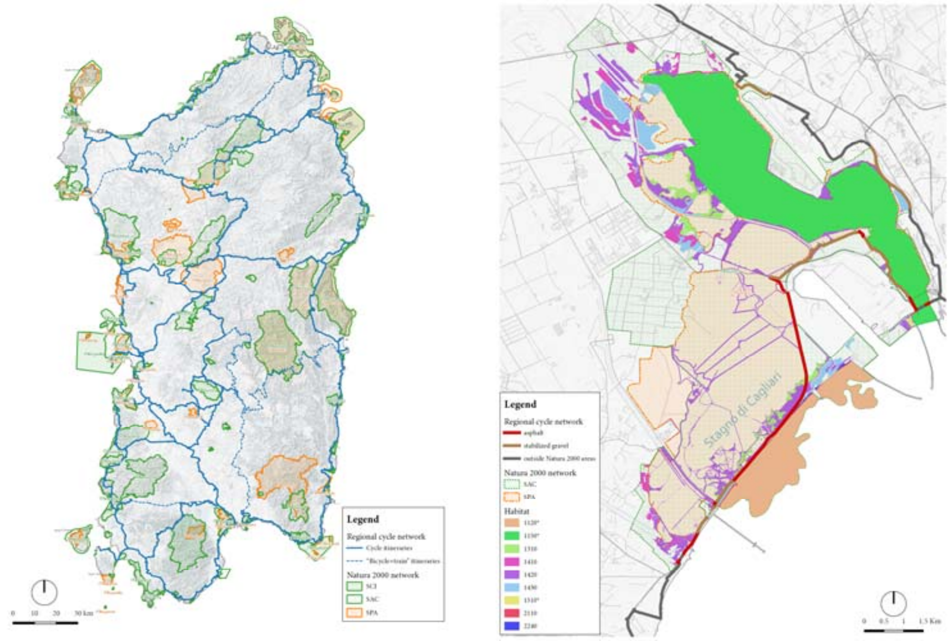
For each of these 47 sites, a specific data sheet reporting the results of a more in-depth analysis is compiled, with the aim to present the site-specific characteristics and to evaluate the possible impacts of the Plan according to the interventions planned in its territory.
The analysis conducted for each site first shows a map, indicating the site boundaries and its typology, the location of habitats of Community interest and the location of the cycle routes designed under the provisions of the Plan, with specific reference to the planned road pavement. Fig. 1(b) shows an example of the maps produced during this phase, representing the "Stagno di Cagliari" site (Site code: ITB044003) and the "Stagno di Cagliari, Saline di Macchiareddu, Laguna di Santa Gilla" site (Site code: ITB040023).



(a) **(b)**

Fig. 1 Map of the intersections between the regional cycle routes and the Sardinian Natura 2000 sites (left, a)
Map of the intersections between the regional cycle routes and two Natura 2000 sites (right, b)

Qualitative information on a given site, reported in the first part of the data sheet, is gathered from the Natura 2000 standard data forms (e.g. general site description, list of species of Community interest), whereas information on the typology, spatial distribution and extension of habitats of Community interest are identified with spatial analysis in a GIS environment using data provided from the Autonomous Region of Sardinia.

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Specific qualitative and quantitative information about the interventions outlined by the Plan, useful to evaluate their implications for each site, is reported in the second part of the data sheet (e.g. length of the cycle routes, the actual paving material and the planned one), while location is reported in the map.

The results of both spatial and descriptive analysis point up that most of the cycle routes are located in correspondence with existing paths or roads and do not generate alteration or fragmentation of habitats of Community interest. Moreover, the development of cycle routes encourages a sustainable use of the site natural heritage, in accordance with the conservation and management measures established in the Management Plan of the specific sites.

6 CONCLUSIONS

In this study we investigate if the provisions of the Regional Cycling Plan of Sardinia are compatible with the conservation of habitats and species of Community interest included in Sardinian Natura 2000 sites, as required by the Habitats Directive.

The analyses conducted both for each Natura 2000 site and for the regional network as a whole, highlight that the RCPS is not likely to have negative effects on sites integrity. Moreover, the design and implementation of a network of cycling routes may contribute to the development of a sustainable fruition of the areas, strengthening the synergies between the need of environmental protection and the promotion of the natural heritage. Lastly, it is worth to highlight that, as the RCPS is a regional plan, it does not provide precise location of the interventions, but it rather identifies a series of corridors, crucial for the subsequent definition of individual travel itineraries. During this last phase, more detailed appropriate assessment may be required with reference to the interception of Natura 2000 sites, as well as a precise quantitative analysis of direct or indirect environmental possible impacts on habitat and species, in order to eventually design alternative solutions and compensatory measures when necessary.

Lastly, the methodology developed in this study can also be applied to other regional contexts in the European Union, where the appropriate assessment of cycling plans is required for the presence of Natura 2000 sites.

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AUTHOR'S PROFILE

Italo Meloni, Full Professor of the Department of Civil & Environmental Engineering and Architecture at the University of Cagliari, where he teaches Transportation Planning. He is currently also director of CIREM and CRiMM, the University centre for research on transport and mobility issues and on the integration between economic development, land use and transport supply and demand. His current research interests lie chiefly in promoting changes in travel behaviour for achieving more sustainable mobility, in activity based and discrete choice modelling for travel demand forecasting, in the micro-meso-and macrosimulation of transportation networks. He is a member of the IATBR International Association on Travel Behaviour Research and of WCTR World Conference on Transport Research.

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IMPROVING REGIONAL ACCESSIBILITY THROUGH PLANNING A COMPREHENSIVE CYCLE NETWORK:

THE CASE OF SARDINIA (ITALY)

***ITALO MELONI, CRISTIAN SABA**
BEATRICE SCAPPINI

Interuniversity Centre for Economic and Mobility Research (CIREM), University of Cagliari
e-mail: imeloni@unica.it, cristiansaba@unica.it
beatricescappini@unica.it, verzucca@unica.it
URL: http://www.unica.it

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ABSTRACT

Investments in cycle tourism can generate generalised benefits, especially in those marginal areas untouched by mass tourism. Cycling infrastructures can promote development, passing from the mere design of the transport infrastructure to what can be defined as a "territorial project". The aim of the present paper is to show how the planning of an integrated cycling mobility system can create opportunities for growth and development in areas along the routes, by describing the regional cycling mobility plan of Sardinia. The plan is based on a systemic approach that involved identifying a complex of both physical and social infrastructuring. The physical infrastructure included the network of routes, facilities for cyclists, intermodal hubs, specialised signs and cycle parks. Social infrastructure consisted of putting in place measures for the governance of the system's implementation and operation. The methodology adopted here allowed us to outline a regional cycle network that will reach 231 municipal territories and over 700 places of interest scattered throughout the island and covering an overall length of 2,000 km. Minor routes of local significance can be linked up with the primary routes to expand the network. The plan analysed the features of the system and its potential socio-economic impact on the island. This model will be able to extend the tourist season by developing year round activities and distributing tourist flows island-wide. It can also produce a positive impact both directly, through direct tourist expenditure, and indirectly by boosting the local economy through the creation of facilities for cyclists.

KEYWORDS
Cycling mobility; Regional accessibility; Bicycle network planning

* The other author is: Veronica Zucca.

1 INTRODUCTION

Over the last few years sustainable mobility planning has seen a growing interest in cycling mobility, as witnessed by the Declaration adopted by Transport Ministers of the EU member states during the 2015 Luxembourg Summit, that acknowledged cycling as a means of climate friendly transport. The environmental, economic, social and health benefits of cycling are universally recognised. The European Cyclists' Federation (2016) quantified the benefits associated with cycling for Europe at 513 billion euros per year. This translates into around 15.4 billion euros in terms of reduced costs associated with pollution and with the effects of climate change, as well as more than 63 billion euros of economic benefits. The European bicycle industry produces some 12.7 million of the 19.6 million bicycles sold, employing over 45,000 workers in 2016 (CONEBI, 2017). The positive effects on health include improved physical fitness and cardiovascular health and reduction of obesity, as reported by Oja *et al.* (2011). One branch of economic activity experiencing substantial growth and associated with cycling, is cycle tourism. Cycle tourism is defined as "recreational visits, either overnight or day visits away from home, which involve leisure cycling as a fundamental and significant part of the visit" (Sustrans, 1999). In many European countries cycle tourism forms an important part of active tourism, often along highly appealing single routes, or along cycle network infrastructure. Investments in cycling mobility and in cycle tourism can generate generalised benefits, especially in those marginal areas untouched by mass tourism (Piket et al., 2013). For example, as recommended by the VENTO project, a cycle route from Venice to Turin along the river Po, a leading role can be played by both cycling and cycle tourism infrastructures in promoting development, passing from the mere design of the transport infrastructure to what can be defined as a "territorial project" (Pileri & Giudici, 2017). Moreover, the recent law n.2/2018 on cycling mobility makes it compulsory for all Italian regions to draw up and approve a regional cycling mobility plan (Art.5), in line with the regional transport and logistics plan and the national cycling mobility plan. The regional plan envisages the creation of rural cycle routes, for discovering and enjoyment of the cultural and natural heritage, of interchange points where cyclists can change to other means of transport as well as parking and service areas. The plan had to be approved within one year of the approval of the cycling mobility master plan. The aim of the present paper is to show how the planning of an integrated cycling mobility system can create opportunities for growth and development in those areas along the routes, by describing the regional cycling mobility plan developed for the RAS (Autonomous Region of Sardinia - Italy). The plan was commissioned by the Sardinian regional government (RAS) to ARST S.p.A., the Sardinian Regional Transport Agency, with the scientific coordination of the Interuniversity Centre for Economic and Mobility Research

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(CIREM) at Cagliari University between 2016 and 2018. This paper aims to contribute to transportation research, in particular in relation to accessibility, which is often not guaranteed in economically and socially marginalised areas, that are, as such, weak demand areas. In fact, one of the main, of the plan's several, objectives was to improve physical and social accessibility in these contexts. Indeed, on the one hand, the physical infrastructure envisaged by the plan ensures access to marginal areas, in terms of economy and tourism, through forms of active mobility. On the other hand, enhancing accessibility to these areas improves the populations' chances of access to resources and opportunities that marginality hitherto precluded their communities from obtaining. From this perspective, the creation of a cycling infrastructure, together with the implementation of social measures, encourages both an increase in the choice to cycle in Sardinia's interior by islanders themselves, and generates new tourism flows from elsewhere, associated with the cycle tourism market. The plan demonstrates how a cycling mobility system can become an important asset for tourism and regional development, being an element of aggregation of the various components of a fragmented and polarised territory. The paper is organised as follows. The next section briefly describes existing cycling infrastructures in Europe and Italy, similar to that envisaged in the present plan. Section 3 describes the Sardinian setting, showing how the regional cycling mobility plan fits into this context. Section 4 explains the methodology adopted, while the last two sections summarise the results obtained and provide some concluding observations.

2 CYCLE TOURISM AND CYCLE INFRASTRUCTURE (LITERATURE REVIEW)

Although only limited data on cycle tourism have been published in recent years, the link between the availability of adequate cycle infrastructure and the growth of cycling is widely addressed in the literature. The two variables are positively correlated, and though some even significant differences emerge in the studies conducted (Pucher et al., 2010), it can be said that the creation of infrastructure is a necessary but not sufficient condition by itself to significantly increase bicycle use. This is particularly true where infrastructure does not form part of a broader system of interventions (Lumsdon & Tolley, 2001). Though this aspect has to be incorporated into a more complex framework comprising measures of a diverse nature, infrastructure is nevertheless central to implementing cycling mobility and stimulating local economies through cycle tourism. Numerous examples of route networks for cycle tourists exist in other, especially northern, European countries. An interesting case is Switzerland, where between 1986, when the first cycle tourism route was experimented, and 1998, the national cycling network "Veloland Schweiz" was created. With an overall length of more than

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3,000 km, the network has been integrated with hiking and mountain bike trails as well as skating and canoeing, making it one of the largest national integrated active mobility networks. Managed by the Switzerland Mobility Foundation, it owes its success to a number of factors, including full accessibility to the region, achieved through a variety of travel options and integration with trains, buses and ferries (della Bicicletta, 2002). At the cross-border level, not to be forgotten is the EuroVelo European network, whose design, which commenced in the 1990s, was the collaborative effort between the European Cyclists Federation and the European Commission. The network is composed of supranational cycle corridors that retrace and link up each country's routes. Italy still lags behind the above European countries, though infrastructure planning for cycling mobility has been gathering pace since 2016, with funding of 374 million euros (91 M for the 3-year period 2016-2018 and 283 M for 2019-2024) and following the adoption of Directive No.375/2017, aimed to plan and put in place a national cycle tourism system. To date, the only Italian regions who have approved the regional cycling mobility plan, other than Sardinia, are the Lombardy and Veneto regions (2014). In these plans the primary objective is to identify a system of routes at the regional, national and European level, integrated with public transport and recognisable by standard signing. This system is defined by linking existing cycle routes that both the Lombardy and Veneto regions already have at the European (EuroVelo) and national level (Bicitalia). This facilitates the identification of the regional network (see for example the Lombardy provincial plans and the hiking trails network for the Veneto region). Besides the strictly infrastructure related aspects, the plan also envisages a campaign for promoting cycling mobility. The entire process is coordinated on a regional basis. One innovative example of cycling mobility project in Italy is VENTO, a cycle tourism corridor that seeks to rediscover the region through soft mobility (cycling), providing an opportunity to visit places, experiencing the pleasure of slow travel. (Pileri & Giudici, 2017).

3 THE SARDINIAN SETTING

Compared to the large majority of the European and Italian cycling mobility examples examined here, Sardinia presents distinctive geographic, cultural and infrastructural characteristics. One intrinsic feature of the Sardinian region is insularity, which puts it at a disadvantage compared with the Italian mainland; the island suffers from limited accessibility, isolation and a limited range of small businesses, that all contribute to its continuous depopulation (EUROISLANDS, 2013). This phenomenon affects the island as a whole, with 250 of the 377 municipalities experiencing population decline, 31 of which are in danger of disappearing altogether in the near future (Cocco et al., 2016). Added to the migration flows away from the island, is the shift of the population from villages to the towns and from the

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interior towards the coast. The outcome is a major regional imbalance, that continues to be fuelled by the dominant role played by coastal tourism in Sardinia. What is more, the nature of the island's landforms, more than 80% of which are hills or mountains, has historically discouraged cycling, except in smallish areas with flat terrain. On the other hand, one potential advantage for developing cycling mobility in Sardinia is its mild climate nearly all year round, a factor that strongly influences bicycle use for leisure purposes (Deenihan et al., 2013). However, it is above all because of the almost total lack of cycling infrastructure that no cycling culture has been created in Sardinia and cycling still remains a marginal mode of transport and largely only for recreation. Over the past few years, local authorities have been showing increasing interest in cycling mobility. In fact, cycle paths in Sardinia increased from 20.4 to 81.9 km between 2011 and 2016 (Centro Studi Continental based on ISTAT data). However, a large part of the actions implemented has focused merely on the infrastructure component, which is still largely discontinuous, disconnected, and concentrated mainly in urban areas.

4 METHODOLOGY

The regional cycling mobility plan for Sardinia is based on a systemic approach that involved identifying a complex of combined and integrated interventions, actions and measures for both physical (*hard*) and social (*soft*) infrastructuring. The physical infrastructure included the network of routes, facilities for cyclists, intermodal hubs, specialised signs and cycle parks. Social infrastructure consisted of putting in place measures for the governance of the system's implementation and operation. This involved identifying the operational coordination structure, creation of a logo, design of a web portal and an app for mobile devices. The cycle routes were planned so as to ensure a comprehensive island-wide network. The network was designed around a hierarchy of routes; primary medium-to-long distance routes that link the main towns, interchange hubs and the major tourist attractions; secondary routes that connect with the main routes and with the places of local interest; local routes that form the continuation of the main and secondary routes in urban areas; intermodal bike+train routes that complete the network in areas where cycling is particularly challenging. The methodology adopted in planning the cycling infrastructure consisted of a GIS-based multi-stage process that made it possible to identify corridors at the regional level within which to develop the design of the cycle routes. The first preliminary step consisted in an overview of the existing cycling infrastructure, namely the infrastructure already in place though not dedicated cycle routes, but with characteristics that could be adapted to include in the network, so as to minimise costs and impacts as far as possible. In this phase a large number of minor roads were identified, consisting of rural roads and roads running alongside waterways. In addition,

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300 km of disused railway tracks were considered, particularly suitable for conversion into cycle paths because of the gentle slopes and reusable foundations. In the next phase, the network nodes were defined. First the gateways to the island, coinciding with the main transportation infrastructure for national and international connections (ports and airports), were identified, so as to ensure accessibility from outside the island. Then the regional transport nodes were defined (railway stations and local public transport stops, ports with inland transport connections) in order to guarantee internal accessibility. With a view to increasing accessibility, the number of network nodes was further increased to include additional routes so as maximise the number of urban centres reached. Special attention was devoted to making the network appealing, including in the network historical, archaeological and cultural attractions and links to areas of particular environmental interest such as national and regional parks and protected areas in the Nature 2000 network. One last important aspect, given Sardinia's landform characteristics, concerns the analysis of slope, so as to be able to compare alternative solutions for the same route. This analysis was performed in GIS environment, using the digital elevation model (DEM) with 10 m grid spacing provided by the Autonomous Region of Sardinia. In order to ensure adequate assistance to cyclists, the plan envisaged installing facilities at points along the infrastructure. Following the same planning logic adopted for identifying the network routes, for the cycling facilities we considered the adaptive reuse of existing buildings with no particular function. These include for example old railway buildings along disused railway tracks, vacant property owned by the state or by local authorities. Where this is not possible, new structures will be built with low environmental impact. The minimum services consist of bike stations, rest areas, infopoints, bike maintenance facilities and bike-hotels. At bike stations users can park their bicycles and change to other means of public transport. At the rest areas, located along the route, riders can freshen up and purchase snacks and beverages. Depending on the services offered, the rest areas can be multifunctional, equipped with vending machines and washing facilities, or manned kiosks and with a covered area. Infopoints can be viewed as the "gateway" to a given area and for this reason are located at each stage of the regional network and near the main tourist attractions. Bike service stations offer every assistance to cyclists and are manned by specialist staff. Riders can also do their own maintenance. Bike-hotels, located at the start/end of each daily stage, provide many integrated and dedicated services for cyclists. The intermodal nodes are situated at strategic points within the regional public transport network. These nodes facilitate accessibility and flexibility of the routes created, providing interconnection and interchange with public transport services and will be equipped with facilities for cyclists. Specialised signs, integrated with those prescribed by regulations, are required to render the routes easily recognisable as well as to provide transport as well as

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tourist information. The cycle parks complete the link between the regional system and the local active mobility networks. These parks provide physical access to the areas concerned and achieve the objective of creating an extensive network for enjoyment of the regional heritage. The cycling infrastructure has been designed in such a way that it can be integrated with other active mobility systems such as hiking and walking trails, historical and cultural trails, horse riding trails or tourist railways.

5 RESULTS AND DISCUSSION

The methodology adopted here allowed us to outline a regional cycle network that, once completed, will reach 231 municipal territories and over 700 places of interest scattered throughout the island and covering an overall length of 2,000 km. Minor routes of local significance, promoted by different authorities and associations, can be linked up with the primary routes to expand the network. The inclusion of cycle parks in the network had precisely this objective and these will serve as connection between the regional and local networks, increasing coverage.Inter-regional accessibility is ensured through connection with the island's "gateway" transport nodes (three airports and the four main commercial ports) and by incorporating the cycle network into the European (EuroVelo) and national (Bicitalia and National System of Cycle Touring Routes) circuits. Intra-regional accessibility on the other hand is guaranteed by the inter-modal aspect of the network that provides for links from the main commercial ports with 49 railway stations and 432 local public non-urban transport stops. In addition, the main urban areas connect with the rural regions through a main route interspersed with local routes as well as with the bike+train routes.

6 CONCLUSIONS

The paper describes the Cycling Mobility Plan for Sardinia, analysing the features of the planned system and its potential socio-economic impact. The plan lays the foundations for an active mobility system able to promote an innovative and sustainable tourism model. This model is by no means an alternative to, but rather it will be able integrate the existing one over time, extending the tourist season by developing year round activities and distributing tourist flows island-wide.

Implementation of the project can produce a positive impact both directly, through direct tourist expenditure, and indirectly, by boosting the local economy through the creation of facilities for cyclists: bike service shops, spare parts, hospitality.

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Fig. 1 The regional cycle network of Sardinia

Adopting the methodology described here, we were able to design a coordinated set of interventions in both physical and social terms. As for the physical infrastructure, the planning criteria were geared towards connecting the greatest number possible of urban centres, places of historical, archaeological and cultural interest, areas of particular environmental interest, the island’s gateways, and a sufficient number of intermodal nodes, so as to improve accessibility to the innermost and marginal areas of the island of Sardinia. Whether increasing physical accessibility will improve economic and social accessibility will depend on a number of conditions. From this perspective, all the soft measures envisaged in the plan, often decisive

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success factors for cycle tourism infrastructure, need to be opportunely implemented. A key role will be played by governance, both for the creation of the physical infrastructure and for the subsequent management of the entire system. The plan designates a single management body at the regional level which will be responsible for coordinating the various players involved and will act as the linkage between the local and central levels.

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AUTHOR'S PROFILE

Italo Meloni, Full Professor at the Department of Civil and Environmental Engineering & Architecture, University of Cagliari, where he teaches Transportation Planning. He is currently also director of CIREM and CRiMM, University centres for transportation research and mobility issues that include integration between economic development, land use and transport supply and demand. His current research interests lie chiefly in promoting changes in travel behaviour for achieving more sustainable mobility, in activity based and discrete choice modelling for travel demand forecasting, in the micro-meso-and macrosimulation of transportation networks. He is a member of the IATBR International Association on Travel Behaviour Research and of WCTR World Conference on Transport Research.

Cristian Saba, Master's degree in Environmental Engineering (University of Cagliari), master's degree in Geomatics (University of Siena). He was awarded a post-graduate research grant at CIREM (Interuniversity Centre for Economic and Mobility Research - University of Cagliari). He is a member of the research team that developed the Regional Cycling Plan of Sardinia. His current research interests are in sustainable mobility, spatial planning and geographical databases.

Beatrice Scappini, Master's degree in Architecture, master's degree in Design for Smart Cities (University of Florence). She has been awarded a post-graduate research grant at CIREM (Interuniversity Centre for Economic and Mobility Research - University of Cagliari). She is a member of the research team that developed the Regional Cycling Plan of Sardinia. Her current research interests are in sustainable mobility, landscape and urban planning.

Veronica Zucca, Master's degree in Architecture (University of Cagliari). She has been awarded a post-graduate research grant at CIREM (Interuniversity Centre for Economic and Mobility Research - University of Cagliari). She is a member of the research team that developed the Regional Cycling Plan of Sardinia. Her current research interests are in sustainable mobility, landscape and urban planning and graphic design.

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VEHICLE ROUTING PROBLEM AND CAR-POOLING TO SOLVE HOME-TO-WORK TRANSPORT PROBLEM IN MOUNTAIN AREAS

ANTONIO PRATELLI, MASSIMILIANO PETRI

Logistic University Center of Livorno
University of Pisa, Italy
e-mail: antonio.pratelli@ing.unipi.it
m.petri@ing.unipi.it
URL: http://www.polologistica.unipi.it

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ABSTRACT

Mountain areas have always been marginal zones for which providing a conventional public transport has been often difficult and burdensome. The present work was carried out within the European project INTERREG ALPINE SPACE called ASTUS - Alpine Smart Transport and Urbanism Strategies, a project focused on solving the mountain areas marginality problems and describes the methodology applied to the Italian pilot area constituted by the territory of "Unione Montana Comuni Biellese Orientale", a union of 23 Municipalities in the northern area of Piemonte Region (Italy). The methodology described in this paper is related to the short term period, applicable immediately and having as its main objective the implementation of a collaborative system between conventional public transport service, car-pooling service and company mobility management. The methodology is made of four main steps: actual mobility demand and supply analysis with research for economies, implementation of supply scenarios, economic and environment plan for each scenarios and, finally, selection of the Reference one. The results show that the proposed methodology is clearly transferrable to every marginal area with the use of very few resources with a guided and goal-oriented way to improve car-pooling solutions in our reality.

KEYWORDS
Mountain areas; Vehicle Routing; GIS applications; Limited accessibility; Car-pooling; ASTUS project

1 INTRODUCTION

Mountain areas have always had difficulty in guaranteeing a satisfactory Public Transport service for their residents, given their marginality, the necessary long distances and the practical impossibility to reach the economic balance. There are a lot of studies about mountain accessibility, regarding the estimation of accessibility indexes (Porceddu, 2006), the definition of these territories (Lella, 2018), the spatio-temporal analysis of their urban structure (Crescimanno et al., 2010, Fondazione Montagna Italiana, 2018) and the planning of strategies to solve their accessibility problems (Uncem Piemonte, 2017, Crescimanno et al., 2016).

In this context this paper presents a work done inside the European project INTERREG ALPINE SPACE called ASTUS - Alpine Smart Transport and Urbanism Strategies, and it describes the methodology applied to the Italian pilot area constituted by the territory of "Unione Montana Cities of Eastern Biella" (involving the UNCEM Piemonte partner), a union of 23 Cities in the Northern area of Piemonte.

In the next paragraph the pilot area is presented and, after, it is described in detail the applied methodology with the final drafting of some conclusions that are not finals because the project is still ongoing.

2 THE PILOT AREA

2.1 GENERAL FEATURES

The pilot area is the territory of 'Unione Montana Municipalities of Eastern Biella" that comprises 23 Cities (Fig. 1) in the province of Biella; its geomorphological structure and the distance from the Provincial Center (Biella) and the Regional Center (Turin), after the impact of the textile industrial crisis, has led to a depopulation phenomenon. This is a tipical situation and process already present in many north italian mountain areas.

The area covers a total surface of about 273.3 square kilometers with 29,198 inhabitants (at January 2017) with a population density of about 107 inhabitants/kilometers. Inhabitants are concentrated mainly in the Municipalities of Trivero, Valle Mosso, Lessona and Pray that contain about the 48% of total Union population (Fig. 2).

The territory is hilly and mountainous with fragmented inhabited centers and Tourism supply and demand have low development with a total of 8.809 tourists, 44 accomodation facilities and 540 sleeping accomodations (2016 tourist supply data).

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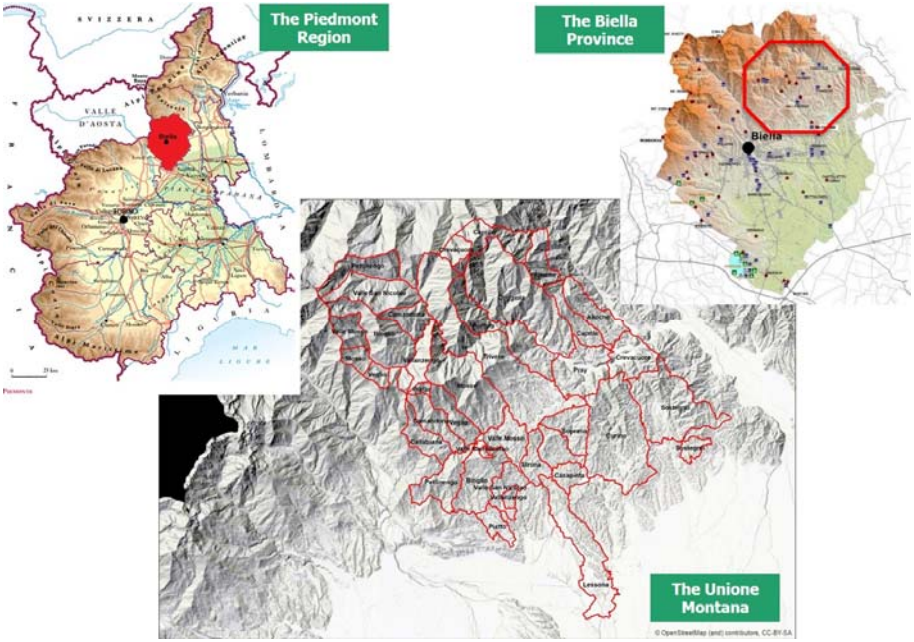

Fig. 1 The pilot area general territory

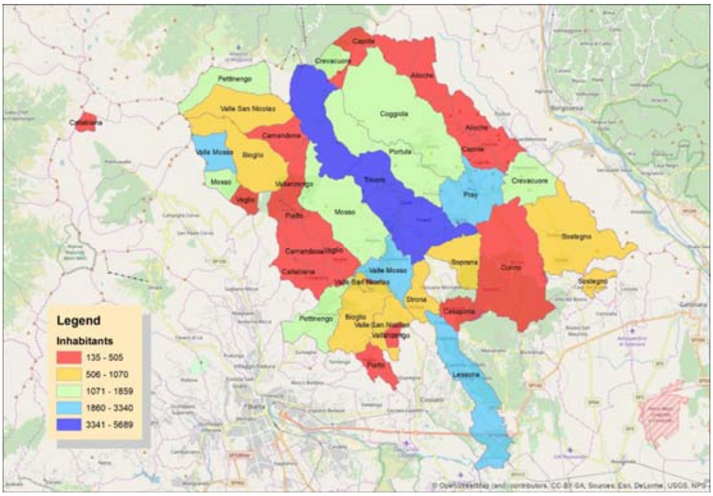

Fig. 2 Population distribution in the Union

2.2 ACTUAL TRANSPORT SUPPLY AND DEMAND

The Union area has a complex road network mainly concentrated in the south zone like also the actual public transport lines (Fig. 3). The more recent transport flow data (2011) coming from Census Survey show the absence of crossing flows with a mean of 1,5 trips/day for each

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inhabitant and the prevalence of work trips (about 76,5%). Crossing flows are practically absent. Tab. 1 shows the subdivision of trip types, by considering the flow types.

Flow type	Daily Work trips	Daily Study trips	Daily Total
Internal	5,596	2,782	8,378
Outgoing	5,705	1,292	6,997
Entering	3,611	501	4,112
Total	14,912	4,.575	19,497

Tab. 1 The actual transport flows

Analyzing the modal split and in particular the trips made by private car it is clear that only Trivero City has a high value of internal trips (about the 47% with 2.700 trips) while the ongoing flows come mainly (64%) from the Province of Biella and the incoming flows come from the Province of Biella (50%), the province of Vercelli (27%) and Milan (15%).

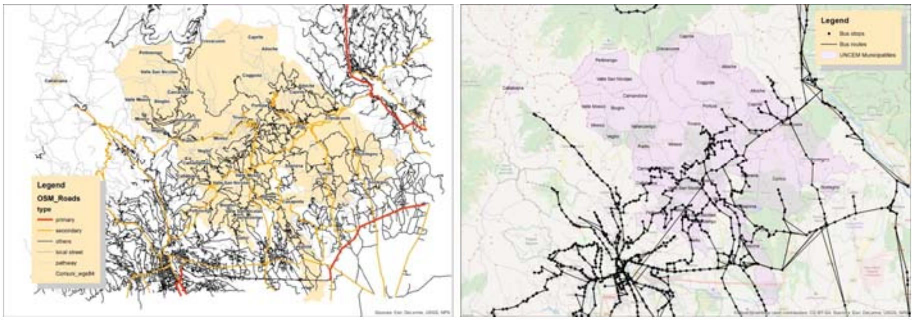
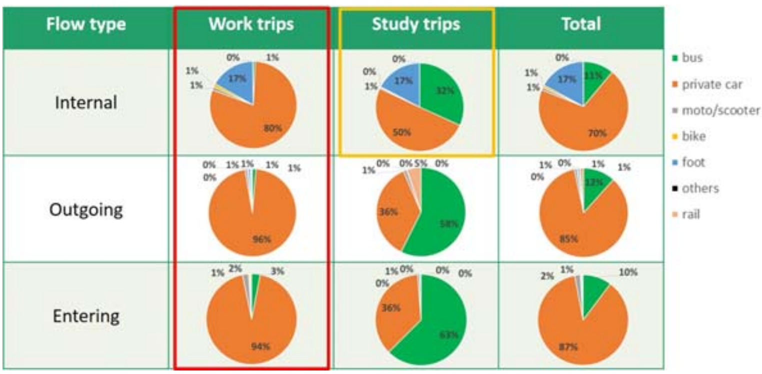


Fig. 3 The local road network (on the left) and the public transport lines and stops (on the right)

The main cause of car trips is the home-to-work mobility as shown in the Tab. 2. So the methodology described in the next part will focus on this problem.



Tab. 2 The actual modal split level

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3 THE METHODOLOGY

The methodology is made of four main steps: actual mobility demand analysis with research for financial resources, implementation of supply scenarios, economic and environment plan for each scenario and, finally, selection of the Reference one. In this paper we analyzed only the first three points because the final Reference Scenario choice is still ongoing, mainly by some workshops/cooperation activity with each local Company. The steps of the Short-Term Scenario methodology are the following:

- analysis of current mobility trends and problems (possible economic availability from little used public lines cutting);
- interviews with companies for home-work mobility;
- analysis of the resulting data with companies headquarters and workers' residences location georeferencing;
- analysis for intra-company solutions (to be funded in collaboration with each company Mobility Manager);
- analysis for inter-company solutions with car-pooling solutions among workers of different companies; identification of solutions for new routes of public transport (using Vehicle Routing Algorithm) to be financed with the resources referred to in point 1 above);
- identification of the car-pooling platform to be used.

3.1 ACTUAL MOBILITY DEMAND ANALYSIS

As many transport services need resources and also to know the actual use of public transport, an introductory analysis of public transport supply and demand has been done.
The analysis in the winter period shows, starting from the operating cost of 1,67€/km, some lines with low passengers (showed in red color in Tab. 3). These lines totally cover about 356 km/day for a total of 595€/day. So, in all winter period, cutting these lines will give a total amount of 151.600€. The analysis in the summer period shows, starting from the same operating cost, some lines with very low passengers (showed in red color in Tab. 4). The summer service is much less used despite a good mileage production. In fact, in the face of a decrease in the 38% offer compared to winter service, there is a drop in attendance of 75%. The low passenger lines totally cover about 2,185 km/day for a total of 3,650 Euros/day. So, in all winter period, cutting these lines will give a total amount of 175,200 Euros. So totally, cutting the low passengers lines give to the Administration a total budget of 326,800 Euros to be used for on-demand services. Moreover, we analyze the actual public transport network

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(Fig. 3) and it is clear how many cities, mainly in the north of the pilot area, are not cover from this service.

Line n°	Line Name	n° rides	km	passengers	pass/ride	pass/km
300	Biella-Cossato-Vallemosso-Trivero	94	1,674	1,891	20.12	1.13
310	Zimone-Borriana-Biella-Valdengo_Bioglio-Vallemosso	53	1,244	739	13.94	0.59
332	Biella-Vaglio	46	437	602	13.09	1.38
400	Cossato-Gattinara	25	612	613	24.52	1.00
410	Cossato-Buronzo	8	114	79	9.88	0.69
430	Cossato-Mezzana-Trivero	9	209	113	12.56	0.54
440	Andorno-Veglio	6	78	27	**4.50**	0.35
501	Pray-Santhia	2	122	14	**7.00**	0.11
548	Lessona-Vigliano	8	91	55	**6.88**	0.60
551	Biella-Varallo	2	116	141	70.50	1.22
552	Pray-Vercelli	2	133	89	44.50	0.67
553	Mosso-Trivero-Pray-Crevacuore	5	140	93	18.60	0.66
555	Trivero	7	83	159	22.71	1.92
556	Mezzana-Vallemosso	3	77	76	25.33	0.99
557	Bioglio-Pettinengo	4	51	39	9.75	0.76
558	Vallemosso-Callabiana	4	65	8	**2.00**	0.12
	Totale	**278**	**5,246**	**4,738**	**17.04**	**0.90**

Tab. 3 The actual public transport frequentation in the winter period

Line n°	Line Name	n° rides	km	passengers	pass/ride	pass/km
300	Biella-Cossato-Vallemosso-Trivero	55	1,057	549	9.98	0.52
310	Zimone-Borriana-Biella-Valdengo_Bioglio-Vallemosso	44	1,149	227	**5.16**	0.20
332	Biella-Vaglio	44	429	329	7.48	0.77
400	Cossato-Gattinara	8	178	39	**4.88**	0.22
410	Cossato-Buronzo	6	84	6	**1.00**	0.07
430	Cossato-Mezzana-Trivero	3	65	5	**1.67**	0.08
440	Andorno-Veglio	6	67	6	**1.00**	0.09
501	Pray-Santhia	2	122	10	**5.00**	0.08
548	Lessona-Vigliano	8	91	14	**1.75**	0.15
	Totale	**176**	**3,242**	**1,185**	**6.73**	**0.37**

Tab. 4 The actual public transport frequentation in the summer period

3.2 SUPPLY SCENARIOS IMPLEMENTATION

We have made a Home-to-Work survey to the workers in the twenty biggest companies present in the study area or near it (Tab. 5). The survey covers almost 80% of total workers with 1,769 people interviewed. The survey asked about actual transport mode used, work hours and residence location and results showed that about 95% of respondents use private car. The first analysis done with the collected data is the geolocation of each worker residence and the planning of three possible action types:

- incentive the use of actual bus lines;
- coordinate with each company for Mobility Management internal solutions and co-financing possibility;

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— evaluate innovative intra-company solutions: VRP algorithm to improve bus solutions and carpooling.

Company Name	Interview Data			Transport mode			
	Interviewed	Totals	Percentage	Car/Moto	Bus	Bike	Walk
Lanificio Carlo Barbera S.r.l.	74	79	93.7%	79	0	0	0
Soluzioni Tessili Srl	12	13	92.3%	12	0	1	0
Gabella Macchine - Officina	39	41	95.1%	32	0	6	1
Kramer Italia Srl	50	50	100.0%	39	1	4	6
Botto Poala Spa	140	140	100.0%	137	3	0	1
Filati Drago S.p.a. - Fintes Filati Drago Srl	62	62	100.0%	62	0	0	0
Filatura Cb Spa	55	55	100.0%	54	0	0	1
San Marco Rubinetteria Srl	36	38	94.7%	34	0	0	2
Trabaldo Togna S.p.a.	0	116	0.0%	0	0	0	0
Cerruti S.a.s. Filatura Cardata	5	5	100.0%	5	0	0	0
Ferla Egidio - Lanificio (s.p.a.)	36	36	100.0%	36	0	0	0
Tonella Srl	14	68	20.6%	12	1	0	2
Manifattura di Ponzone	28	28	100.0%	27	0	0	1
Lanificio Zignone Sp	71	130	54.6%	68	0	0	3
FALPI srl	14	14	100.0%	13	0	0	1
ETA service	4	4	100.0%	4	0	0	0
LANIFICIO CAMPORE BROGLIA QUINTINO	51	64	79.7%	48	0	0	3
Successori Reda S.pa.	344	378	91.0%	335	3	0	6
Lanificio Zegna Ermenegildo & Figli	266	460	57.8%	242	2	0	23
Vitale Barberis Canonico S.p.a.	468	468	100.0%	444	2	0	20
Totals	**1,769**	**2,249**	**78.7%**	**1,683**	**12**	**11**	**70**
			Percentage	**94.8%**	**0.7%**	**0.6%**	**3.9%**

Tab. 5 The interviewed Companies with some survey results

In the following part we describe the intra-company solution and the latest more complex inter-company solution with the integration of Vehicle Routing Modelling for conventional public transport solutions and bottom-up organized car-pooling. It is important to underline that the methodology does not choose for self-organized car-pooling solutions but it indicates the detailed worker to belong to each car-pooling group.

For each scenario simulated, it has been implemented a Low CO2 scenario to evaluate the decrease in CO_2 emissions. For the example showed, relative to work entry/exit at 22:00, Tab. 6 illustrates the basic parameters of the emission equation:

$$\mathbf{CO_2 = Pers \times \frac{Trips}{Pers} \times \sum_{m} mode\ share \times \frac{Pass - km}{Trip_m} \times \frac{Veh - km}{Pass - km} \times \frac{CO_2}{Veh - km}}$$

where:

CO_2 = Total transport-related CO_2 emissions within a defined system

Pers = Number of persons within a defined system

Trips/Pers = Number of trips per person within a certain time period

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mode share = Percentage of trips travelled with mode m
Pass-km/Trip$_m$ = Average distance travelled with mode m on a single trip
Veh-km/Pass-km = Number of vehicle-kilometers per passenger-kilometer
CO_2/Veh-km = CO_2 emission by transport mode m over one kilometer

The Intra-Company scenarios

Starting from the inaccessibility to workplace using the actual bus lines network (verified starting from actual bus service schedule time), we have made a mobility analysis for each company to find possible car-pooling worker clusters or the possibility to join many workers in a little bus (with the possibility to use also bus adopted as school-bus). The analysis divides workers of each company on the base of work-hour and it made a spatial clustering of them indicating which ones can be joined in a car-pooling system or in little bus service. For example, the analysis of the Botto Paola Company with 140 total workers (Fig. 4) shows a result regarding 93 workers with:

- two car-pooling groups for work hour 22:00-06:00 (3 + 2 workers);
- one car-pooling group for work hour 08:00-14.00 (2 workers);
- two car-pooling groups for work hour 08:00-16.00 (2 + 4 workers);
- one car-pooling group for work hour 06:00-14.00 (5 workers);
- four bus solutions for work hour 06:00-14.00 (15 + 10 + 24 + 6 workers);
- one bus solution for work hour 22:00-06:00 (6 workers);
- one bus solution for work hour 08:00-18:00 (7 workers);
- one bus solution for work hour 08:00-14:00 (7 workers).

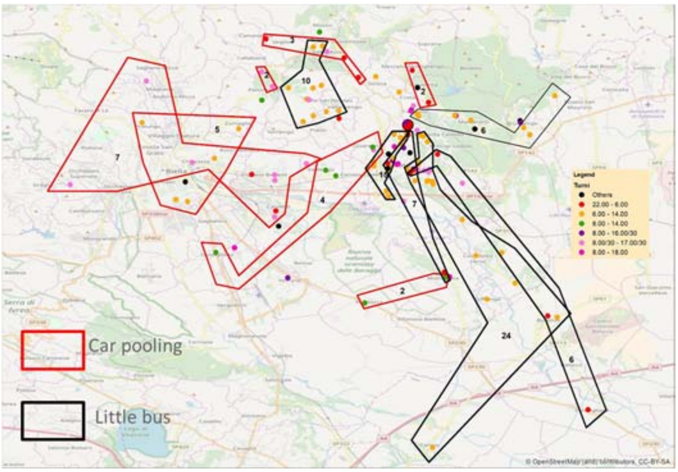

Fig. 4 Example of home-to-work analysis at intra-company level (black number shows the number of joined workers)

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The decrease in car trips for the Company exemplified changes from 280 to 112 (-60,0%) with a decrease of CO_2 emissions of about 41.5% (from the Baseline scenario with 180.6 to the simulated scenario of 105.5 tons of CO_2/year) (Tab. 6).

Botto Paola spa

Baseline					
Total Emissions	180,6	Tons of CO2			
Persons	140				
Trips / Person (year)	500				
	Mode Share	Trips / Person	Passenger-km / Trip	Vehicle-km / Passenger-km	Grams of CO2 / Vehicle-km
Foot	4%	19,5	1	1	0
Bicycle	1%	3	3	1	0
Car	95%	474	15	1	180
Public Transport	1%	3,5	15	0,2	1000
Other	0%	0	0	1	0
Total	100%	500	14,382		

Scenario					
Total Emissions	105,5	Tons of CO2			
Persons	140				
Trips / Person	500				
	Mode Share	Trips / Person	Passenger-km / Trip	Vehicle-km / Passenger-km	Grams of CO2 / Vehicle-km
Foot	4%	19,5	1	1	0
Bicycle	1%	3	3	1	0
Car	47%	235	15	0,666666667	180
Public Transport	49%	242,5	15	0,090909091	1000
Other	0%	0	0	1	0
Total	100%	500	14,382		

Tab. 6 Example of Scenario CO2 emission evaluation for an Intra-Company Scenario

These scenario types are mainly based on the availability of little buses (taken between the City school buses or bought by the same company). This feasibility is in order of evaluation.

<u>The Inter-Company scenarios - The Vehicle Routing Model</u>

The vehicle routing problem (VRP) is a superset of the traveling salesman problem where one set of stops is sequenced in an optimal fashion. In a VRP, a set of orders needs to be assigned to a set of routes or vehicles such that the overall path cost is minimized. It also needs to honor real-world constraints including vehicle capacities, delivery time windows, and driver specialties. The VRP produces a solution that honors those constraints while minimizing an objective function composed of operating costs and user preferences, such as the importance of meeting time windows. The VRP solver starts by generating an origin-destination matrix of shortest-path costs between all order and depot locations along the network. Using this cost matrix, it constructs an initial solution by inserting the orders one at a time onto the most appropriate route. The initial solution is then improved upon by resequencing the orders on each route, as well as moving orders from one route to another, and exchanging orders between routes. The heuristics used in this process are based on a Tabu Search metaheuristic. The basic form of Tabu Search (TS) is founded on ideas proposed by Fred Glover (1986) and it is based on procedures designed to cross boundaries of feasibility or local optimality, instead of treating them as barriers Glover and Laguna, 1997).

In our case, we introduced constraints relative to:

- maximum travel time not bigger than twice the private car one;
- route starting at the two bus depots nodes;
- arrival at work 30-5 minutes before working time;
- existing one ways in the road network.

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For example, the inter-company analysis for worker with entry time at 22:00 involves 8 companies and 157 workers. The solution involves 81 workers and elaborate two routes: one for 27 workers of about 82 kilometers length, and the other one for 54 workers of about 73 kilometers lenght. Moreover results show a decrease of trips bigger than 50% with only two busses starting from the depots of the local public transport operator (Fig. 5) and, the calculated low-CO2 scenario, revealed a decrease of CO_2 emissions of about 46.7%, from 202,6 to 108 tons of CO_2/year (Tab. 7).

Entry at 22.00

Baseline

Total Emissions	202,6	Tons of CO2
Persons	157	
Trips / Person (year)	500	

	Mode Share	Trips / Person	Passenger-km / Trip	Vehicle-km / Passenger-km	Grams of CO2 / Vehicle-km
Foot	4%	19,5	1	1	0
Bicycle	1%	3	3	1	0
Car	95%	474	15	1	180
Public Transport	1%	3,5	15	0,2	1000
Other	0%	0	0	1	0
Total	100%	500	14,382		

Scenario

Total Emissions	108,0	Tons of CO2
Persons	157	
Trips / Person	500	

	Mode Share	Trips / Person	Passenger-km / Trip	Vehicle-km / Passenger-km	Grams of CO2 / Vehicle-km
Foot	4%	19,5	1	1	0
Bicycle	1%	3	3	1	0
Car	44%	219,5	15	1	180
Public Transport	52%	258	15	0,024691358	1000
Other	0%	0	0	1	0
Total	100%	500	14,382		

Tab. 7 Example of Scenario CO2 emission evaluation for an Inter-Company Scenario

4 CONCLUSIONS

The methodology built and being tested in the reality of the "Unione Montana Comuni Biellese Orientale" of Piemonte (Italy), constitutes a realistic operative proposal to optimize and solve the marginality and poor accessibility problems of mountain areas. It starts from the identification of the possible resources availability, starting from the structure of the current public transport service, this being a necessary but not sufficient condition for the following phases.

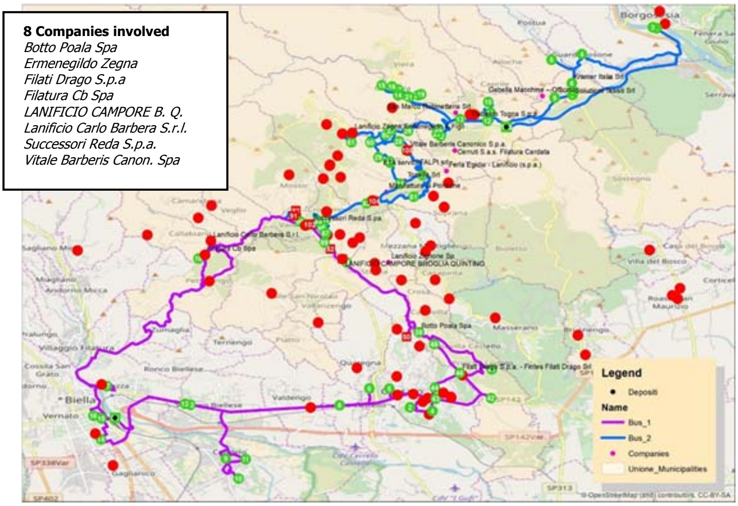

Fig. 5 Example of home-to-work analysis at inter-company level

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Once a budget of available resources has been identified, it becomes possible to analyze the local transport supply and demand level and, through complex vehicle routing technologies combined with spatial clustering techniques, identify optimized solutions integrating different transport service types, from conventional public transport to car-pooling or demand services. What we found is the need for a bottom-up approach, going to find solutions with a very strong detail but able to convince both the single worker involved and the Company Mobility Manager (MAX, 2009). The first meetings in which the developed project scenarios were presented showed each working reality has different sensibilities towards sustainable mobility, but these scenarios constitute the starting point for the design of shared solutions. Next steps are the validation of the measure described directly with the workers for the home-to-work phase while, for the home-to-service mobility (mainly regarding old residents) and tourist accessibility, the research group are designing an integrated approach where tourist transport services will give the possibility to reach the economic balance also for an on-demand public transport service available for citizen.

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AUTHOR'S PROFILE

Antonio Pratelli, Professor of Traffic and Transportation Engineering at University of Pisa. Scientific director of LOGIT-Lab at the University Logistics Services Center of Livorno of the University of Pisa. Author of over a hundred-twenty of scientific articles dealing with urban network planning, roundabout design, logistics and freight transport. Visiting fellow at University of Kentucky (USA) and University of Zagreb (HR). Member in some scientific committees of relevant international journals and conferences. WIT Eminent Scientist Medal, year 2011, awarded by Wessex Institute of Technology, Southampton (UK) for "his outstanding contributions in the field of transport studies and planning".

Massimiliano Petri is currently research fellow at the University Logistics Services Center of Livorno of the University of Pisa and works within the LOGIT-Lab, he is a lecturer in the course of Logistics of Distribution and Transport at the University of Pisa. At a professional level, he is a member of the TAGES company s.c. and current consultant of the Technical Structure of the Ministry of Infrastructures and Transport, recently participated at the EU Regiostars Award 2018 Final with the SaveMyBike project. He worked in numerous projects related to freight logistics (pharmaceutical, port, nursery, urban, related to security, etc ..), urban mobility (ITS integration, real-time management, etc.) and integration between mobility and land use (LUTI models).

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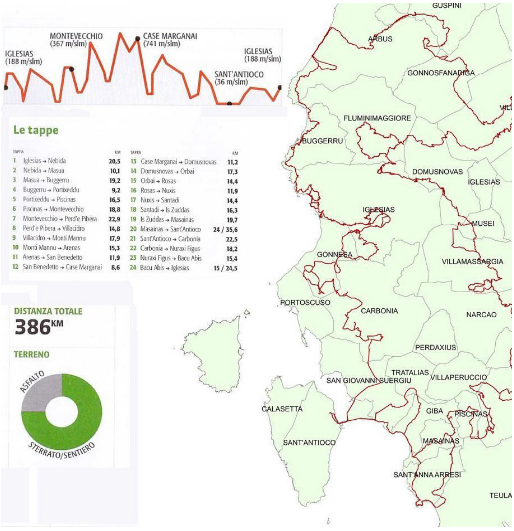

WAVE, WALK AND BIKE TOURISM

THE CASE OF SULCIS (SARDINIA - ITALY)

GINEVRA BALLETTO[a]
ALESSANDRA MILESI[a], LUIGI MUNDULA[a]

a Department of Civil, Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: balletto@unica.it
ginevraballetto@gmail.com
alessandra.milesi@gmail.com
luigimundula@unica.it

b Department of Economics, Business Mathematics and Statistics
University of Trieste, Italy
e-mail: giuseppe.borruso@deams.units.it

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ABSTRACT
Slow tourism is a different way of traveling that is spreading more and more in Italy and in the world, which means traveling in a less consumeristic way, discovering beauties, cultures and local traditions, also through outdoor sports. It belongs to the categories of sustainable tourism and is opposed to fast mass tourism identified mainly with cruises and short breaks in the big cities. It is a way of traveling that enhances and promotes the development of responsible and sustainable territory. Slow tourism includes soft mobility systems such as walking, cycling and horse riding. It is a form of outdoor sports tourism, which also includes hiking and aquatic tourism, more commonly called wave (windsurfing, sailing, canoeing, etc.). With this work the authors intend to analyze the slow "wave, walk and bike" tourism of the Sulcis area (Sardinia, Italy) and the role of the Santa Barbara Walk, through digital tracks (walk and bike) of the relative smart community. The goal is also to geographically represent the slow tourism phenomenon with the main sites of environmental, historical, cultural and mining interest that characterize the Sulcis and the accommodation supply, in order to identify a strategy to strengthen sustainable tourism starting from slow tourism.

KEYWORDS
Smart tourism; Sustainable tourism; Smart community; Slow tourism

* The other author is: Giuseppe Borruso.

1 INTRODUCTION

Tourism in Sardinia has always been characterized by seasonality and in particular the Sulcis Iglesiente is the area in which tourism presented itself since the last twenty years following the closure of mining activities that has been the free use of some areas (Modica et al., 2018). Get out of seasonality is the objective to aim for in the development of tourism in Sardinia (Destination Sardinia 2018-2021, Strategic Plan for Development and Tourism Marketing of Sardinia).

In fact, tourism in Sardinia today is still characterized by seaside tourism especially in the summer months. However, changes in the tourism phenomenon at national and international level have allowed new forms such as slow tourism (wave, walk and bike), which in Sardinia also manifests itself in the need to convert large mining areas such as the Sulcis into tourist areas.

The remaining part of the document is organized as follow.

Paragraph 2 describes the main changes in tourism model both at local and global level and introduces the importance of the role played by the local community with particular reference to the tourist model of Sardinia and in particular of the Sulcis Iglesiente.

Paragraph 3 describes the case study of Santa Barbara and the characteristics of the territory crossed.

Paragraph 4 concern the methodology used to analyses smart community bike and walk tracks.

Paragraph 5 analyzes the slow network in Sulcis area obtained from the walks and bikes tracks and the different kinds of accommodation offer.

In paragraph 6 concluding remarks highlight major results and future developments of the research.

2 OVERVIEW OF THE MAIN CHANGES IN TOURISM BETWEEN LOCAL AND GLOBAL

According to UNWTO (2018), international tourism continues to grow (up 6.7% compared to 2016 and around up 4% per year on average since 2010) and in Italy in particular 2017 ended with 122 million foreign travelers, up 4.5% compared to 2016 (website of MIBACT - Directorate-General for Tourism).

A growing industrialization of the tourist phenomenon, the globalization of flows and the presence of large groups increasingly "multinational", has triggered new challenges to the tourism market, both in terms of demand and supply. In fact, in recent years there has been

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a constant increase in requests from travelers: new and exclusive destinations, personalized services, increasingly direct sales channels. These are just some of the aspects that have influenced the changes taking place and that can affect the new scenarios.

Tourism demand has changed greatly, becoming not only more global, but also more selective and unstable. We have gone from a model in which the annual holiday was one and important to considering tourism as a commodity. In particular, tourists are looking for new experiences, emotions and tastes of the territory they visit (Campos et al., 2018). In addition, the role of the organized tourist (tour operator) with the do-it-yourself (digital) role was rebalanced with the consequent need for a more advanced and differentiated promo-marketing system (DMO) (Hall and Veer, 2016). Finally, the international tourist has had a considerable push not only from the growing and significant role of low-cost transport, but also from the new point-to-point routes (from smaller airports) without stopovers.

The tourist offer, if before it was mainly views in a productive way and referred to a "solid" product or packaged to be chosen and consumed, today, instead, it is the customer who creates the product starting from his personal needs. Therefore, the product is no longer solid but liquid and moldable. However, this highlights problems and opportunities arising from the customer's accessibility to the product / motivation and its immediate and easy usability (new social and web channels).

In the digital age, the tourist has become proactive, constantly looking for new solutions, customized and increasingly responding to his expectations and needs, which require the supply of tourist services of being able to respond more quickly.

Moreover, the archaeological, landscape, food and wine heritage’s richness of a territory is no longer sufficient to transform it into a tourist product or even better into an attractive tourist destination, if not included in an integrated system between all available resources.

In the recent tourist scenario, the immersive and experiential aspect of the tourist plays a fundamental role, which is activated through the local community strongly related to the context, history and innovation. Emotions, lifestyles, culture of a territory become fundamental elements of a territory, to improve the destination appeal.

In this context, Sardinia, and in particular Sulcis Iglesiente, in line with national and international trends, are characterized by the presence of new players, which expand and integrate the offer of destinations: sea, culture, environment and nature, sport and taste. However, there is still a strong dependence on the seaside factor linked to seasonal hotel structures which are progressively orienting towards a service of excellence, partially overcoming the negative effects typical of seasonality.

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3 THE SANTA BARBARA WALK: SLOW NETWORK OF THE SULCIS IGLESIENTE

The Santa Barbara walk retraces the ancient mining routes of the Sulcis Iglesiente - Guspinese, developing as a ring for a length of about 400 km. Since 2013 it has been included in the regional register of historical-religious paths of Sardinia and in 2017 the Ministry of Cultural Heritage and Activities and Tourism has included it in the first Atlas of the Paths of Italy.

It is accessible on foot, by bicycle or by horse and its altitude spans from zero at the sea level to an altitude of 900 meters. The route consists of 24 stages in the Sulcis area defined on the basis of the following parameters: length in km, difficulty traveling and availability of accommodation facilities.

The area of Sulcis Iglesiente has been for millennia interested from a complex mining activity, such as to be considered the main extractive basin not only of the Island but of the whole Mediterranean (Fig.1)

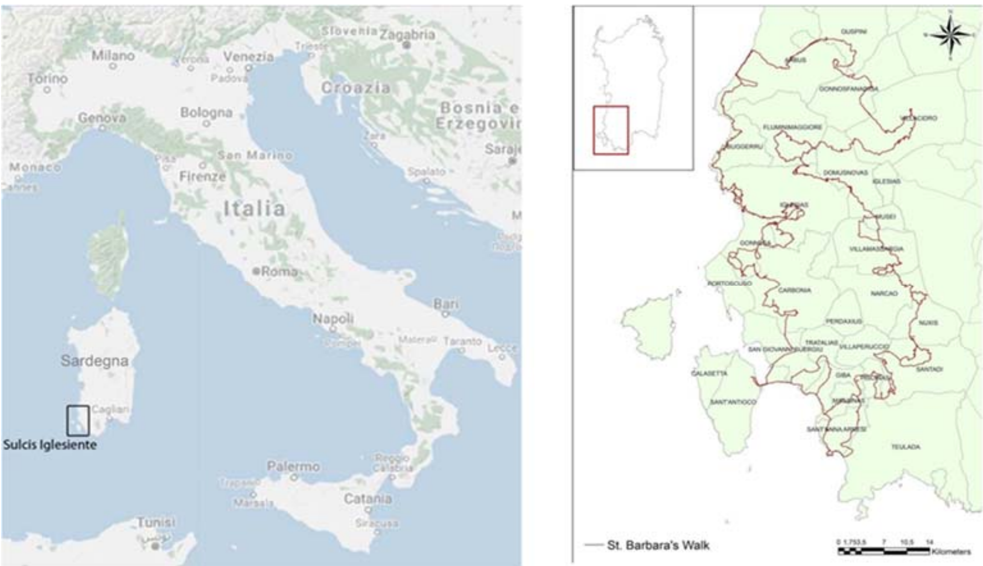

Fig. 1 Territorial Framework of St. Barbara's path in the Sulcis area (Sardinia)

The landscape of the path is characterized by a complex geological heritage and industrial archeology - mineral deposits, excavations and mine dumps and buildings - from an important ancient archeological heritage - domus de janas, nuraghi, sacred wells, etc. - and significant heritage natural (beaches, cliffs, lagoons, etc.).

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The remains of the previous mining activity make the Santa Barbara Walk one of a kind among all the most known national and international paths.
In fact, the mining heritage of residential and production buildings, landfills, etc. constitutes the environmental and landscape background of the path that connects inland and coastal areas. Wave, walk and bike sports tourism is manifested in this landscape, through a (slow) network of sporting activities: surfing, windsurfing and kayaking in the seaside resorts, with trekking, climbing and mountain biking in the most inland areas.

4. METHODOLOGY

The authors analyzed the behavior of the smart community (users living digital tracks on social networks in the Sulcis, also in relation to the recent establishment of the Santa Barbara walk. The analysis developed was based on the territorial elements considered relevant, classifying them according to their nature as points (or nodes) and lines (or arcs), or 'simplifying' natural and anthropic elements according to their punctual, georeferenced nature, and connections between these elements.
In the context of this work, the network analysis focused on the classification and representation of nodes and arcs, proceeding with a first visual analysis of their spatial distribution and trying to highlight the most dense areas with regard to the various how to use the territory.
The representation of the slow network of the Sulcis area was obtained with the following methodology: identification and analysis of the GPS tracks in walk and bike mode that were voluntarily loaded by the users on the platform. It was not possible to identify wave traces, because they are not generated by users. Instead of the wave traces, the maritime state concessions of the Sulcis published on the institutional site of the Sardinia Region were identified and analyzed.
In particular, the main digital platforms related to hiking, biking or other means related to sporting activities have been evaluated, which allow the user to both download the GPS tracks but also to load those tracks he/she realized or run.
Among the different platforms available for trekking and hiking Wikiloc was chosen, as it provides free GPS maps to members who register for free at the site, which can download tracks and upload and share new ones. Moreover, this platform allows a higher level of interaction with the broad community of users and integration with the other (geographical) services present in the Google ‘environment’. The search for traces was limited to the area of Sulcis Iglesiente for a total of 460 useful tracks divided as follows: 230 walk tracks

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(downloaded between 20 and 29 January 2019) and 230 bike tracks (downloaded between 21 January and 3 February 2019)[1].
The georeferenced tracks with relative database (including the following information: length, name of the route, date of loading of the track by the user, number of downloads, number of views, link to the card, category of user, sex and origin) were processed by means of an open source GIS platform (QGIS 3.4).
Then, the authors proceeded to the evaluation of the main hospitality typologies present in Sulcis Iglesiente: hotel, extra hotel (B&B, landlords, holiday homes), home sharing. The data relating to the hotel and extra-hotel equipment were taken from Region of Sardinia open data (http://opendata.sardegnaturismocloud.it/IT/turismo/offerta/ricettivita/, 2017), while data on home sharing were taken from the Airbnb site (downloaded between 4 and 12 February 2019). From the elaboration of the tracks (wave, walk and bike) and of the tourist accommodation (hotel, extra hotel and home sharing) the authors have elaborated the following information layers in shapefile format, Tab.1.

INFORMATION LAYER	CODE	DESCRIPTION	SOURCE	REFERENCE DATE
Network	NW 01	St. Barbara's path	https://www.camminominerariodisantabarbara.or\g/	2019
	NW 02	walk tracks in Sulcis area	https://it.wikiloc.com/	2019
	NW 03	bike tracks in Sulcis area	https://it.wikiloc.com/	2019
Wave nodes	N01	maritime state concessions	http://dati.mit.gov.it/catalog/dataset/concessioni-demaniali-marittime	2018
Environmental nodes	N02	historical, cultural, environmental point of interest	http://webgis2.regione.sardegna.it	2015
	N03	abandoned mining areas	http://webgis2.regione.sardegna.it	2015
Receptions nodes	N04		http://opendata.sardegnaturismocloud.it/IT/turismo/offerta/ricettivita/	2017
	N05		http://dati.regione.sardegna.it/dataset/registro-regionale-degli-identificativi-univoci-iun-delle-strutture-ricettive-extra-alberghiere	2017
	N06		https://www.airbnb.it/	2019

Tab.1 Slow network of Sulcis - information layer

[1] Dott. G. Cosseddu collaborated in downloading data.

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5 SLOW NETWORK ANALYSIS

The interpretation of the information layers took place associating for each network (NW01, NW02, NW03) the different wave (N01), environmental (N02, N03) and of receptivity (N04, N05, N06) nodes. The authors then selected the main cartographic representations of the information layer associations, Fig. 2.

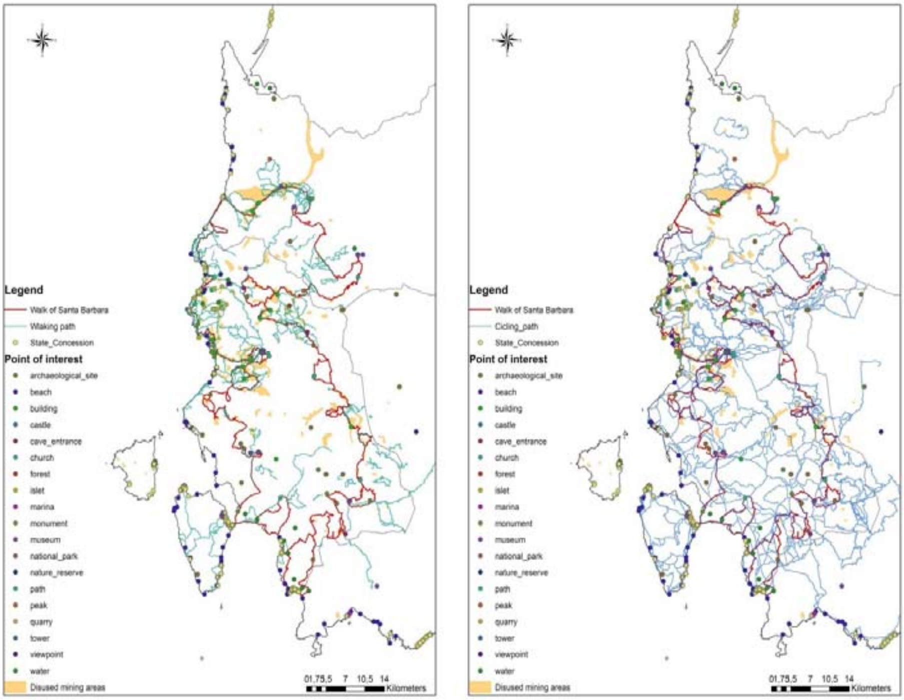

Fig. 2 On the left NW1-NW2-N01-N02-N03, on the right NW1-NW3-N01-N02-N03

From the analysis of the pedestrian paths (Fig. 2 on the left) we can highlight some significant aspects: in the northern part, where the points of interest and abandoned mining sites are concentrated, the walk tracks are also more concentrated. These follow the path of Santa Barbara on the coast and at the same time connect the coast to the interior (Piscinas - Montevecchio). In the southern part, the pedestrian paths are less dense and concentrate more on the coast, in correspondence with the maritime state concessions.

From the analysis of the bike tracks (Fig. 2 on the right) we can see a diffused and uniform slow network in the Sulcis area. However, even in this case there is a greater concentration in the north, with circular tracks that partly follow the path of Santa Barbara.

The slow network in the Sulcis, obtained from the walk and bike tracks, shows diversities, both in distribution and in concentration, within the territory. In particular the walk tracks are

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in correspondence of the greater concentration of points of interest (wave included) of the mining landscape, unlike what happens for the cycle tracks, which seem to follow sporting and competitive motivations, not always linked to the context landmarks.
However, both the walk and bike tracks highlight that the Santa Barbara Walk constitutes an important infrastructure for slow tourism.
The accommodation offer in the Sulcis area has been also analyzed, divided by category (hotel, extra-hotel, home sharing) to evaluate the correlations with slow tourism.
As shown in Fig. 3 the Sulcis presents all the forms of accommodation facilities (hotels, extra-hotels and home sharing), but with different characteristics. The hotel and home sharing offer is mainly concentrated in the summer period and in coastal area, demonstrating that tourism in Sardinia is still highly seasonal and linked to seaside tourism.

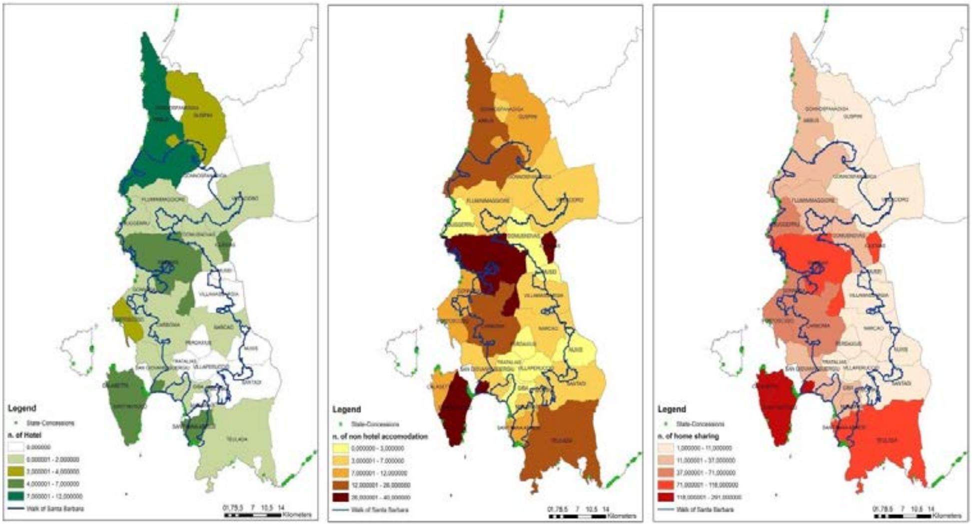

Fig. 3 Distribution of accommodation facilities in the Sulcis area. Hotels (left), extra-hotel (center), home sharing (right)

Otherwise, the extra-hotel type of accommodation offer is constant throughout the year, resulting unrelated to seaside tourism. Moreover, the extra-hotel offer is more evenly distributed throughout the territory and localized near the points of historical, cultural and natural interest.
This confirms that the home sharing also in the Sulcis is strongly in competition with the hotel offer. On the other hand, the extra-hotel offer, also located in the more internal territory of the Sulcis area, represents an important response to slow tourism, both because it is highly contextualized and because it is free from summer seasonality (Caffyn, 2018).

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In this research framework also based on voluntary data, which certainly still deserves developments and insights, the territory of Sulcis proves to be a territory suitable for slow tourism. Furthermore, the slow network shown is consistent with the abandoned mining context from which it draws appeal and motivation together with the marine context.

6 CONCLUSIONS

The representation of the slow network (on foot and by bicycle) of the Sulcis is attributable to the tourism of the paths, which presents similarities with the new forms of national and international tourism. It is a tourism deeply linked to the context, from the landscape to local knowledge and traditions.

The natural and historical emergencies, above all the anthropic emergencies deriving from the mining remains, constitute the landscape background of the Sulcis, on which the slow network is rooted.

In particular, slow tourism intercepts a tourist demand more oriented towards non-hotel accommodation, which in the case of Sulcis requires strengthening interventions. Furthermore, the organization and image of the non-hotel structure is the basis for the promotion of the slow network.

The analysis of the slow network of the Sulcis with the walk and bike tracks has highlighted different uses connected with the multitude of landscape features. In this framework of potentiality, the Sulcis area requires a further step (Destination of Sardinia 2018-2021, Strategic Development and Marketing Tourism Plan of Sardinia) aimed at making the quality of services recognizable, i.e. through a single brand.

In the same vein, the Santa Barbara path have to evolve towards a more structured and integrated typologies of management (i.e quality certification for all the infrastructures and facilities of the network) in order to promote the transition from seasonal tourism towards more sustainable and resilient forms in time and space. With this target in mind the next steps of this research work, according with the agreement protocol between DICAAR Department of Cagliari University and Foundation of the Santa Barbara Walk (signed in December 2018), intends to develop further analysis to define governance actions and to favor the diversification and integration between new and traditional forms of tourism.

NOTE

This paper is the result of the joint work of the authors. In particular: paragraph 2, have been jointly written by the authors L. Mundula and G. Balletto; A. Milesi has written paragraph 3,

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4, and 5 have been jointly written by the authors G. Balletto, A.Milesi and G. Borruso; paragraph 1 and conclusion have been jointly written by all authors.

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AUTHOR’S PROFILE

Ginevra Balletto (Rome, 1971) is Associate Professor of urban and territorial planning, DICAAR, University of Cagliari. Her actual research interests are related to urban planning and environmental

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Alessandra Milesi (Cagliari, 1972) is scholarship holder at Department of Civil, Environmental Engineering and Architecture University of Cagliari, for the project "TSulki: methodological approach for the identification of networks and connection nodes to support sustainable tourism in the Sulcis"

Luigi Mundula (Cagliari, 1972), is Adjunt Professor of Economic and Political Geography at University of Cagliari and Research Fellow at the Tor Vergata Economic Foundation. His research interests are related to economic and territorial development policies, urban geography with particular reference to the role of ICT and innovation.

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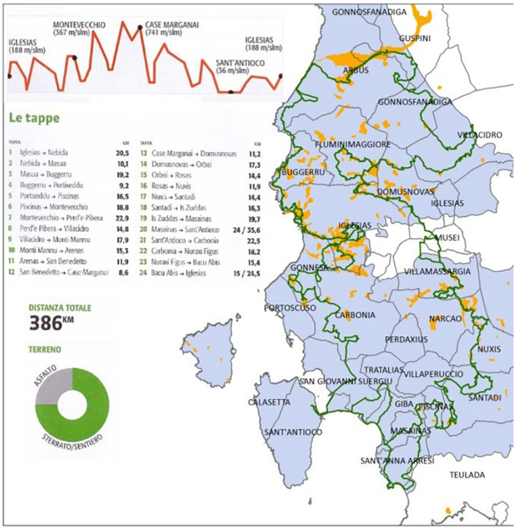

SMART COMMUNITY AND LANDSCAPE IN PROGRESS

THE CASE OF THE SANTA BARBARA WALK (SULCIS, SARDINIA)

***GINEVRA BALLETTO[a]**
ALESSANDRA MILESI[a], STEFANO NAITZA[c]

[a] Department of Civil, Environmental Engineering and Architecture, University of Cagliari, Italy
e-mail: balletto@unica.it, alessandra.milesi@gmail.com, luigimundula@unica.it

[b] Department of Economics, Business, Mathematics and Statistics
University of Trieste, Italy
e-mail: giuseppe.borruso@deams.units.it

[c] Department of Chemical and Geological Sciences, University of Cagliari, Italy
e-mail: snaitza@unica.it

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ABSTRACT

Tourism of the paths is a phenomenon that undergone considerable development in recent years. Initially linked to religious paths (i.e. the way of Santiago in Spain or the Via Francigena in Italy), today also includes cultural, landscape, naturalistic and spiritual paths. In Italy 2016 was the 'Year of the Paths' with the aim of building and / or consolidating a "slow network in the sensitive landscape", while 2019 was dedicated to slow tourism. The slow itineraries constitute a network that flows smoothly into the territories, some of which not yet mature as tourist destinations. Opportunities offer by the new technologies create smart communities that make these destinations and travelers the undisputed protagonists, in contributing to the formation of Big Data (open and close). The objective of this study is to analyze the Santa Barbara Walk in the Sulcis area, considering its particular changing and dangerous nature, by analyzing the open (walk and bike) GPS tracks left by the Smart Community. The interest shown by the smart community through the digital traces sharing, also referring to the danger of a landscape in continuous change, proves to be of strategic importance for the use of the slow network in the Sulcis. In this sense, the role of the smart community is fundamental for the implementation of the information layer relating to risks and for the management of risks in sensitive and evolving contexts.

KEYWORDS
Smart Tourism; Slow network; Smart community

* The other author is: Luigi Mundula.

1 INTRODUCTION

In Italy there is a dense network of paths that is approximately around seven thousand kilometers, from which the numerous routes not yet exploited are excluded. In order to promote slow mobility and to enhance this dense network of paths, MiBACT - The Italian Ministry of Cultural Heritage and Activities - has established the Atlas of paths[1], an interactive map that gathers 44 itineraries to date, meeting the guidelines set by the ministerial directive. These paths can be traveled with sustainable soft mobility systems, each of which is characterized by a tourist offer connected to the geographical, environmental and historical cultural context. The network of paths of the General Directorate of Tourism is part of the national slow network, linked to the recent development of slow tourism.

The slow network activated through (known and less known) paths presents multiple motivations (religious, cultural, sport and leisure, etc.) and travel methods (walk, bike, house ride and more).

In other words, the slow network is a highly flexible network, strongly linked to places, productivity and efficiency with respect for the person and the environment. Moreover, the 'slow movement', at the base of the network, aims to redefine the concepts of time.

Slow tourism is the application of this philosophy to leisure and relaxation times and consequently cannot be a mass tourist offer and is linked to the territory through landscape and material knowledge (monuments, museums, villages), intangible (traditions, religion, taste) and new social media experience (instagram, facebook, ecc).

Slow tourism also establishes relations with the local community through bottom-up initiatives and is enriched thanks to the support of new technologies and through social networks, becoming real smart communities. In this sense the territory of the Sulcis represents a unique example for the peculiarity of its mining landscapes, from material knowledge to the immaterial.

The smart community (walk and bike) shares, through dedicated apps, GPS tracks and images, becoming the pioneer community for its main Walk, that of Santa Barbara, and for the inland areas of the Sulcis.

The remaining part of the document is organized as follow.

Paragraph 2 describes the case study of Santa Barbara walk and the context of South-Western Sardinia, where most of the route is located.

[1] http://www.turismo.beniculturali.it/home-cammini-ditalia/

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Paragraph 3 proposes the research methodology based on the concept of the network and on the examination of its fundamental elements.
In paragraph 4 concluding remarks highlight major results and future developments of the research.

2 THE SANTA BARBARA WALK: SLOW NETWORK OF THE SULCIS IGLESIENTE

The Santa Barbara Walk, established in 2016 above the ancient mine roads of the Sulcis, presents a ring shape of about 400 km total length divided into 24 arches of 16 km each.
In 2017 the walk was inserting by the Ministry of Cultural Heritage and Activities and Tourism in the first 'Atlas of the Paths of Italy'. The walk crosses a territory characterized by a complex mining basin which constitutes the Geomineral Historical Environmental Park of Sardinia.
This territory was the most important district for national and international mining due to its large production of lead and zinc.
The crisis in the mining sector and the subsequent closure of the mines in the 1990s left a rich heritage of industrial archeology and infrastructure, as well as a unique landscape.

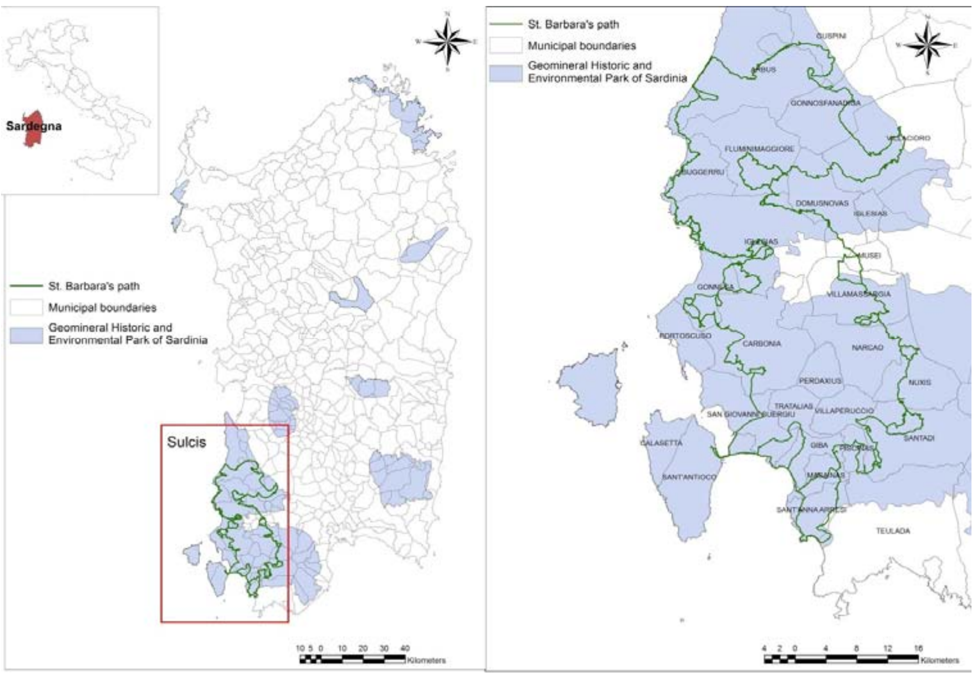

Fig. 1 Territorial framework

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The context of South-Western Sardinia, where most of the route is located, is geologically set on Cambrian-early Ordovician rocks, dating back to about 550 million years ago. Starting from the bottom, the geological succession shows the terrigenous sediments (mostly sandstones) of the Nebida Formation, followed upwards by the thick carbonate successions (dolomites and limestones) of the Gonnesa Formation, up to the fine-grained slates of the Cabitza Formation, which in the whole region are unconformably covered by the conglomerates and other coarse-grained siliciclastic sediments of the middle-late Ordovician Monte Argentu Formation ("Puddinga" Auct.: Servizio Geologico d'Italia, 2015).

These rocks shaped the landscapes of the Iglesiente and Sulcis, where the sea and the mountains merge, and where, for millennia, men have fought against the adversities of nature to extract a large underground wealth of ore deposits, profoundly modifying the morphological aspect of the territory.

The landscapes of South West Sardinia are in fact deeply marked by the consequences of mining activities, with the presence of large open-air and underground excavations, mine adits, tunnels and numerous mine wastes. These latter are constituted by accumulations of different types of waste rocks and tailings from mines and processing/metallurgical plants. All these elements highlight the vastity of mining operations carried out in the main mining places of the district, such as the great mines of Monteponi, San Giovanni and Masua, and their related processing plants and handling systems, as the historical Laveria Lamarmora and Porto Flavia plants.

The Santa Barbara Walk then crosses a landscape rich in natural and anthropogenic elements (landfills, mine muds and abandoned buildings), but at the same time mutable, because its vulnerability. This condition of changing landscape (or landscape in progress) it's so linked to a potential GeoTourism that "*provides economic, cultural, relational and social benefits for both visitors and host communities".* (Gordon, 2018).

3 METHODOLOGY AND SLOW NETWORK ANALYSIS

The authors analyzed the behavior of the smart community (walk and bike) in the Sulcis, also in relation to the recent definition of the Santa Barbara Walk.

The analysis developed was based on the concept of the network and on the examination of its fundamental elements. In fact, taking up the basis of the network analysis, the territorial elements considered relevant were considered, classifying them in points (or nodes) and lines (or arcs), zones (or areas) according to their punctual, georeferenced nature and the connections between these elements.

The analysis of network structures has, in fact, the advantage of understanding the organization of the territory in an "oriented" manner, independent from hypotheses of

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homogeneity of space. In the case in question, the movements of people for the reasons related to tourism in the area take place along paths, the linear elements of the network, and the connectors between these act as privileged places such as origin, destination and flow interchange.

As part of this work, the network analysis focused on the classification and representation of nodes, arcs and zones; proceeding with a first analysis on the spatial distribution of these and trying to highlight the more "dense" areas - in the present research following a 'visual' approach - as regards the various ways of using the territory.

Following a lack of official data concerning the number of people accessing the path in its different segments and on preferences about ways of enjoying it, the authors decided to rely on a 'smart community' of users, as in "Neogeography" approach (Turner, 2006), relying on the user-generated contents by means of GPS - enable portable devices. In particular, the authors have investigated the traces left freely on the web by walk and bike tourists who have visited the Sulcis.

These data currently represent the only data available regarding the Santa Barbara Walk.

The digital application used for data collection was Wikiloc, which allows the user to record in real time, save and share GPS tracks related to their itineraries (Battino S., Lampreu S., 2018). In addition to the track it is possible to save and georeference the photographs as well as comment, evaluate and report particularities along the route. The Wikiloc community is made up of over 4 million users who share about 11 million tracks and 20 million photos.

The data download operation was performed manually, using the geographic search option made available by the website, applying search filters. Following the identification of all the tracks, we proceeded with the homogenization of the data, transforming the paths into shape files and implementing the database with some fields obtained directly from the user data registration (path length, name of path, upload date, number of views and number of downloads).

In particular, starting from January 20, 2019 until January 29, 2019, the 230 walk tracks were identified and downloaded from the Wikiloc website, and from January 21, 2019 to February 3, 2019 the 230 bike tracks were identified and downloaded from the Wikiloc website (Fig. 2)[2].

At the same time we proceeded to construct the information layers attributable to the elements characterizing the mining landscape of the Sulcis (in ESRI Shapefile format, tab. 01), using the following categories taken from the official site of the Sardinia Region:

[2] Dott. G. Cosseddu collaborated in downloading data

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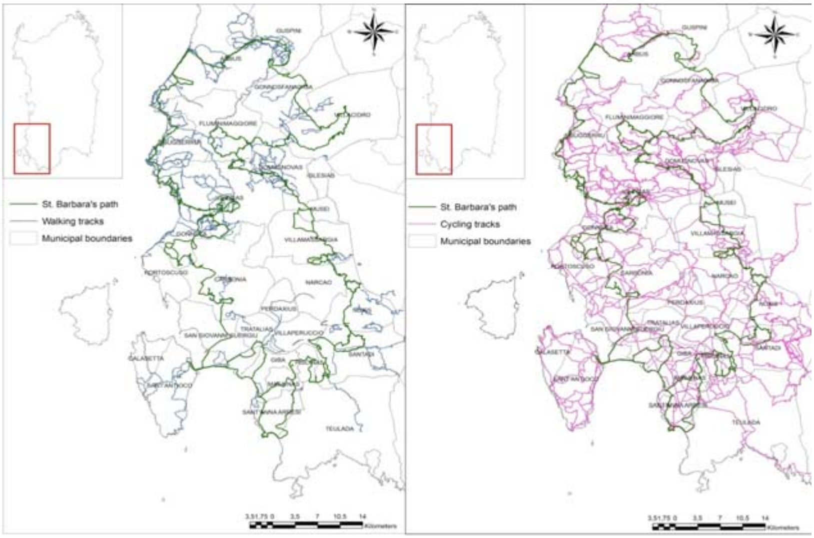

Fig 2 On the left St Barbara's path and walking tracks, on the right St. Barbara's path and cycling tracks

- Past mining areas: the mining sites of Sulcis-Iglesiente and Guspinese districts have been for a long time the real economic and cultural driving force of their territories. Indeed, many of the existing urban centers in these areas were created to support mining. The activities initiated from the II millennium BC and carried out until the late 1990's left positive and negative inheritances. While the mining industry has brought economic prosperity and cultural growth, it has certainly left a hard legacy of environmental degradation, geomorphological instability and widespread pollution.
- Points of interest (POI): the points of interest, related to historical and cultural sites, and to sites of environmental and landscape interest (published within the Geoportal of the RAS- Autonomous Region of Sardinia http://webgis2.regione.sardegna.it/), have been overlaid on the map in order to analyze the relationships between the position of these elements and the paths taken by users.
- Geomorphological and hydraulic hazards: data on geomorphological and hydraulic hazard published in the RAS Geoportal were downloaded and overlaid. The data have been shaped on the area of interest and thematized on the basis of hazard and risk classes. This phase evidenced the incompleteness of the available data, as the territories of Sulcis-Iglesiente and Guspinese have been only partially studied, regarding the aspects of hydraulic and geomorphological risks. However, the presence of instability phenomena, both natural and deriving from human activities, is marked and evident throughout the territory. In the study area, these phenomena include physical and mechanical instability of mine wastes and excavations and phenomena related to the

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sinking of the soil better known as Sinkholes, studied with increasing attention over the last few years.

- Sinkholes**:** Data about these phenomena, linked to sudden land collapses, have not yet been made public in vectorial format, therefore it was not possible to proceed with the precise identification and location of related sites. As described by Mureddu A (2015), the general setting of these phenomena refers both to large outcrops of Paleozoic limestones in Sulcis Iglesiente, subject to natural sinking of the overlying alluvial detrital covers, (e.g. Cixerri, Narcao-Nuxis and S. Anna Arresi plains), and to areas of past mining affected by sinkhole-type landslides and collapses. These latter are generated by sudden failure of roofs due to the decrease of geomechanical properties of rocks at the sides of deep mining voids. A comparison with the Hydrogeological Planning Plan (PAI) of the Sardinia Region highlighted that out of 247 measured subsidence phenomena 214 (85%) occur in areas outside the PAI boundaries and may not be classified as landslide risk sites. From a comparison with the Landslide Phenomena Inventory in Italy (I.F.F.I. Project), it emerges that 175 sites among those surveyed (71%) by the technical table have not been inventoried. In many areas of the territories of South-West Sardinia, particularly those lacking adequate vegetation and soil cover, past mining activities greatly enhanced the rock stability problems deriving from the natural presence of steeply sloping slopes set on fractured rocks.

INFORMATION LAYER	CODE	DESCRIPTION	SOURCE	REFERENCE DATE
Network	NW 01	St. Barbara's path	https://www.camminominerariodisantabarbara.org/	2019
	NW 02	walk tracks	https://it.wikiloc.com/	2019
	NW 03	bike tracks	https://it.wikiloc.com/	2019
Point of interest	POI 01	historical and cultural point of interest	http://webgis2.regione.sardegna.it	2015
	POI 02	points of landscape interest	http://webgis2.regione.sardegna.it	2015
Mining areas	MA 01	Abandoned mining areas	http://webgis2.regione.sardegna.it	2015
	MA 02	Historical environmental geo-mineral park of Sardinia	http://webgis2.regione.sardegna.it	2015
Risk areas	RA 01	Hydraulic hazard	http://www.sardegnageoportale.it	2018
	RA 02	Geomorphological hazard	http://www.sardegnageoportale.it	2018

Tab.1 Information layer slow network of Sulcis.

The three networks (NW 01, NW 02, NW 03) were then associated with the points of interest (POI 01, POI 02), with the mining areas (MA 01, MA 02) and with the areas at risk (RA 01

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and RA 02). All these information layers have shown distribution and concentration in the abandoned mining areas (MA 01 - Abandoned mining areas).
From the analysis of the walk tracks we can see how the mine areas (MA 01 and MA 02) constitute the main areas crossed by users, (Fig. 3).

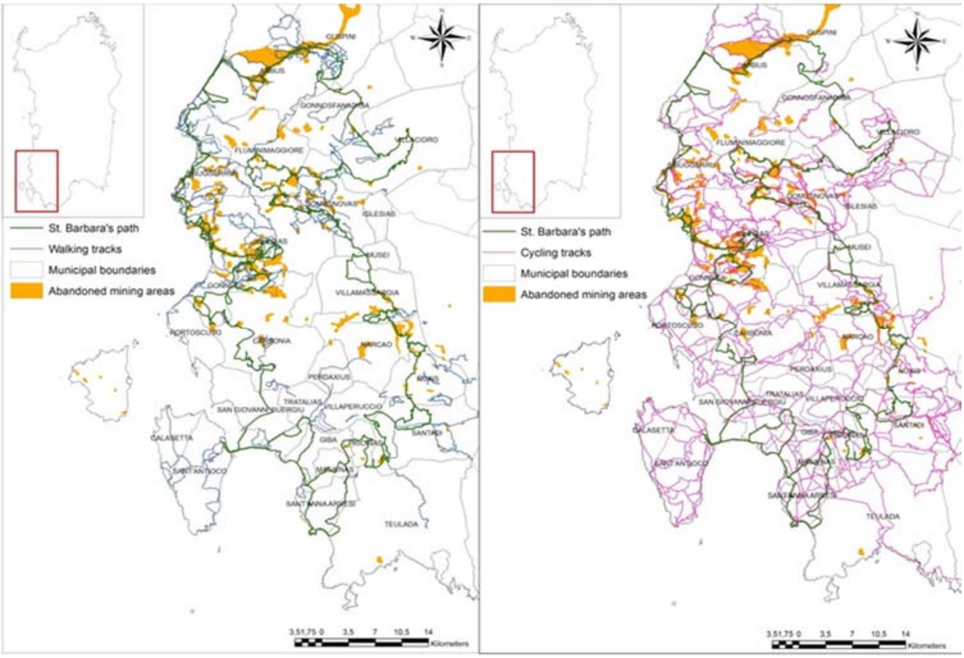

Fig. 3 On the left NW 01, NW 02 and MA 01, on the right NW 01, NW 03 and MA 01

As shown in Fig. 3 the walk tracks are developed in areas characterized by abandoned mining landscapes and therefore in contexts in evolution (Varrica, D. et al, 2018), while the bike tracks seem to be connected to sports motivation.
The mining landscape is constantly changing also due to the phenomena of hydrogeological instability, however it is recognized by the smart community as a landscape of particular interest and beauty (Balletto et al, 2016).
Moreover, in Sulcis not all the remains of a mine can be reclaimed, environmentally requalified and rebuilt, because the low population rate does not allow to balance costs and benefits.
In this sense, the knowledge of the risks is therefore the necessary condition to guarantee the protection and development of the Sulcis tourism development.
This is why the risk reports coming from the smart community (walk, bike and others) are strategic and enrich the user tracks of important information.

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4 CONCLUSIONS

From the analysis of the spatial distribution of the elements of the slow network of the Sulcis, it possible to observe how the walk community mainly crosses the abandoned mining sites, highlighting a cultural motivation, while the bike community is distributed over the whole territory of the Sulcis, according to a sporting motivation.

The evolution of the mining landscape of the Sulcis is correlated to the danger deriving from the ordinary and extraordinary geological instability connected to the abandonment of the mines.

In this sense, the smart community plays and can play an important role also in reporting dangerous situations to allow an immediate knowledge of the most significant environmental changes. For this particular evolutionary condition of the landscape, the authors in agreement with the National Research and Innovation Roadmap on Smart Communities (2016), aim to promote and consolidate the slow network in the Sulcis, even with the recent Santa Barbara Walk, considering that the management of risks based on voluntary information is of particular importance.

Following these guidelines and ideas, further step of the present work, in accordance with the protocol between Dicaar Department of the Cagliari University, DMI Department of Trieste and the Foundation of the Santa Barbara's Walk (December 2018), will be the development of an application that allows to signal the dangerousness of the places and at the same time to update the information layers related to the hydrogeological risks, to better govern the danger of the evolving landscape of the Sulcis and of the path of Santa Barbara in particular. More in detail, the idea is to propose the creation of a sort of 'digital hub' able to collect the information deriving from the different already existing social networks to share not only the available information but even the request of information, among the smart community users of the Santa Barbara Walk.

NOTE

This paper is the result of the joint work of the authors. In particular: paragraph 2, have been jointly written by the authors G. Balletto; A. Milesi and L. Mundula; paragraph 3, have been jointly written by the authors G. Balletto, A. Milesi, S. Naitza, G. Borruso; paragraph 1 and conclusion have been jointly written by all authors.

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AUTHOR'S PROFILE

Ginevra Balletto (Rome, 1971) is Associate Professor of urban and territorial planning, DICAAR, University of Cagliari. Her actual research interests are related to urban planning and environmental sustainability. Her participate in the research "TSulki:methodological approach for the identification of networks and connection nodes to support sustainable tourism in the Sulcis"

Alessandra Milesi (Cagliari, 1972) is scholarship holder at Department of Civil, Environmental Engineering and Architecture University of Cagliari, for the project "TSulki: methodological approach for the identification of networks and connection nodes to support sustainable tourism in the Sulcis"

Stefano Naitza (Cagliari,1965) is Adjunt Professor of Economic Geology. His research interests are related to economic geology, mineralogy of geological resources and environmental characterization and assessment of pollution in abandoned mining sites.

Luigi Mundula (Cagliari, 1972) is Adjunt Professor of Economic and Political Geography at University of Cagliari and Research Fellow at the Tor Vergata Economic Foundation. His research interests are related to economic and territorial development policies, urban geography with particular reference to the role of ICT and innovation.

Giuseppe Borruso (Trieste, 1972) is Associate Professor of Economic Political Geography at the DEAMS - Department of Economics, Business, Mathematics and Statistics "Bruno De Finetti. His actual research interests are related to economic geography, with particular reference to urban geography, transport and population.

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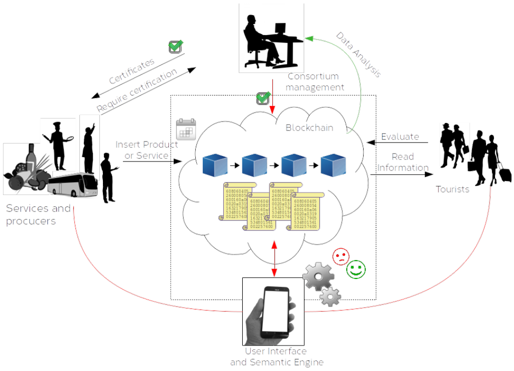

A BLOCKCHAIN APPROACH FOR THE SUSTAINABILITY IN TOURISM MANAGEMENT IN THE SULCIS AREA

***GAVINA BARALLA[a], ANDREA PINNA[a]**
ROBERTO TONELLI[b]

[a] Department of Electrical and Electronic Engineering, University of Cagliari, Italy
e-mail: gavina.baralla@diee.unica.it
a.pinna@diee.unica.it
mannaro@diee.unica.it

[b] Department of Mathematics and Computer Science, University of Cagliari, Italy
e-mail: roberto.tonelli@dsf.unica.it
marchesi.michele@gmail.com

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ABSTRACT

The Sardinia island is a well-known tourist destination for holidays, famous for its coasts and its beautiful sea but also for its food. Tourism is one of the most expanding sectors of the regional economy and the use of innovative technology becomes a key element to keep abreast of the times. The complexity of the tourist system is exemplary: it affects several activities and people and influences environmental protection. In this work, we propose a blockchain based platform to guarantee the traceability and the provenance certification of the local agri-food product, to manage and promote the tourism activities in the Sulcis area and to allow tourists to provide their feedback, designing a system that takes into account the sustainability as an objective and a systemic non-functional requirement. Given the complexity of the system and the novelty of the proposed solution, we adopt the Agile methodology, which stresses the attention in customer satisfaction and incorporates sustainability. The adopted approach and the efficiency of the technology due to the security of non-corruptible data, to the use of the cryptography, to the sharing of data between actors in the supply chain, make the proposed system sustainable, competitive and promising for the tourism sector.

KEYWORDS
Blockchain; Sustainability; Provenance Certification; Tourism

* The other authors are: Michele Marchesi, Katiuscia Mannaro.

1 INTRODUCTION

Located in the middle of the Mediterranean Sardinia is the second biggest island of Italy. It is one of the most popular tourist destinations for holidays, famous for his 1800 km of coastline and his beautiful beaches and sea. According to Sardegna Turismo[1] , tourists from all around the world claim that five of the most beautiful beaches in Italy are in Sardinia. Sardinia is well known not only for its natural beauty but also for its history, culture and food. A tourist, for instance, can find many excellent local agri-food products of the highest quality, most of them come from craft productions.

Started at the end of 1950, tourism is now one of the most expanding sectors of the regional economy. Its impact can be both positive and negative if it is not adequately planned and developed. Therefore, the use of technology to manage tourism activities becomes a key element for the tourism organization.

We propose a blockchain based system to support tourism services and activities and to promote local agri-food products. Our case study is the Sulcis area, located in the Southwest of Sardinia. Due to the blockchain structure, it is possible to guarantee the security of data and the transparency of information. A record within a blockchain system can not be modified retroactively and information is shared with all the involved stakeholders. In this way, we can guarantee the traceability of products and ensure their provenance. The tourist is the consumer of that products and by using our system he will check the authenticity of the food product, identified by means a QR code. The system through a proper user interface will give back the identity card of the purchased good, that includes some information, from the raw materials used to details about production and distribution phases. Moreover, by using the system, it will be possible to create a network among tourist operators in order to enrich the offer and increase revenues. The tourist can evaluate the purchased product or the enjoyed service through feedback by posting text messages, photos or videos. An external semantic engine connected to the system will analyze all reviews. Tourist operators can improve their services by means of consumers' suggestions.

The tourist system is complex, it involves several activities and people and it influences environmental protection. For those reasons to design our system, we take into account sustainability as an objective and a non-functional requirement. In addition, to develop our system we will adopt the Agile methodology. The methodology puts attention on customer satisfaction and incorporates sustainability.

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[1] https://www.sardegnaturismo.it/en/node/252311

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The paper is structured as follows. Section 2 presents related works. In section 3 we describe the approach and the methodology adopted. Section 4 and 5 describe the proposed platform based on blockchain technology and his implementation. Finally, Section 6 contains the conclusions.

2 RELATED WORKSP

Our work is placed in the research macro area regarding the sustainability of the tourism supply chain. This research area is a relatively new discipline. Font et al. (Font, 2008) introduced the analysis of the sustainable supply chain (SSC) applied in the management of tourism. They first analyzed the status of SSC adoption in tourism operators, putting the attention in environmental sustainability, and then individuated the priority area for improvement in SSC management. These areas include accommodation, transport, ground activities, food and local craft producers and supply. The subsequent studies have covered all aspects related to the management of tourism sustainability. In (Szpilko, 2017)
Szpilko analyzed the literature in the tourism supply chain in order to map the research areas. Economic sustainability in the tourism supply chain was the focus of Piboonrungroj and Disney (Piboonrungroj, 2015). They analyzed the origin of economic costs using the method of the transaction costs of each collaboration in the tourism supply chain. Collaborations represent the interaction between the actors of the tourism system, that result very connected and influenced each other. The definition and the design of metrics, software framework and tools for the tourism supply chain has been the subject of growing interest. Jiang and Ke (Jiang, 2019) putted the attention on the importance of the exchange of information between actors of the tourism system, providing a mathematical tool to counteract the bullwhip effect, a point of risk related to the unpredictable volatility of the demand in the top of the supply chain, and to measure performances. Environmental sustainability is the main objective of the framework proposed by Chu and Chung (Chu, 2014) for tourism management. They integrated performance indicators provided by the balanced scorecards and network analysis tools.
In literature, the adoption of the blockchain tourism is under investigation. Calvaresi et al. (Calvaresi, 2019) realized a literature review aiming to identify the point of major interest and to evaluate the point of matching between theoretical results and practical implementation such as *WindingTree* and *Lockchain*. For instance, the goals of startups are to make the travelling cheaper, but also increase improvements of tourism operators. There is a conflict between customer advantages and tourism supplier advantages. In our work, we considered all the actors' objective from a holistic point of view, aiming to the sustainability of the system. Önder and Treiblmaier (Önder, 2018) proposed three research proposition to approach the

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study. The first proposition regards the possibility to collect tourists' reviews and in particular to the possibility to define new trustworthy rating systems. The second proposition regards the impact of the blockchain in the development of new types of customer to customer services given by the adoption of cryptocurrencies. The last proposition regards the distributed and decentralized nature of the blockchain and its possible role in the disintermediation in the tourism industry.

3 OUR APPROACH

Sustainability is a systemic property of processes able to continue in certain conditions for an indefinite time. In other words, this means that the process must be kept active using the available resources. Often, when it comes to sustainability, we focus on economic resources. Process sustainability is actually based on three fundamental pillars, namely Social, Environmental, and Economic Sustainability. Social sustainability is the capability of a system to fit in the society taking into account the involved people, and the socio-cultural context. Environmental sustainability is the capability of a process to continue without consuming natural resources to a greater extent than the natural environment is able to produce in a period of time. Finally, we obtain Economic sustainability if the process uses the economical resources that the process produces itself. The three pillars are interconnected and they contribute to the total sustainability. This means that sustainability involves all the actors in the process. Sustainability is definitively an objective and a non-functional requirement, we have to obtain, regardless of the aim of the system.

In the scenario of the Sulcis tourist system, sustainability is a key element to ensure the continuance of the process by respecting the environment, the social fabric, and economic development. The complexity of the tourist system is exemplary. Take for instance the case of the development of a new tourist destination. It's easy to understand that this will affect several activities, in a waterfall of interactions. For example, will affect the people involved in the management of the passenger service, in the production of local product and souvenirs, in the catering service and in the production of local food, in the overnight accommodation services, in the trekking equipment rental service, etc. Further, given the possibility of new business opportunity, it can lead to the opening of new commercial activity and to the request of loans. In addition, it affects the environmental protection, the protection of the site, and to the empowering of all assistance services.

The management of such a complex process is not easy and is possible thanks to the development of specific software. In this work, we propose a software system to manage a sustainable tourist system. To control the sustainability of the process it is necessary to consider its feedback, or in other words, to know its state. The state of the process is

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composed of the value of a set of specific performance indicators. The design of indicators, the data elaboration, the definition of the actors of the system, and the data acquisition are the elements of the software design. The software system gives to the process the property of visibility, that is the possibility to provide its state to the process manager.

We approach the problem starting from the principles of the sustainable software engineering summarized in the Karlskrona manifesto (Becker, 2015) and in the work of Oyedeji et al. (Oyedeji, 2015) from the Agile methodology which principles are described by Beck et al. (Beck, 2001), and from the innovative blockchain technology.

Our system will be placed in an under development context, both in a technological and administrative perspective. For this reason, we conceived our proposal to be adopted gradually and to be upgradable by adding, removing or modifying features, according to the feedback produced by the tourism system manager and by the other actors. In this way, the system will be able to help the management of the current state of the tourism system in Sulcis and will be ready to face change and novelty of future generation tourism services.

3.1 SUSTAINABLE DESIGN

The software engineering for sustainable design involves the analysis of the process on the base of on a division into five dimensions of sustainability that are individual, social, economic, technical and environmental.

The five dimensions are described by Becker et al. (Becker, 2015) as following.

The individual dimension covers individual freedom and agency (the ability to act in an environment), human dignity, and fulfilment. It includes individuals' ability to thrive, to exercise their rights, and develop freely.

The social dimension covers relationships between individuals and groups. For example, it covers the structures of mutual trust and communication in a social system and the balance between conflicting interests.

The economic dimension covers financial aspects and business value. It includes capital growth and liquidity, investment questions, and financial operations.

The technical dimension covers the ability to maintain and evolve artificial systems (such as software) over time. It refers to maintenance and evolution, resilience, and the ease of system transitions.

The environmental dimension covers the use and stewardship of natural resources. It includes questions ranging from immediate waste production and energy consumption to the balance of local ecosystems and climate change concerns.

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The five dimensions represent the objective of the effects that the software system will produce in the process. In particular, we analyzed the actors of the tourism system in the Sulcis area, according to the division in five dimensions.
In particular, we identified the following representation.
The Individual dimension includes:

- the effects to the tourist, starting from his satisfaction to the creation of the desire to return and the influence to other tourists.
- the effects to the tourism system manager in terms of changes in the quality of his life and in the perspective of a stable workplace.
- the effects to the service provider in terms of personal satisfaction and in terms of their influence on other people for the starting of new tourism services.
- the effects to the producer of local products in terms of satisfaction and quality of life.

All these effects regard actors taken as single individual and concern his possibility to act on the system.
The social dimension includes effects on the social fabric of the Sulcis, and concerns the improvement of social cohesion between different categories, the improvement of communication channels, and the promotion of the development of better social conditions.
The economic dimension includes effects on the revenues of local tourist operators, effects on the local economy and effects on the local financial activities. Economic and social effects are results of the tourism process that can be managed thanks to the feedback provided by our software system. The blockchain technology allows the acquiring of certificated data of productions and sells, and the collection and the sharing of tourist's feedback.
The technical dimension concerns the effects of the proposed software system and its evolution.
As will be described below, we decided to use the agile methodology to allow an incremental design and faster development iterations, continuous communication with the tourism system domain experts, and a change ready software, by exploiting the possibility to customize its smart contracts. The environmental dimension includes effects on the environment of the Sulcis area. Our system can help to manage the use of renewable resources and to organize the tourist's transport in order to reduce the production of pollution and minimize the impact on the environment.

3.2 AGILE METHODOLOGY

Given the complexity of the system and the novelty of the proposed solution, we have chosen to develop the system by adopting the Agile methodology. As described in the Agile principles,

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that methodology puts the attention in the customer satisfaction as the result of the continuous exchange of information between the development team and the customer, that can lead to changing requirements in any stage of the development.

The Agile methodology incorporates sustainability and makes it one of its principles:

- *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely*[2].

We have chosen the SCRUM methodology, that is one of the Agile methodologies. The development of the tourism management system could face several points of uncertainty. For this reason, we chose is the SCRUM methodology, that allows a development process characterized by being flexible, adaptive and iterative. The SCRUM methodology can emphasize the importance of the communication between the different typologies of users, the product owner and the development team. The chosen blockchain technology is a natural communication channel. All recorded data are shared between actors and always available from the product owner. We identify the role of the Product Owner in the system admin, that is who will manage the tourism system.

In our proposal, we take into account the presence of a set of stakeholders of the tourism process, that, as will be described in the following section, are represented as an actor in the system. In addition, the feedback provided by the tourists, the local producer data, and the tourism services data is collected by the blockchain network and processed by smart contracts and can be used to improve both the tourism services and the system functionalities. The Product Owner, that is the manager of the tourism system, will periodically analyze and process collected data.

The results of the analysis should represent the feedback that the Product owner gives to the developer team. Continuous communication allows giving importance to the users' experience that has a very important role in all the stages of the development process, in order to check the correctness and the efficiency of the system in every development iteration.

3.3 BLOCKCHAIN TECHNOLOGY

The blockchain is well known as the technology that supports Bitcoin cryptocurrency and used for financial transactions. In recent years, due to the success of the Ethereum Blockchain and other platforms that allow implementing smart contracts, blockchain applications have spread to a variety of industries. The blockchain is a distributed and decentralized public ledger, which contains all cryptocurrency transactions. As the name suggests, it is composed of blocks, a

[2] http://agilemanifesto.org/iso/en/principles.html

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growing list of records, chained in chronological order and managed by a peer to peer network. Therefore, a record within the blockchain can not be modified retroactively because of its structure.

To validate a new block, each node of the network has a private copy of the ledger and needs to adhere to a protocol. A blockchain can be considered as a global online database in which information is recorded in a verifiable and persistent way without future manipulation. In addition to transactions, within the blockchain we can record digital data such as documents, or manage information such as identities, food traceability, agreements between parties, etc.. Indeed, by using smart contracts, we can automate processes and make them legally binding. A smart contract is a special typology of account recorded in a block. It can receive and transmit messages from and to other accounts, it contains programming language and it is self execute under some conditions.

By using the blockchain technology, it will be possible to guarantee:

- the security of the information by means the use of cryptography;
- the transparency of information because all actors can access it and audit transactions;
- the trust among parties without the use of an intermediary because the blockchain is decentralized and it is accessed and copied by any node on the network;
- the immutability of information given the structure of the ledger.

4 THE BLOCKCHAIN BASED SYSTEM

We first describe the objective of the system and subsequently the set of actors which interact with the system. Then we define the general architecture and finally, we describe the functionality in terms of *use cases*.

4.1 OBJECTIVE OF THE SYSTEM

We propose a tourism management system to help the sustainable development of tourism in the Sulcis area. To obtain this result we take into account the several aspects of the tourism system, and we identify all the actors involved. In particular, the business logic will be managed by the system with a triple objective:

- create a network among all actors involved in the Sulcis tourism economy. Operators can aggregate their services to promote the local area, encourage tourism and enrich the tourist offer, by offering combined tourist tours, routes with a limited number of participants or last-minute ticket. The customer will receive promotions both through the platform and traditional advertising channels.

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- have feedback from the final consumer. A customer can purchase two different types of product: agri-food product or tourist trail. In both cases, he receives login credentials to the system and he can leave feedback in terms of text message, photo or video. The User Generated Content will be analyzed by an external semantic engine connected to the system with the purpose to improve services and to increase the tourist demand.
- ensure the provenance certification of agri-food local product to guarantee the traceability. All local products registered within the system will be labelled by a QR code. By using a smartphone, the customer will be able to retrieve the product history from raw materials it was originated from, to the production and preservation of the product during the distribution.

4.2 ACTORS OF THE SYSTEM

We identified the following actors in the system.

- System Admin is a figure recognized by all the participants in the supply chain. It is the entity authorized to register the products and to include the various actors within the system. Each actor involved in the process must be authorized and certified to access within the system. In fact, every stakeholder, be it a tourism service provider, a producer or a distributor, must confirm its role by providing all the necessary documentation concerning the work license or any other authorization. Depending on the assigned role, each actor will be enabled to perform a limited set of operations, by recording only certain types of data.
- The tourism service provider is enabled to record data about tourist product such as sightseeing tours, last minute offers or multiple services coupons from different aggregated operators.
- Producer records data about agri-food local product, such as raw materials, processing and production. He can add a new production batch with related information and documents.
- Distributor adds information about the preservation of the product during the distribution phase: i.e. temperature, location. Moreover, he can record data about ownership change.
- Customer adds a review on
- the product purchased, he can also insert photos or videos. In the case of agri-food product, he can verify the integrity by reading all the product history.

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4.3 ARCHITECTURE

The architecture of the system is composed of three main layers, as represented in Fig.1.

- *Consortium Layer* consists of all the stakeholders involved in the tourism activities who sign and share an agreement regarding the tourist products. The purpose of the Consortium is to increase the tourist offer by certifying their product and guaranteeing their reliability.
- *Rest API Layer* provides the integration with the blockchain platform. It allows to signed users of the consortium, to view and interact with blockchain applications, such as execute actions on a smart contract or view contract instances. By using the REST API Layer, a User Interface will access to information recorded within blockchain, to display it to the end user.
- *Blockchain Layer* is the core of the system. It contains all business logic, implemented by using smart contracts. It contains data related to product recorded in a verifiable and permanent way. Users will access information through a properly implemented User Interface.

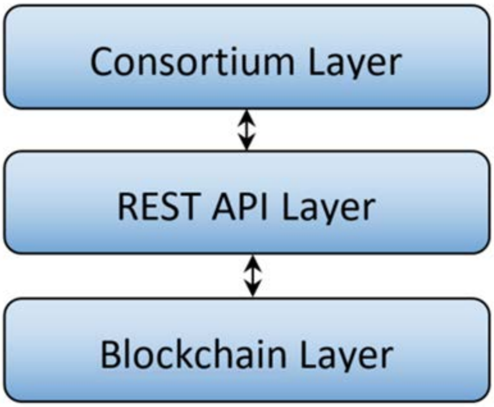

Fig. 1 Architecture of the system

The system manages two different types of data: one deriving from consumers that release feedback. These data are managed by the semantic engine, which analyzes them and returns the result to the BC system. The other one deriving from the other actors of the system.

Whenever a data is recorded in the blockchain, a specific smart contract is called. A smart contract is written in computer code, it allows the automation of processes because it is self-executed under some conditions. More specifically, we will implement a different smart contract for every macro process within the system.

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4.4 SYSTEM FUNCTIONALITIES: A USE CASE EXAMPLE

We present below a possible use case of the system. All the actors involved in the supply chain communicate with the system by using a User Interface. Depending on their role, each actor has different permission and displays different windows. Fig.2 represents the system functionalities and the involved actors.

- A System Admin, as a representative of the Tourism Consortium, entity regulating the tourist service, manages the accessing to the system.
- A stakeholder (or a Producer or a Distributor) requires credential to the Blockchain system providing all documents to certify his role.
- The System Admin issues the credentials to the actor. He records the actor within the system assigning a specific role.
- The Tourism service provider inserts within the system a coupon containing his product service (he adds a description, price, location area, expiration date and other useful information).
- The Tourism service provider inserts within the system a coupon (or last-minute deal) containing different product services from several operators (he adds descriptions, price, location areas, list of operators involved, expiration date and other useful information).
- The Producer inserts within the system a new production batch - related to an agri-food local product - (he adds a description, date, list of raw materials, certifications, expiration date and other useful information).
- The Distributor inserts within the system data related to the production batch: its new ownership and its conservation during the distribution phase (he adds ID production batch, temperature, location and other useful information).
- A consumer obtains information on the purchased product (agri-food product) through a QR code. He can read the product identity card that certifies the traceability and the reliability of the good.
- A consumer can insert within the system feedback on the purchased product. Indeed, he receives credentials to add a review in term of text, image or video.
- An external semantic engine, SE, connected to the system, analyzes the User Generated Content coming from consumers. The SE returns the result of the analysis as a positive or negative review. That information will be recorded within the blockchain system.
- Product reviews will be available to system actors to enhance products and services offered.
- Consumers that granting authorization, will receive the offering and advertising on local product.

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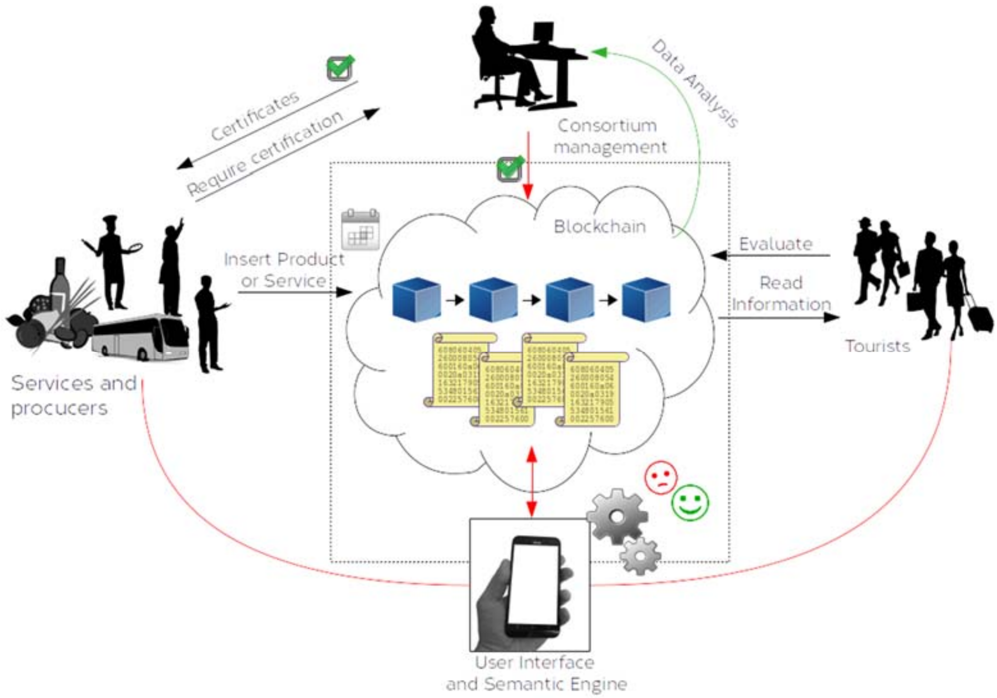

Fig. 2 The System functionality

5 IMPLEMENTATION

In this section, we briefly describe the main software element that composes the back-end of the software system. The first component is the set of smart contracts (SC) that will implement the business logic of the system. The second component is the semantic engine that is connected to the system to acquire and analyze comments and other types of feedbacks coming from the customer.

5.1 SMART CONTRACTS

We identify the following four smart contracts that will manage the business logic of the system.

- *SC-Access*. It is the smart contract responsible for the registration of new actors and for the login. It allows the System Admin to register actors and subsequently it allows actors to login to the system. For the registration process, the SC receives in input the business

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name, the address, the role, the list of recordable products within the system (only for Producer and Tourism service providers). If the registration succeeds, it releases the actor's credentials. In the login phase, the actor sends to the SC its credential. If the credentials are correct, the SC enables access to the platform, with view and permissions dependent on the actor role.

- *SC-Traceability* allows producers and suppliers to record data about agri-food local products. It receives data from producers regarding each specific product, such as raw materials, production techniques, location, the id of the production batch and other useful information. Instead, the contract receives from distributors data about current ownership, storage temperature, location and other useful information.
- *SC-Coupon* is devoted to Tourism service providers. It receives data about tourist attraction such as sightseeing tours, last-minute deal or a multiple service ticket come from different operators.
- *SC-Feedback* manages feedback released by consumers. It records and manages the processed information coming from the semantic engine in terms of positive or negative evaluation.

All smart contracts functionalities will be available to actors by means a proper user interface. Moreover, the interface will communicate with the semantic engine responsible for feedback coming from consumers.

5.1 SEMANTIC ENGINE

The Semantic engine is an external module linked to the blockchain system. It will be designed by using semantic techniques in order to improve the tourist market in the Sulcis area. its main objective is to analyze different types of data (text message, photo, video) coming from several consumers. To define the relationship among concept, the tool will use appropriate ontologies defined in the tourist domain. An ontology includes a representation, a definition of categories, properties, relations between data, entities and concepts that verify one or more domains. In addition, to manage the UGCs the system will use also a folksonomy, namely the operation to categorize the data inserted by users by using keywords or tags, the extraction of terms will be used to enrich an existing ontology (or a classification) or to develop a new one. The only result of the analysis that will be recorded within the blockchain system is expressed in terms of a positive or negative review. The integral result of the analysis will be available to the stakeholders, through the user interface, in order to improve their services or products, enhance their reputation and increase their revenue.

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6 CONCLUSIONS

This paper proposes a blockchain based platform to support the tourism system development by means the promotion of the local agri-food product, the management of services and tourist activities and the collection of tourist opinions. Our system has a triple objective: ensure the provenance certification of agri-food local products to guarantee the traceability, create a network among actors involved in the territory and have a feedback from the consumer in order to enhance products and increase revenues. The system will be used in an under development tourism context like that the Sulcis area, both from a technological and administrative point of view.

The use of the blockchain technology will ensure the transparency and the immutability of the information, will allow trust among parties and guarantee the security of data. Through smart contracts, it will be possible to automate processes and implement new functionalities. The actors will access to information by using a properly implemented User Interface with a customized view, depending on the role. The system will be connected to an external semantic engine whose job is to process feedback and analyze User Generated Content come from consumers. We take into account the sustainability as an objective and a non-functional requirement. Therefore, the use of the system will have benefits for all stakeholders involved, for the territory and for the economy. To ensure the sustainability of the system and according to the Agile methodology, we have conceived our proposal as gradual and updatable by adding, removing or modifying the characteristics, through the analysis of the feedback produced by consumers and the tourism system operator. To sum up, we believe that the proposed system will be able to help the management of the current state of the tourism system in the Sulcis area, and at the same time, it will be ready to face change and novelty of the future generation tourism services.

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http://sustainabilitydesign.org

AUTHOR'S PROFILE

Gavina Baralla, received the Laurea degrees in Electronic Engineering from the University of Cagliari in 2012 with a thesis entitled: 'An approach for managing the knowledge on the web'.Currently, she is a PhD student in Electronic and Computer Engineering at the same University. Her research interests are focused on Knowledge Management referred to Semantic Web, use of taxonomies, ontologies and linked data. Furthermore, she is concerning about blockchain technology and smart contracts.

Andrea Pinna, received the B.S. and M.S.degrees in electronic engineering from the University of Cagliari in 2012 and the Ph.D. degreein Computer Engineering from the University ofCagliari in 2018. Since 2018 has beena research fellow at the University of Cagliari.His research interests concern the study ofblockchain technology and its applications. Histopics of interest include the study of smart contracts, the engineering aspects in the developmentof decentralized applications, and the enhancement of the software sustainability thanks the blockchain technology. He also dealt with the study of datastored inside blockchain, of network features and users' behaviours.

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Roberto Tonelli, is a researcher at the DMI of Cagliari University and received his Laurea degree in Physics, magna cum laude. He holds two Ph.D., one in physics and one in software engineering. He is professor of Information Systems and DBMS and of Informatics at University of Cagliari. His expertise are in the modeling and analysis of complex systems, in statistics, in software engineering and blockchain technology. He is the author of more than 100 papers in international journals, books and conference proceedings. He is editor of various books proceedings and is the organizer of many international workshops on software metrics, on agile methodologies and on blockchain software engineering. He is Principal Investigator of various financed projects amounting at more than one million euros.

Michele Marchesi, received the Laurea degrees in electronic engineering and in mathematics from the University of Genoa in 1975 and 1980, respectively. He is professor of software engineering at the University of Cagliari. His research interests include software modeling using complex system approach, agile methodologies, open source development and applications, modeling and simulation of financial markets and economic systems using heterogeneous interacting agents, blockchain analysis and applications. He has published more than 250 papers in international journals, books and conferences. He has been the leader of several research projects amounting various million Euros, and is a consultant for various companies and public bodies. He is member of IEEE.

Katiuscia Mannaro, received the Laurea degree cum laude in Engineering from the University of Cagliari in 2001. Since then, she has actively continued post graduate research, holding in 2002 a Master's degree in Internet Banking from University Cattolica of Sacro Cuore of Milan and in 2003 she won a scholarship for young researchers in FIRB project (MAPS -Agile Methodologies for Software Production). In 2008 she received her Ph.D. in Electronic Engineering and Computer Science with a thesis on "Adopting Agile Methodologies in Distributed Software Development." Since June 2010 she holds a Postdoctoral Fellowship position at the Department of Electrical and Electronic Engineering, University of Cagliari. Her research interests include but are not limited to software modeling, agile and lean methodologies, blockchain analysis and application, knowledge representation and management, smart cities and Big Data. Her research is published in a large number of conference proceedings, articles in books and international journals

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PEOPLE AND HERITAGE IN LOW URBANISED SETTINGS

AN ONGOING STUDY OF ACCESSIBILITY TO THE IGLESIENTE AREA (ITALY)

NAĐA BERETIĆ, TANJA CONGIU
ALESSANDRO PLAISANT

Department of Architecture, Design and Urban Planning, University of Sassari, Italy
e-mail: nberetic@uniss.it, tancon@uniss.it
plaisant@uniss.it

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ABSTRACT

The traditional preservative concept in heritage studies shifts the nature towards heritage conservation. The shift concerns heritage values as a living idea and contemporary issue shaped from the past. The new conception requires a new approachin both, planning and management. The literature review of planning theory and practice highlightthe essential role of civic participation, the inclusion of local capacities and practices in the decision-making process. Social capital is considered essential for a more sustainable development of heritage places. Participative territorial governance is affirmative to understanding the social capital as a unity of social networks of trust among various levels of peoples' associations that implement the activity of common interest. Due to national and regional legislative and laws, this research frames the social capital of the Iglesiente area. It deepens the condition of non-profit and voluntary associations of the civic sector, which implement their activities in the social and cultural domain. This paper has qualitative character and pragmatic orientation, aiming its findings to the project currently in progress that the Region of Sardinia funds as basic research contributing to the "Plan of Sulcis". Theoretical findings of the paper are relevant to the definition and mapping of the social capital as a cornerstone to base or integrate the sustainable development strategies for the heritage territory. Specifically, insights of the paper focus on mapping of the voluntary associations of the civic sector inthe Iglesiente area.

KEYWORDS
Heritage; Social Capital; Civic Sector; Sardinia

1 INTRODUCTION

Heritage includes natural and man-made legacy and there are as "many definitions of the heritage concept as there are heritage practitioners" (Harvey, 2001). An intensive period of heritage as a global industry arises after the 1970s with the role of heritage in 'restructuring of the world economy' and 'museum culture'. Opposing the traditional concept from the 1970s, the evolving heritage concept is changing. The contemporary idea recognizes heritage values as a living idea, opening up the path to time-space continuity and conceptual dynamism according to peoples' contemporary concerns and experiences (Harvey, 2001; Tunbridge & Ashworth, 1996;).The conservation process favours people, function, use and development of heritage places. Through maximizing vitality, values and functions that benefit current and future generations, the sustainable social system as signed an important role in heritage resources. In the last two decades, heritage conservation orients towards people and identifies public participation in the decision-making process and bottom-up approach critical for sustainable development.

The results of this paper contribute to an ongoing project about accessibility to the territorial knowledge in the heritage setting at the area of Iglesiente in Italy (the Region of Sardinia funds the project as basic research contributing to the "Plan of Sulcis"). The wider framework of the project recognizes social capital and social-cultural attributes of heritage places important for sustainable development. The paper aims to determine the social capital of Iglesiente, departing from the definition of local human resources. It concentrates on voluntary associations of the civic sector that implement their activities in the social and cultural domain as a cornerstone of sustainable development strategies of the heritage territory.

The Iglesiente area belongs to the Geo-mining Park in Sardinia (UNESCO heritage) that aims to conserve the universal value of a regionally unique production system resulted from centuries of the mineral extraction. Regardless of administrative and legislative opportunities at the regional, national and international level, the Geo-mining Park still lacks in organisational capacities and development strategies. This condition reflects the disposal of spatial dynamics, depopulation and socioeconomic crisis. For that reason, the paper arguments social capital of civic sector as a vital component of local life in Iglesiente. It centralises civic sector practices, the character of its activities, spatial distribution and coexistence among the domains as sustainable development opportunities that benefit the local community and heritage conservation.

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2 PEOPLE AND HERITAGE CONSERVATION

Spatial configurations are a symbiosis of symbolic and material and, they are as much as cultural constructions as economic. Cultural construction must not be a reaction or response to economic processes, but a product of the intimate bonding. Heritage conservation supports kind of development as a solution to act beyond mass culture thesis (industrial heritage and heritage tourism concepts etc.). Ongoing dynamics on heritage conservation rests on stable and pre-political features and constant re-creation within the heritage context. The conservation approach in heritage studies relies on new tensions produced by people's activities and the identity of the population while interpreting the heritage 'object' (Taylor, 2008).The relationship of space and identity is a unity of place and people that "masks the processes of production of difference in a world of culturally, socially, and economically interconnected and interdependent spaces" (McCabe, 1993). This thesis centralizes active making and construction of space through people's activities (where space becomes a neutral grid of cultural differences), historical memory and societal organization (Gupta & Ferguson, 1997).

Public participation is essential for heritage conservation, enabling heritage transfer to future generations. The roles of public participation vary, but the paper highlights the shift from the purely architectural and historic approach to heritage conservation towards society and cultural conservation (Tweed & Sutherland, 2007). The 'participative governance' appears in the 1990s, emphasizing the role of the civic sector (NGO, associations, etc.) and the need to "joins with governments and industry lobbies in a common decisional pattern to achieve agreements between the three parties." (Ballet et al., 2007). Affirmative to this approach, the concept 'community of practice' (Wenger, 1999) represents a group of people who interact frequently over periods and who perform a shared practice and address tasks in a specific domain. Correspondingly, 'norms of trust', 'community of practice' and experiences of heritage places should lead the establishment of the development strategies and territorial planning.

2.1 SOCIAL CAPITAL

The social capital represents "social networks and the norms of trust and reciprocity that flourish through these networks" (Sander & Lowney, 2006; 2).Assessment and characterization of human resources help the development process, defining condition about stakeholders, the social potentials, paucity and if the ties among stakeholders are strong or weak. Furthermore, the mapping of social capital gives strengthening possibilities for local communities. Pertinent to heritage conservation, participative government, and communities

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of practice, this paper illustrates the social capital of Iglesiente through the official voluntary activities of the civic sector.

2.2 CIVIC SECTOR AND PARTICIPATION IN SARDINIA

Subjects that are composing the voluntary activities of the civic sector in the Region of Sardinia are non-profit and voluntary associations (associations of cultural and social promotion), social cooperatives and foundations (art. 36 par. 3 of Legislative Decree No. 118/2011). The General Register of Voluntary Activities in the Region of Sardinia articulates seven sectors with corresponding sections (Regional Law No. 39 of 13thSeptember 1993):

- Social Sector with Sections: Health, Social Assistance, Hygiene, and Sports;
- Cultural Sector with Sections: Education, Cultural Heritage, Permanent Education, and Cultural Activity;
- Environmental Sector with Sections: Environmental Protection, Rehabilitation, and Reduction of Risks, Protection of Flora and Fauna, and Protection of Pets;
- Sector Of Civil Rights with Sections: Protection of Consumer Rights and Protection of the Rights of Public Service Users;
- The sector of International Cooperation (No Sections have been Established for this Sector);
- Civil Protection Sector with Sections: Fire Protection, Special Operations, Sea, Search Operations for Missing Persons and Radio communications and;
- The sector of Regional Coordination of Voluntary Organizations. The Registry is a subject to a (bi) annual review aimed to verify both, the continuity of the requisites, and the actual performance of the voluntary activities.

Public associations of the civic sector could include diversified forms of associations of public administration and various forms of profit associations and agencies. However, the paper highlights the priority of the official voluntary activities of the civic sector. A full picture of such as social capital requires also are view of unregistered civic initiatives, yet this research phase excluded those for economic reasons.

National and Regional norms and laws guarantee public participation and measure it for multi-purpose use with the survey on social "aspects of daily life". The survey expresses the frequency of information of public about Italian politics, regional and geographical distribution. It collects basic information on the regional level about all the phenomena while deepening thematic investigations of the system, as, for example, family forms and evolution, cultural fruition and the relationship with free time activities, health conditions and the use of health services, safety and holidays. (National Institute of Statistics Italy - ISTAT, 2017).The survey

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method defines family as "de facto" family and this definition limits statistical units to families that have Italian residence, excluding the permanent members who live in cohabitation (for example, unmarried couples, people who live in Italy for the religious motives, health care, etc.).Having said that, participation measurements by using this method gives an insight into the satisfaction of elementary dimensions of the daily life exclusive to the Italian residents.

3. THE AREA OF IGLESIENTE, CIVIC SECTOR AND VOLUNTARY ASSOCIATIONS

Located at the south-west Sardinia, the historical sub-region of Sulcis-Iglesiente is a characterized by intensive extraction activities and it is UNESCO heritage that celebrates homogenous territory of Sulcis-Iglesiente-Guspinese. The geo-morphological configuration divides a complex system of Sulcis-Iglesiente in two basins: metalliferous (northern) and carboniferous (southern). Those two basins defer in landscape modifications due to the distinct process of mineral extraction and periods of active mining. The area of Iglesiente belongs to the metalliferous basin. The city of Iglesias has always been the administrative and functional centre of the area, entirely depended on mining economy. The mines and the buildings that served them rose to face the urban centre and grouped in isolated neighbourhoods. Functional organisation of the city provided that industrial buildings are clearly distinct from civil ones. Everything was structured according to the work and the control of the workers, following the morphological characteristics of the territory. Iglesias, intended as a city centre, with time acquires a leading role, serving as a reference point for all the surrounding mining villages.

Nowadays, Iglesiente area belongs to the Geo-mining Park in Sardinia that aims to conserve the universal value of a regionally unique production system resulted from centuries of the mineral extraction. The UNESCO recognised its technical-scientific heritage, historical and cultural landscape, as well as the environment related to human events that have interests in the geology and mineral resources of Sardinia (Carta di Cagliari, 1998). The items can be physically distant, but the essence of the heritage system is the spatial continuity of mining activity (ISPRA, 2008). The most intensive anthropogenic modifications of the Sardinian landscape appeared in the eighth century with the modern age of mining industry and large-scale territorial specialisation in mining activities. Rapid changes after the Second World War lead to the mine closure all around Europe (Wirth, Černič Mali and Fischer, 2012). Sardinia shared a downward trend, and during the 1960s and 1970s, most of the mines were closed. The mining industry has always been the only territorial economy and closure of mines resulted in the post-mining phenomenon consisted in the disposal of spatial dynamics and

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socioeconomic crisis (Gambino, 2001; Wirth et al. 2012). The phenomenon funds in exclusion of civic sector from the decision-making process and loss of identity (Beretić et al., 2018; Perelli et al., 2011). The deep territorial crisis continues for the period on. The area of Iglesiente has a low density and increasing depopulation trend.

It is possible to distinguish five Municipalities that make Iglesiente area: Iglesias, Fluminimaggiore, Buggeru, Domusnovas and Gonnesa. Even though the administrative organisation does not perfectly correspond to the ex-mining organisational units, mapping process of social capital have to begin with administrative portions. The reason has an operational nature. Regional and Provincial registers of voluntary associations are listed by communities. Thereby, further research continues starting from the five communities of Iglesiente area.

4. CONCLUSIVE REMARKS

This study contributes to further understanding of social capital as a strategy for sustainable development of the Iglesiente area as a heritage site and territory where daily activities take a place. The findings of this ongoing study are an integral part of the ongoing project that Region of Sardinia funds as basic research to the "Plan of Sulcis".

As the literature highlighted, the conception of heritage faces the transition from preservation to conservation. The transition prioritizes the role of cultural conceptions and everyday practices; social constructions of space that affect and reflect heritage places. Place and heritage, both involve regionalization of experience and localization of identity and tradition. People, function and use are matters of priority in the sustainable development of heritage places. Likewise, the establishment of the development strategies and sustainable planning of heritage places grounds in local and civic practices and shared experiences. Such as participative governance necessitates assessment and characterization of human resources and social capital. The social capital understood as an assembly of social networks of the civic sector reveals both, social potentials and deficits.

The paper provides an insight into assessment and principles to map the social capital of Iglesiente area that makes Geo-mining Park in Sardinia. The literature review of national and regional legislation and laws stressed the significant features about civic sector activities and the categorisation of domains, sectors and sections in which associations can implement the practice. The discussion about the present method of surveying suggested additional research about associations. Whilst relevant in the Iglesiente area (present data are measured for the regional level, administrative borders and exclusive to Italian residents), further research should include detailed research about the sectors and section in which the associations implement their activities. Networks of implementation sections would result in relationship

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patterns of voluntary activities and interests of community practices (spatial and/or thematic) to form development strategies. The criterion for sampling the survey is another issue to revise. Finally, complete knowledge about the social capital of Iglesiente area demands to map unregistered civic initiatives as well.

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AUTHOR'S PROFILE

Nađa Beretić, has an annual Post Doc Researcher Grant at the Department of Architecture, Design and Urbanism - DADU in Alghero, University of Sassari - UNISS, Italy. She has a PhD of Architecture and Environment, MSc in Landscape Architecture and MSc in Urbanism and Regional Development Planning. She assists laboratories about the design of urban spaces, town and territorial planning. She is a fiduciary and project manager of Public art & Public space – PaPs program, having joined in 2012. PaPs is an international, interdisciplinary, scientific, research and educational program of artistic design of public space (an independent program of Faculty of Architecture, University of Belgrade, Serbia).

Tanja Congiu, Temporary Assistant Professor of Transports at the Department of Architecture, Design and Urban Planning - University of Sassari. Civil engineer and Phd in land use and transport planning, her research activity focuses on mobility and transport issues with a particular concern for the interactions between built environment configuration, sustainable transport policies and trends in travel behavior. Recent studies deal with methods and tools to measure, assess and enhance urban walkability intended as central quality in the design of urban realm. Consultant for local authorities in transport planning at different spatial levels based on sustainable mobility solutions. Latest assignments: Mobility Plan for the Municipality of Alghero (ongoing); Responsible of accessibility issues in the urban regeneration program of S.Avendrace district – Cagliari.

Alessandro Plaisant, is an assistant professor of Urban Planning at the Department of Architecture, Design and Urban Planning, the University of Sassari and he held a PhD at Cagliari University. His current research explores decision-making processes in public policymaking, strategic planning, policies and tools pluralism-oriented, with the aim to re-think roles and modalities of public action in urban governance and participation in policymaking at all scales. He combines his research activities, carried out at the inter-university Laboratory of Analyses and Models for Planning (LAMP), with higher education and international cooperation activities, as director of the II level International Master's Program "Advanced Methods and Tools for Sustainable Planning", developed in academic cooperation with Harbin Institute of Technology (China).

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PLACE BRANDING AS A TOOL TO IMPROVE HERITAGE-LED DEVELOPMENT STRATEGIES FOR A SUSTAINABLE TOURISM IN THE SULCIS-IGLESIENTE REGION

ANNA MARIA COLAVITTI, ALESSIA USAI

Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: amcolavt@unica.it, a_usai@unica.it

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ABSTRACT

Place branding is becoming a highly political process used to form and force through policy agendas. Similarly, in cultural districts, design stakeholder coalitions and policy networks are shown to be relevant variables in the design process, especially in Italy. The paper focuses on this aspect exploring the impacts that a substantial reorganization of the local institutional and entrepreneurial network can produce on local place branding and the heritage-led strategies already adopted, especially, in the case of geotourism, where partnership building is still weak and linked to sender-controlled communication. The incidence of the administrative and institutional reform on the local partnerships is assessed through a comparative analysis of the place branding strategies set by the Local Tourism System (LTS), the Sardinia Geopark and Sardinia Region for the Sulcis-Iglesiente region in light of the contemporary reform of the local administrative and planning system and according to the framework elaborated by Colavitti and Usai (2015) to operalise the partnership building strategy aspects in institutional place branding. Finally, the paper outlines the most critical and challenging questions in order to develop a competitive identity able to both influence and be influenced by the local planning instruments for cultural heritage.

KEYWORDS
Place Branding; Sustainable Tourism; Partnership Building Strategy

1 CULTURAL DISTRICT DESIGN AND PLACE BRANDING TO SUPPORT PARTNERSHIP BUILDING IN HERITAGE-LED DEVELOPMENT STRATEGIES

The construction of a cultural heritage chain as a multi-level network made of districts, regions and firms, is a complex path. It requires a stable form of government and a clear definition of the roles assigned to the different nodes as to provide strategic unity and organizational coordination to the network. This aspect is particularly relevant for contexts with a predominance of small family-owned firms such as Italy. Here cultural districts have not developed under the planning for the arts but thanks to the application of Becattini's industrial district idea to cultural heritage management, especially by Walter Santagata and Pier Luigi Sacco. The research of the two authors on Italian regions, including Sardinia, has brought out the peculiarities of the organizational models that govern the chain of cultural heritage, from protection to valorisation, as well as the ability to generate "hybrid" districts linked to technological innovation, agri-food and tourism. They bring together companies rooted in different but complementary territories in terms of the supply chain or skills and provide them a coordinated image and offer to compete on the market (Ferilli et al., 2017; Ponzini et al., 2014; Sacco et al., 2013A, 2013B; Usai, 2016a, 2016b). The attempt is to produce narratives that can anchor and, at the same time, push forward local identity introducing a new "ethic" in territorial competition (Anholt, 2007). In this sense, place branding strategies built on the concept of "competitive identity" by Anholt (2011, 2016) can be a useful mean to build a coherent district image and a cooperative network taking it forward. "Competitive identity" concept refers to a place as a representation, as "physical-place-making" or both. In particular, Anholt (2011, 2016) highlights three key elements that Destination Management Organisations (DMOs) have to considered defining the competitive identity of a place: *Strategy* (i.e. a clear idea about who a place is and who it want to be tomorrow, according to an internal and external perception); *Substance*: the effective implementation of the Strategy through several activities (economic, legal, political, social, cultural and educational); *Symbolic Actions*: some activities characterized by an intrinsic communicative power and repeated for a long time in order to protect DMOs' Strategy from anonymity.

The greatest challenge in *Strategy* development is reconciling needs and expectations of different actors leading them toward goals which must be both inspiring and feasible (Anholt, 2011, 2016). At this purpose, Hankinson (2010) proposes a participation-based approach in which the DMOs are renamed as Place Branding Organisation (PBOs). PBOs work following the hexagon of competitive identity created by Anholt (2011, 2016) and guide local authorities

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towards the best strategy to attract visitor and investors and involve local residents - while traditionally, local authorities opt for standard solution, like mass advertising. Colavitti and Usai (2015) define this activity of networking as partnership building strategy.

Partnership building is also a pillar of sustainable tourism. Fostering harmonious relationships among local communities, the private sector, not-for-profit organizations, academic institutions, and governments at all levels as well as developing management practices and philosophies that protect natural, built, and cultural environments while reinforcing positive and economic growth, are the main challenges in managing sustainable tourism (Edgell Sr, 2016). Soulard et al. (2018) suggest that the stakeholder support in destination strategic plans increases as bonding and bridging social capital intensifies. Similarly, Lakner et al. (2018), with reference to Hungary, indicate the inclusion of different interest groups and long-term prognoses in local decision making as factors to minimise the environmental burden of tourism. Vice versa, Mc Camley and Gilmore (2018) prove that weak coordination, in terms of strategic marketing planning, has negative implications for heritage tourism in terms of strategic orientation, resource allocation, products and services development and destination promotion.

In the geotourism sector destinations have to conserve the very resources that make them attractive to be successful in the long term; so any marketing and planning for the destination also has to pursue responsibility and sustainability goals. Place branding creates destination loyalty using techniques such as "heritage interpretation" to generate tourist income responsibly and sustainably for local communities (Hart Robinson, 2015). Despite this, the projected image of geosites is often a deliberately constructed form of communication or grounded in authority-led projects (Chan & Zhang, 2018). The geoparks' image is often the result of a "sender-controlled communication" which concerns the *primary communication* (the communicative effects of actions taken by institutions) and *secondary communication* (the official communication issued by institutions). Colavitti and Usai (2015) illustrate these dynamics through the case of the Sulcis-Iglesiente region in Sardinia (IT) where an extensive recovery of industrial archeology sites took place after the crisis of the mines in the Seventies and Eighties.

The historical region of Sulcis-Iglesiente is included, along with the Guspinese territory, in the area n.8 of the Sardinia Geopark (see Fig. 1). The authors chose this territory for the following reasons:

- it holds a considerable quote of the heritage belonging to the Geomining Historical and Environmental Park of Sardinia (hereafter: Sardinia Geopark);
- it was the object of two communication campaigns between 2006 and 2009: the first campaign was organized by the Local Tourism System (LTS), a body created by the

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Carbonia-Iglesias Province and supported by the Sardinian Geopark and other private organizations. The second campaign was directly promoted by the Sardinian Geopark Consortium and monitored by the European Geoparks Network (EGN).

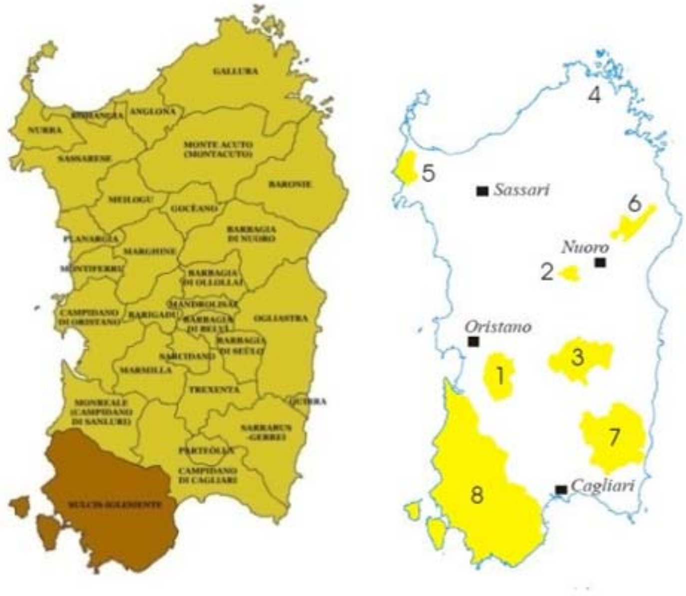

Fig.1 The Sulcis-Iglesiente historic region and the area no.8 of the Sardinian Geopark (Source: Elaboration by the authors)

The valorization of local mining sites at cultural-tourism purposes has led to the formation of various institutional networks on the local scale. Firstly, the networks of local institutions, companies and associations belonging to the Sardinia Geopark which, since 2007, is part of the European Geoparks Network (EGN) and, since November 2015, of the UNESCO Global Geoparks Network (GGN). Secondly, the aggregation of institutions, companies and cooperatives which have born thanks to regional policies for cultural tourism: from integrated planning interventions (PIA CA 07 Sud-Ovest. Sistema Turistico, PIA CA 01 Ovest - North-West - Repairing Interventions for the harbor infrastructure: *Interventi di ripristino delle infrastrutture portuali*) to interventions supported by the Regional Law 4/2000 art. 38, up to the Sulcis Inter-communal Strategic Plan (*Sistema Integrato di Gestione Beni Culturali e Ambientali Sulcis – Iglesiente*). Finally, the Sulcis-Iglesiente LTS, an institution created in 2006 by the Carbonia-Iglesias Province, which includes the Geopark and other actors of the tourism sector.

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The LTS and the Geo-mining Park have represented the main PBOs of the territory and have contributed to the construction of the Sulcis-Iglesiente district image in the context of local tourism strategies for the heritage (Colavitti & Usai, 2015).
The 2010 Provincial Urban Plan was essential to the creation and strengthening of these PBOs because it established the "Provincial historical-cultural heritage networks" (Provincia di Carbonia Iglesias, 2010). Furthermore, in December 2009, Sardinia Region published a call for tenders for the funding of integrated landscape programs in implementation of the planning guidelines for the RLP. The mechanism of participation adopted in the call for tenders is interesting because it saw the competition between neighboring municipalities – belonging to the same landscape unit and represented by a common leader. Among the twelve programs funded in 2011 there is "Sulcis: landscapes of work", a program presented by the Municipality of Portoscuso in a network with the Municipalities of Carbonia, Gonnesa, San Giovanni Suergiu, which provides for the conservation and redevelopment of the industrial archeology of coal mining infrastructure for sustainable tourism[1]. In 2012, with the Plan for Sulcis, the Sardinia Region proposed again the network logic adopted for integrated landscape programs in various calls, pushing the municipalities, public bodies and companies of the Sulcis-Iglesiente region to cluster[2]. In particular, local businesses operating in the cultural heritage supply chain have joined together to create new economic operators with a network structure - also to cope with the reduction in public spending and the decline in tourism recorded between 2012 and 2013 (Colavitti & Usai, 2015; Curto et al., 2014). According to the networking dynamics emerged in the Sulcis-Iglesiente case study, Colavitti and Usai (2015, p.156) provides a new definition of *partnership building strategy* as "the set of links that a PBO established or plan to establish with local and supra-local actors through formal agreements or joint activities in order to ensure *Substance* and, therefore, *Symbolic Actions* to the competitive identity they intend to build and implement for a specific place".

2 METHODOLOGY

Literature on cultural heritage district design and place branding both recognize the involvement of public actors as an important variable in defining the place branding strategies for the future of a place, especially when the same public actors are or act as the main PBOs in the region. Despite this, only a few studies address this issue from the opposite point of view questioning: (1) the impacts that institutional changes can have on the heritage-led

[1] http://www.regione.sardegna.it/documenti/1_19_20111221130928.pdf (02.02.2019)

[2] http://www.regione.sardegna.it/documenti/1_73_20120918143145.pdf (02.02.2019)

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strategies already undergoing and (2) the effective capacity of public actors in reducing the negative outputs and reorienting such strategies.

Geotourism represents an ideal research field because it is a sector where public actors and sender-controlled communication have a prevalent role. This is the case of Sulcis-Iglesiente region where both the local PBOs are linked to the local governments, as illustrated by Colavitti and Usai (2015). Furthermore, in 2014 the Delrio[3] law changed the Italian institutional architecture. In Sardinia it led to the establishment of the Cagliari Metropolitan Area and a new division of the regional territory into four provinces: Nuoro, Oristano, Sassari and South Sardinia[4]. The new Province of Southern Sardinia[5] replaces the old province of Carbonia-Iglesias, administrated by an external commissioner until new elections (scheduled for spring 2019) (see Fig. 2).

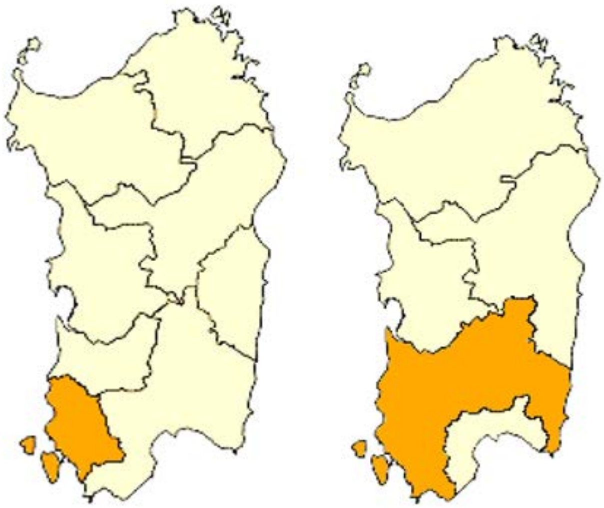

Fig.2 The Carbonia-Iglesias Province and the new South-Sardinia Province (Source: Elaboration by the authors)

As a consequence, the LTS have been dismantled and the Sardinia Geopark has become the only PBO in the area while the regional government has set a new strategy for tourism to coordinate the local PBOs. These events, not covered by Colavitti & Usai (2015), make the

[3] L.56/2014.

[4] L.R.15/2013, L.R. 24/2014 art.19, L.R.7/2015, L:R:2/2016

[5] https://www.provincia.sudsardegna.it (22.02.2019)

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Sulcis-Iglesiente area the ideal case study in order to explore how institutional actors can influence/reorient the heritage-led strategies already undergoing. For this reason, the paper recalls the methodological framework and the case study of Colavitti & Usai (2015) and, in the same line of research, trying to illustrate what happens after to the local PBOs and their heritage-led strategies.

The incidence of the administrative and institutional reform on institutional place branding and on the Sardinian Geopark's image is assessed through a comparative analysis of the place branding strategies set by the local PBO (the Sardinia Geopark) and the Sardinia Region after 2014, also in light of the contemporary reform of the Regional Landscape Plan (RLP).

The comparison is carried out according to the framework elaborated by Colavitti and Usai (2015) to operalise the partnership building strategy concept in institutional place branding (see Tab. 1). In particular, we analyse the activities listed in the periodic Progress Reports sent by the Sardinia Geopark to the EGN (secondary communication sources) on the base of Tab. 1. After, we discuss the outcomes in light of the provisions of the Strategic Plan for Tourism by Sardinia Region (a primary communication source) and the data on tourism from 2014 to 2018.

PROMOTION	MARKETING	PARTNERSHIP BUILDING
1. Customer-oriented website 2. Media communication 3. Co-marketing initiatives 4. Diffusion of the park image within the territory	1. Offer-based programs 2. Discounts by type of user 3. Special formulations based on time or type of visit 4. Educational workshops/events	1. Local partnerships through specific projects 2. Joint planning of interventions and policies in renewable energy, research and training

Tab. 1 Analytical framework adopted in the study.
(Source: Colavitti & Usai, 2015)

3 PARTNERSHIP BUILDING IN HERITAGE-LED DEVELOPMENT STRATEGIES FOR A SUSTAINABLE TOURISM: THE CASE STUDY OF THE SULCIS-IGLESIENTE REGION

In 2014 the Delrio Law and the subsequent commissioner management of the Province of Carbonia-Iglesias, have determined the disappearance of the LTS, one of the two PBOs responsible for the tourist promotion of the Sulcis-Iglesiente area. The 2011-2013[6] activity plan was not followed up and the tourism sector planning was entrusted to the South Sardinia Province Tourist Office[7], still under construction.

[6] Approved with the Delibera di Giunta Provinciale n. 182 in 01.08.2011.

[7] http://www.provincia.carboniaiglesias.it/aree-intervento/sistema-turistico-locale-sulcis-iglesiente

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Skills in the area of land planning and management have also been transferred to the Province of Southern Sardinia, in particular: The Strategic Environmental Assessment (SEA) procedures for urban planning instruments, the territorial projects related to the old Provincial Urban Plan – still in force and interventions for tourism development of the territory. The modified institutional structure has also affected the governance of the Sardinia Geopark but it continued with the place branding activity, which can be seen through the reports sent every six months to the EGN8 (Fig. 3).

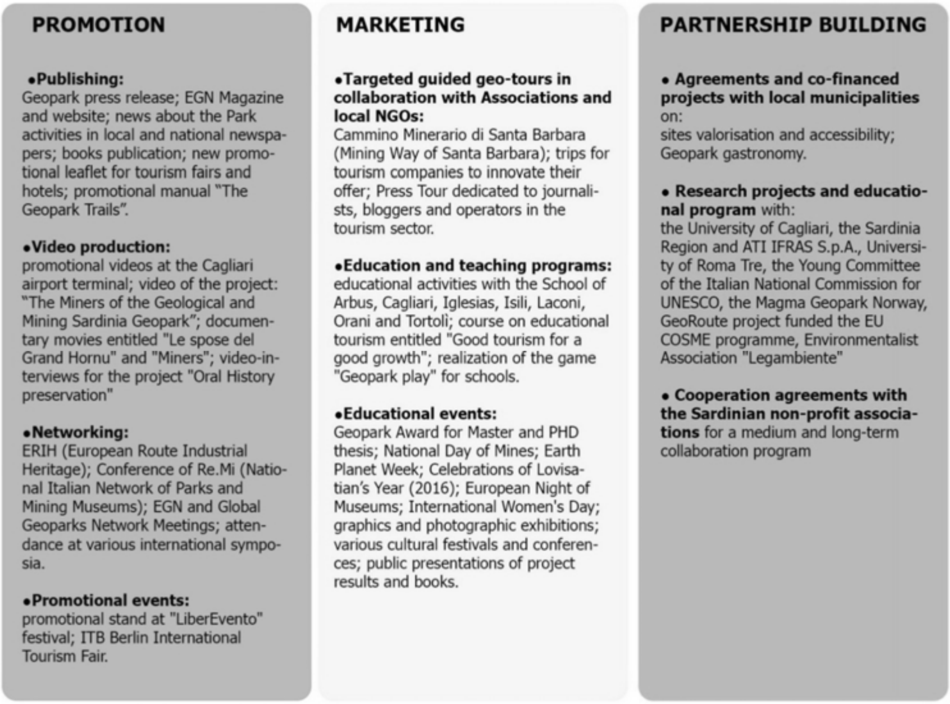

Fig. 3 Place branding activities carried out by Sardinia Geopark in the period 2014-2018 (Source: Elaboration of the authors on EGN Progress Reports)

The re-validation procedures of 2013 and 2017 for the maintenance of the European Geopark and UNESCO Geopark labels were successful passed by the Sardinia Geopark. Some remarks have been made regarding the structure of the park, which is still divided into eight areas, although in 2014 its legal competence was extended to the entire regional territory[9]. The

[8] http://www.europeangeoparks.org/?page_id=1060 (22.02.2019)

[9] Resolution no. 34/10 of 02.09.2014 of the Autonomous Government of Sardinia extending the jurisdiction of the Sardinia Geopark to the whole island territory.

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recommendations in this sense of the European Geopark Network concerned: the production of an updated cartographic and promotional documentation that gives visibility to the Geopark as a regional reality; the description of the links between geology, culture and ecology values and the synergies between these components outside the eight areas of the Sardinia Geopark; the synergy between the Sardinia Geopark and the stakeholders outside the eight park areas; active participation in the international geoparks networks[10]. The approval of the Management Plan for Mining Sites on 21st April 2018 enabled the first president of the park to be appointed on 17th April 2018 after eight years of commissioner management[11].

Consistent with the National Strategic Plan for Tourism 2017-2022 of the Italian Ministry of Culture, in 2018 the Sardinia Region adopted the Regional Strategic Tourism Plan 2018-2021 (STP), the reference document at the regional level for the destination management and marketing. Compared to the past, the plan's vision was built through a participatory process[12] with thematic work tables in different Sardinian municipalities (April-July 2018), the online platform *www.sardegnapartecipa.it* and on *desk* analysis carried out by technical and scientific consultants.

The Strategic Axis 1 of STP related to *governance* envisages the creation of a single regional Destination Management Organization, called "DMO Sardinia" on which the territorial DMOs depend. The Axis Strategic 12 related to the *place branding* proposes the establishment of a Sardinia Brand as *Brand Master* and *Umbrella Brand* within which to place the destination, product and territorial brands that can be developed by local DMOs and exploited by tour operators. Although the marketing and distribution of the tourism offer is held by private operators, the STP emphasizes the importance of public support and attributes to DMO Sardinia the task of guiding and supporting *Destination Management Companies* (DMCs) in the marketing and distribution of tourism products created by the DMO Sardinia and the territorial DMOs. The Strategic Axis 7 is dedicated to sustainability (strategic objective 7.1) and inclusion (strategic goal 7.2) for tourism. This axis is linked to the RLP as it regards the protection of the territory and the environment. Responsibility for its implementation is mainly assigned to the region, municipalities, DMO Sardinia and territorial DMOs (see Tab. 2).

[10] The 2013 revalidation letter is available at: http://www.parcogeominerario.eu/attachments/article/677/Lettera%20Zouros.pdf (22.02.2019). For the 2017 revalidation decision, see: UNESCO (2018). SC/EES/EGR/17/11537. Paris: UNESCO Global Geoparks Council, 2nd session. Available at: https://issuu.com/comissaonacionaldaunesco/docs/letter_and_report_of_the_unesco_glo (22.02.2019).

[11] Parco Geominerario Storico Ambientale della Sardegna, Amministrazione trasparente, organizzazione, organi di indirizzo politico: http://www.parcogeominerario.eu/index.php/amministrazione-trasparente-1/organizzazione/848-organi-di-indirizzo-politico-amministrativo?lang=it (22.02.2019)

[12] L.R. 16/2017 as modified by L.R. n. 23/2018.

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STRATEGIC AXIS 7. SUSTAINABILITY AND INCLUSION	RESPONSIBILITY	LOANSS	PRIORITY ACTION
7.1 Eco-friendly Sardinia			
7.1.1 Promoting efficiency in the use of natural resources	☑ Region, Municipalities	☑ Region	
7.1.2 Sardinia Responsible destination	☑ Municipality, private companies	☑ Municipalities	
7.1.3 Sustainable management of beaches	☑ Region, Municipalities, private companies	□	☑
7.1.4 Incorporate sustainability into tourism development	☑ DMO Sardinia	☑ DMO Sardinia	
7.1.5 Spread of sustainability as a differential factor in Sardinia	☑ DMO Sardinia, DMO Territorial, Region	☑ DMO Sardinia	
7.2 Sardinia Inclusive Tourism			
7.2.1 Handbook on Accessible Tourism	☑ DMO Sardinia	☑ Associations for people with disabilities	☑
7.2.2 "Tourism for everyone"	☑ Region	☑ Co-financing of the responsible parties	☑
7.2.3 Valorization and identification of accessible tourism and accommodation facilities	☑ Region (Council and Department of Tourism), DMO Sardinia	□	☑
7.2.4 Professional training on accessible tourism	☑ DMO Sardinia, Region (Regional Labour Agency)	☑ Region (ROP-ESF)	☑
7.2.5 Promotion of Sardinia as an accessible tourism destination	☑ DMO Sardinia	☑ DMO Sardinia	☑

Tab. 2 The role of DMO Sardinia and the territorial DMOs in sustainable tourism measures (Source: Elaboration of the authors on RAS, 2018)

On February 24th, 2019, regional elections were held. The new government has not yet formulated its program for the next five-year term. It is therefore not yet possible to know whether the STP will be maintained as a regional planning document on tourism, if it will be implemented in whole or in part, if it will be implemented in the manner established by the previous council or according to different formulas. Meanwhile, data on the tourism offer for 2012-2016 period reveal the recovery of positions lost by the Carbonia-Iglesias Province in 2012-2013, with a slight but steady growth in the number of beds and arrivals. Nevertheless, there was also a reduction in the number of visitors and, therefore, of the average stay of visitors, which went from 4.1 days in 2011 to 3.2 days in 2016 with a decline of 0.9 days (for Sardinia the decline was of 0.4 days) (see Tab. 3).

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	2011	2012	2013	2014	2015	2016
Bedplaces						
Sassari	32,837	30,085	30,189	34,168	34,168	33,455
Nuoro	19,539	19,228	18,796	18,769	18,769	19,031
Cagliari	40,687	40,475	36,779	42,050	46,158	44,237
Oristano	12,661	12,975	12,576	12,618	12,500	12,355
Olbia-Tempio	78,255	78,887	61,318	77,045	78,447	78,385
Ogliastra	13,691	13,969	13,898	13,767	14,071	14,062
Medio Campidano	2,720	2,628	2,661	2,780	2,473	2,503
Carbonia-Iglesias	6,612	6,324	5,467	5,656	5,634	5,868
Sardinia	200,390	198,247	176,217	201.197,	206,586	204,028
Average visiting (days)						
Sassari	4.0	4.0	4.5	4.2	4.2	4.1
Nuoro	6.2	6.1	5,4	5.3	5.5	5.3
Cagliari	4.6	4.5	4.3	4.3	4.4	4,4
Oristano	3.2	3.3	3.1	3.1	3.1	3.1
Olbia-Tempio	6.1	6.1	6.0	5.7	5.6	5.5
Ogliastra	6.2	6.2	5.9	5.6	5.5	5.4
Medio Campidano	3.6	3.6	2.4	2.5	2.4	2.2
Carbonia-Iglesias	4.1	4.1	3.6	3.4	3.3	3.2
Sardinia	5.1	5.1	4.9	4.8	4.7	4.7

Tab.3 Touristic offer in Carbonia-Iglesias Province
(Source: Elaboration of the authors on Istat data)

4 RESULT DISCUSSION AND CONCLUSIONS

The LTS and the Geo-mining Park were responsible for improving the knowledge and intelligibility of the local landscape through a place branding built on a diversified offer (cultural, environmental and tourist-recreational) in order to satisfy local and foreign users (Colavitti & Usai, 2015). Despite this, in the study some criticisms of the local cultural and tourist system have emerged. First, the prominent role played by public institutions in local

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networks and in their establishment, in this case the Sardinia Geopark, the Local Tourism System and, recently, the Sardinia Region with the STP. A feature that derives from a too institutionalized and institutionalized vision of the cultural district that relates the emergence of extra-regional entrepreneurial clusters solely to the internationalization policies adopted by the public administrations (Ponzini, 2015; Usai, 2016b). Second, the local business networks that, despite being sufficiently articulated and diversified and having a propulsive role in the tourist enhancement of the sites, maintain a "one to one" approach in the destination governance. Another critical element is the overlapping, in some cases redundancy of the Destination Management Companies (DMCs) programming and also of the local PBOs until 2013. With the abolition of the Carbonia-Iglesias Province, in fact, the activity of the LTS was interrupted and the Geopark remained the only PBO in the area, waiting for the South-Sardinia Province Tourist Office to become operational. The activities carried out by the Geopark between 2014 and 2018 focus on dissemination (publishing, video production, networking at EGN and GGN events), education and training programs for schools, employees and tour operators and partnership building. The promotion and marketing activities previously carried out by the LTS, such as participation in events and trade fairs (e.g. the BIT in Milan), described in Colavitti & Usai (2015), are almost completely missing. Meanwhile, the increase in arrivals and the reduction in average stay, are indicative of a "hit and run" or weekend tourism, opposite to the sustainability principles pursued by local policies.

The Regional Strategic Tourism Plan 2018-2021 (STP) recognizes these critical issues and proposes as a response the construction of a unitary public governance (the Sardinia DMO) to promote, guide and regulate the horizontal collaboration of local stakeholders (the territorial DMOs) establishing priority interventions and their respective responsibilities. However, the STP has not yet been able to put its *Symbolic Actions* into practice and even less to rely on a stable local partnership, given the reform of the provincial administration. All this does not seem well prefigured for the Sulcis-Iglesiente region with respect to the definition of a competitive identity, as described by Anholt (2007, 2016). In this sense, territorial and urban planning offered an important contribution in the analysis and governance of territorial dynamics, in the involvement of local communities through participatory methods. An element that seems to have been seized and adopted by the regional administration in the construction of the STP vision, unlike the past programming.

The case of Sulcis-Iglesiente regions suggests that a contamination of place branding with participatory techniques of urban planning can improve the stakeholders' involvement and, vice versa, that the narratives developed in place branding can improve the communication of local planning tools (aims, goals, provisions, etc.). Thus, mixing participatory techniques from collaborative urban planning and communication techniques from place branding can be

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the key for the public institutions in the geotourism sector to influence/reorient the heritage-led strategies already undergoing. A fundamental aspect for the future Geopark Territorial Coordination Plan, above all in the aspects concerning economic and productive activities that pursue sustainable environmental and cultural tourism for local communities. As pointed out by the EGN, in fact, the extension of the park's legal competence to the entire region must pass through a greater synergy between the Sardinia Geopark and the stakeholders residing outside the eight park areas and through a cartography that can describe these human ties, in addition to the geological, cultural and ecological values of the park.

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AUTHOR'S PROFILE

Anna Maria Colavitti is Associate Professor in Urban Planning at the Department of Civil, Environmental Engineering and Architecture (DICAAR) – University of Cagliari (IT) and PhD in Urban Planning. She teaches Fundamentals of Urban Planning, Urban and Regional Planning. She is member of the Scientific Board of the PhD Programme in Territorial planning and Urban Development. Her research focuses on recent developments in cultural heritage, environmental and urban planning with

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particular attention to local development approaches, integrated area-based programs and territorial governance processes.

Alessia Usai is Civil Engineer and PhD in Technology for the Preservation of Architectural and Environmental Heritage. She researches at the Department of Civil, Environmental Engineering and Architecture (DICAAR) – University of Cagliari (IT). Her research focuses on the relationship between cultural heritage and urban planning according to the creative city principles and the landscape approach outlined by the European Landscape Convention to identify best practices for the development of innovative cultural policies and new urban regeneration tools.

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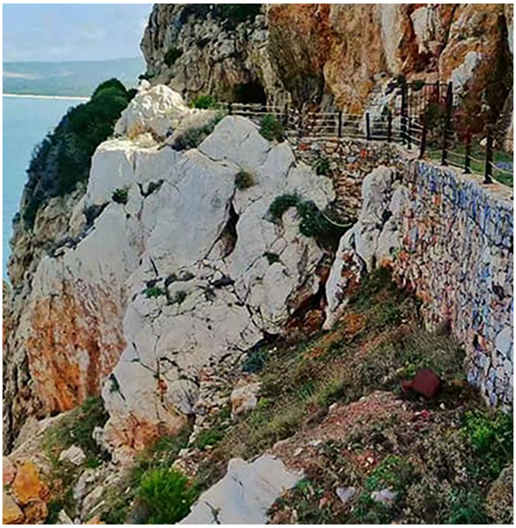

WALKABILITY AS A TOOL FOR PLACE-BASED REGENERATION: THE CASE STUDY OF IGLESIENTE REGION IN SARDINIA (ITALY)

CHIARA GARAU, GIANLUCA MELIS

Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: cgarau@unica.it, gianlucamelis@uniss.it

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ABSTRACT

The paper aims at exploring an extension of the concept of walkability to the rural contexts, focusing on the case study of the territory of Iglesiente, in Sardinia (Italy). The walkability paradigm is an operational framework of increasing interest in the field of urban planning, due to the intrinsic ability to read, in an innovative way, the accessibility approach and the mobility in the city between urban facilities. Nevertheless, it remains an open and slightly explored topic in rural and low-density contexts. The territory of the Iglesiente has a patrimony of nature and history of great interest for the peculiar relationship between the environmental and anthropic components related to the past mining activity: the city followed the production in the places where the mineral resources were present. Settlements in the Iglesiente area today appear poorly organized and fragmented both on the territorial and urban scale. In particular, each of the villages, which has undergone the strong impulse to grow by mining production, today shows an unresolved relationship with the places that were once dedicated to production, this even if many mining sites after long years of oblivion have recently restored and opened to the touristic fruition. The objective of this article is to focus the research on the inversion of the relationship between mining towns and places of production, rethinking and adapting the interpretative categories of walkability to rural contexts. The definition of paths inspired by the criterion of walkability to re-establish a relationship between Iglesiente area settlements and restored mining sites as urban facilities, appears to be a point of interest for a new interpretation of urban quality.

KEYWORDS
Walkability; Mining Landscape; Mining sites; Iglesente; Sardinia

1 INTRODUCTION

In the regional and urban planning literature, walkability is a measure of how easy and safe it is to walk in the urban environment (Forsyth, 2015; Rattan et al, 2012). Walkability is also investigated through various variables such as urban density, land use mix, connectivity, and urban morfology in general (Zaninović et al., 2019).

Shengxiao et al. (2019) underline that "city planning agencies often aim to improve walkability through various design strategies, planning more services and recreational facilities [...], and improving the sense of community [...] by preserving [...] the urban landscape" (Shengxiao et al. 2019).

Thus, walkability is generally an urban concept, but, according to Giles-Corti et al. (2019) and Hajna (2015), can be adopted also in rural contexts and small regional cities.

For these reasons, the authors intend to deepen and explore the concept of walkability in Iglesente area, a particular context in Sardinia where, an historical and powerful mining activity, left traces in the environment, in the social context, and in the morphology of rural settlements. The peculiarities of this settlement system, in which the development was driven by mining phenomenon, are in contrast with the pre-existing rural environment, strongly related to the environmental opportunities (Angelillo, 2018).

In fact, the mining towns of the Iglesiente region, were born as a subordinate element to the production and for this reason, at the time of the cessation of this activity, they found themselves substantially without their raison d'être. In other words, the condition for which the city pursued the development of the mine - and not vice versa - was happened, and the exhaustion of mineral deposits (as well as the changing economic conditions) marked the decline and, for some cases such as Montevecchio, the death of those cities born due to mining activity.

This has led and still leads to the need for reconstruction of the relationship between mining town and places of past production, reversing the hierarchy: the driving element must be the settlement with its territorial force and its critical mass of inhabitants. Thus, the places of production assume the semantic power of places full of history that inspire new forms of use and interpretation of the landscape.

Generally, the Iglesiente mining structure with its facilities follows the industrial organizational criteria. Its development is linked to a decontextualized culture, characterized by a condition of isolation, because of communication difficulties and based on specific technical and scientific principles. The construction of a mine, often distant and decentralized with respect to the city, imposes itself, in most cases, on the pre-existing rural livelihood economies.

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In this regard, the starting point of this paper comes from the flow of workers who daily moved from the places of residence to the places of production, linking the settlement and mine in a unidirectional semantic relationship. Today, the trace of this flow can be re-read as the privileged path through which the mining past becomes the identity way on which to reconstruct, reversing, the relationship between the city and its territory.

The territorial analysis showed how the places of mining production, redeveloped and open to fruition, have become important centers of tourism promotion of the territory linked both to industrial archeology and to the intrinsic environmental and landscape value of the places. These centers, which today play an important role in the construction of a new identity for the whole territory, are however punctual and disconnected elements, lacking the direct relationship with the settlements to which they were historically linked.

These connections, if rethought to serve the historical settlement, show the potential to re-establish the relationship mine-mining village, reversing the semantic roles of the two elements. To this end, it is necessary that these connections have the typical characteristics of urban environments, to bring the restored mining sites at the role of urban places. The determination of these characteristics is one of the central elements of the present operational proposal that rethinks the variables used for walkability in urban environments according to the most natural contexts. Based on these premises, the article intends to propose a system of interpretative categories, based on GIS analysis and based on the paradigm of walkability as a tool for the development and rebalancing of the territory.

In other terms, the aim of this paper is to extend the concept of walkability particularly to low-density settlements, by adopting an operative framework that considers the environmental and anthropic components to be strictly correlated. This link is strongly true for the mining industries. In fact, as the industrial city born as a place of production in order to minimize the distance between the manpower and the factory sites (Mistretta & Garau, 2013; Talia, 2007), in the same way the genesis of the mining sites is represented by a first core of services to the complex and dangerous extraction activity, and then the same minining sites are constituted by also the settlements of workers with their families.

The study context, strongly characterized in its main components, is described in the first part in order to have the theoretical and conceptual bases for the subsequent development of the proposed methodology. The results obtained will first be discussed in general in the paragraph describing the results and subsequently interpreted in the conclusions.

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2 THE CASE STUDY OF IGLESIENTE IN THE REGION OF SARDINIA (ITALY)

The Sulcis-Iglesiente region (Fig. 1), located in the south-west part of Sardinia (Italy) has mining basins that in the past were among the most important in Western Europe. In fact, the quantities of minerals produced reached world-wide levels, representing for almost two centuries one of the most important economic activities on the island.

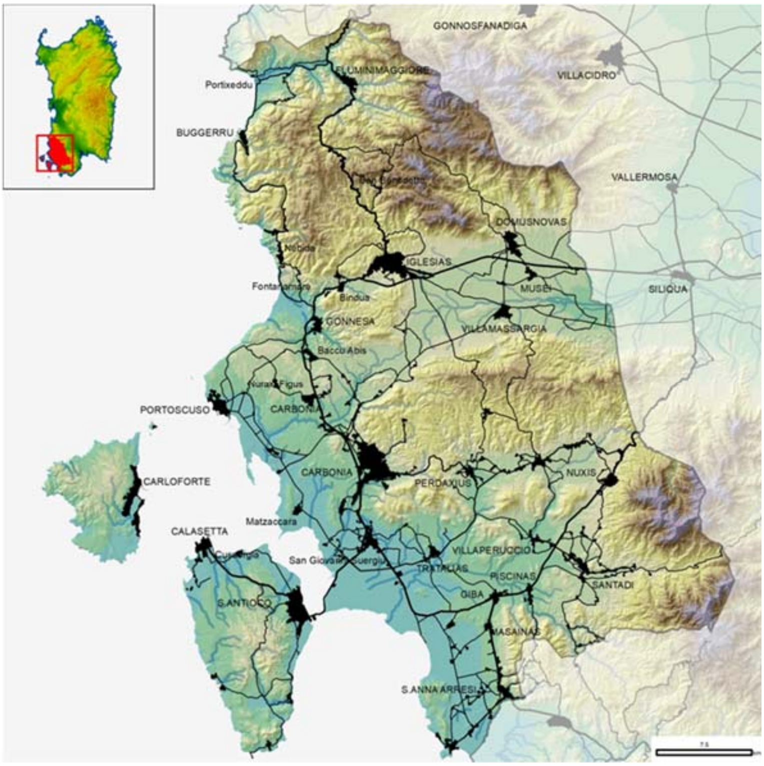

Fig. 1 The Sulcis-Iglesiente area

The cultivation activities of the metalliferous veins ceased completely about thirty years ago (the formal closure of the last active mine dates back to 1991), and the disposal process left on the territory both an extraordinary heritage of industrial archeology (consisting of residential and industrial buildings, machinery, open-air excavations, tunnels, etc.) and a social and settlement system, now lacking its main *raison d'etre.*

Therefore, the development of the Sardinian mining industry not only created wealth and employment for over a century (starting from 1848 with the extension to Sardinia of the mining law of June 30, 1840, already in force for all the other contexts of the Savoy kingdom);

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but permanently raised the level of education and the class consciousness (the Buggerru motions of 1905 represent a significant case on the European scale).
However, it left as a inheritance the compromise of extensive portions of territory, in particular in the Sulcis-Iglesiente area, creating a settlement and identity "emptiness" that has inevitably led the areas under study to a today's phase of necessary strategic choice for the natural decadence of the environment (due to environmental dynamics, toxic residues, system fragility) and existing structures (Peghin, 2018).
In Sulcis-Iglesiente, as in the rest of the world, mining complexes settled where resources are present and this often leads them to distant places separated from the urban contexts, in places dominated by the natural component. This determines a condition of isolation, caused not only by the difficulties of communication, but also by the differential relationship with respect to the host context linked to the extraction processes in the environmental context. This led to the definition of the concept of mining habitat (Sanna, 2014), as a whole connected to the system of extractive infrastructures, and also to all the works and elements, including natural ones, functional to the cultivation process.
Considering the complexity of the entire mining system in Sulcis-Iglesiente, the authors analyse, as a case study, the historical region of the Iglesiente (constituted by the municipalities of Bugerru, Domusnovas, Fluminimaggiore, Gonnesa, Iglesias, Musei and Villamassargia). Fig. 2 shows how the territories of these municipalities were affected by the mining activity (a total of 12.3% of their overall extension) and the extension of the density of mining concessions (78%) not related to the coal extraction.

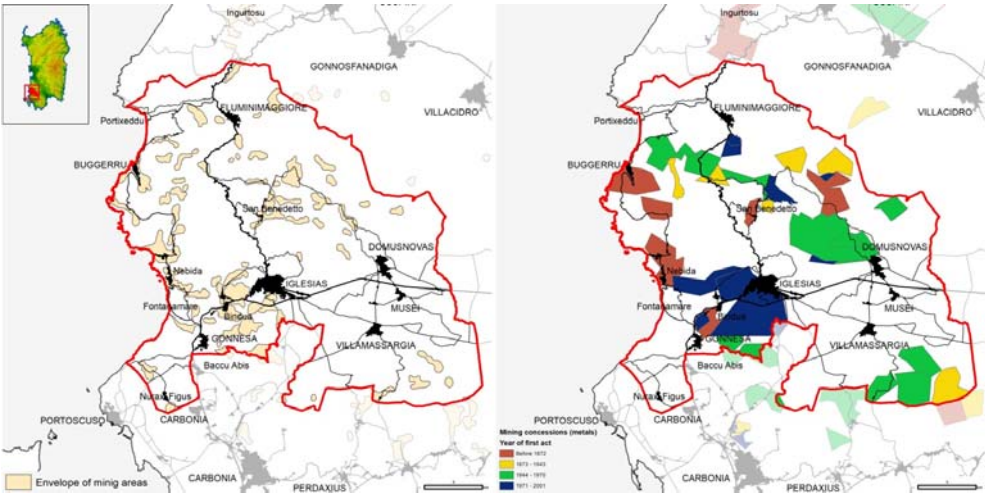

Fig. 2 The red border indicates the Iglesiente Region in Sardinia (Italy) with its envelope of mining area and its mining concessions

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The area under study was therefore characterized by the mining of metalliferous minerals which characterized its settlement history. The infrastructure linked to the extraction process in the Iglesiente area had, in general:

- an industrial settlement (for example, constituted by castles of extraction, turner lathe areas, offices, laboratories, laundry, silos, storage, social places, power production and transformation plant, etc. etc.);
- landfills for tailings and muds;
- transport infrastructure for the mineral and its aggregates as well as for the water used for processing and processing plants;
- a civil settlement (workers' homes, shop, management).

The settlement components connected to the extraction and mining processes and their placement within wide reference territorial areas, have, over time, left an industrial and civil heritage, not very populated, with a non-functional connective - infrastructural network, but particularly significant for the relations with the environmental system. Dismissal, redevelopment, recovery and reclamation are therefore terms that identify this territory, which still today has profound environmental, social, economic and managerial effects (Peghin, 2006).

3 METHODOLOGY

The specific purpose of this contribution is to define a system of interpretative categories capable of extending the concept of walkability from the urban to the rural context as an operational tool to reconnect renewed mining sites, villages, and the environmental and natural contexts.

In this regard and considering the area under study, the authors refer to the application of the walkability concept to a micro urban level, working on the direct relationship between the individual and the context also through the concepts of perception, efficiency, sense of security, and pleasantness of the path. In particular, the literature indicates three main categories of interpretation for the definition of walkability in an urban context: 1) the number of destinations of urban interest/opportunities within walking distance; 2) their distance, and 3) the quality of pedestrian routes to these destinations (Blečić et al., 2015; Forsyth, 2015; La Riccia et al., 2019).

These categories are thus rethought by the authors, considering the peculiarities of the context under study: 1) the elements of cultural value in urban centers with a significant number of inhabitants present in the rural context (the number of inhabitants is important because is the critical mass on which to base the concept of the place-based city renewal to

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which authors are referring) and the valuable elements of the mining habitat; 2) their distance, and 3) the quality of the path, taking into account both the comfort along it (slope) and the environmental richness (natural elements of value).

All the elements were analyzed in a GIS environment, due to a specific territorial information system organized on contents capable of relating both layers related to (1) the mining habitat (mining concessions, mining works, envelopes of the areas subjected to processing, historical mapping); (2) the natural heritage (rivers, coastline, protected areas, vegetation cover); (3) the anthropic dimensions (census analysis on the population in the time horizons of the censuses, mapping of the services present in the territory); and (4) accessibility with existing fruition infrastructures, such as roads, tourism and/or religious paths, such as the Mining path of Santa Barbara (*Cammino Minerario di Santa Barbara*).

4 RESULTS

The methodological criteria presented allowed the identification (1) of potential points of interest for each of the smaller villages with a significant resident population and (2) of a system of paths with the characteristics defined by the extension of the concept of walkability from the urban environment to the rural one (Fig. 3 and 4).

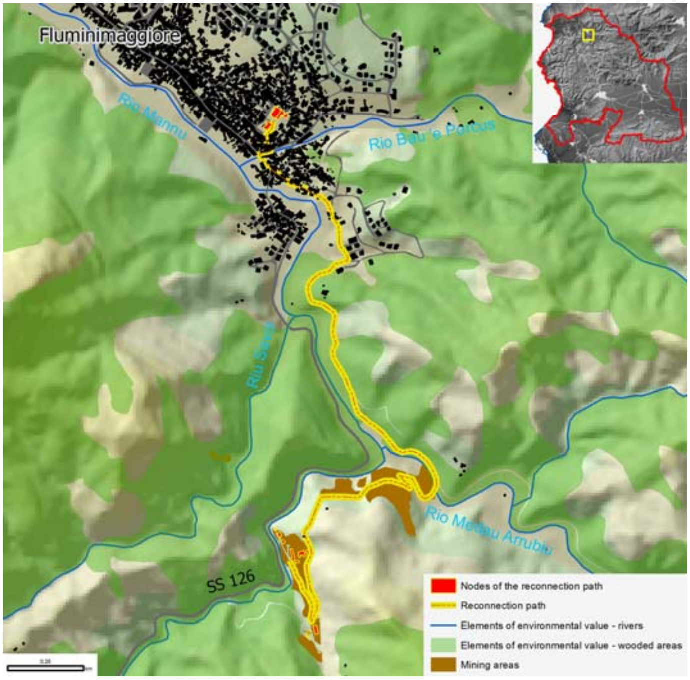

Fig. 3 Walkable reconnection proposal in Fluminimaggiore area

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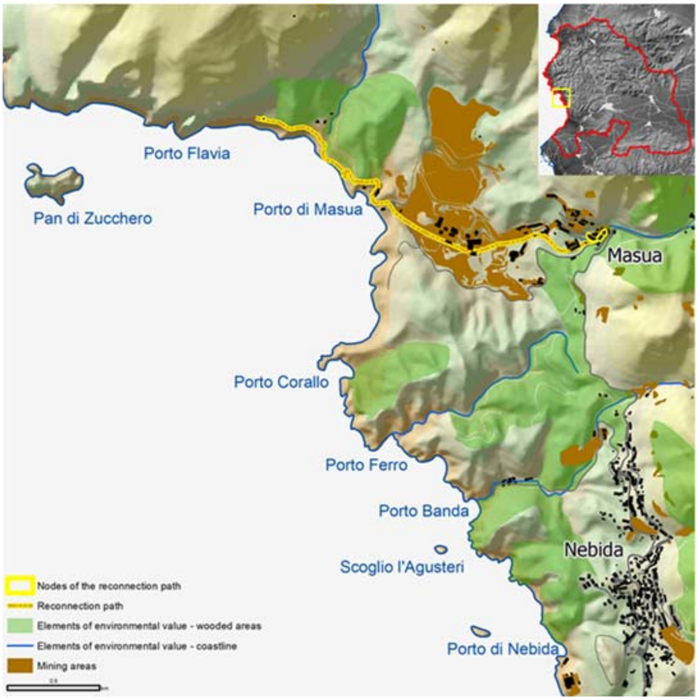

Fig. 4 Walkable reconnection proposal in Nebida - Masua area

The analyzed villages were the most isolated but most populous ones in the Iglesiente area (Fluminimaggiore, Nebida and Buggerru). The main center of Iglesias was not considered in the present analysis for the differences in scale, in fact the resident population exceeds the others centers of an order of magnitude showing distinctly urban characters and a regenerative potential that the smaller centers do not possess.

Thinking about destinations, each of the selected centers showed, in its compact urban fabric, at least one valuable identity element linked to the mining context. The analysis around the centers in question - considering the elements of the mining heritage now redeveloped and open, able to be used as an element of the mining town to be reconnected with new meanings to the urban context - was limited to a distance of 3 km, because the literature identified it as the threshold beyond which the alternative of walking on foot loses interest compared to the use of cars (Lefebvre-Ropars et al., 2017).

It was thus possible to identify for the three centers in question an origin within the urban center and a destination of high interest at a distance of less than 3 km. This, together with the analysis of the connections historically present between the town and the elements of the mining heritage used by the workers and functional to the productive phenomenon, and to the comparison with the current state of the places and with the results of the environmental

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analysis of the context, has produced the definition of a walkable itinerary of reconnection between urban and places of mining production now in the inverted meaning that these show of places of service to the city and no longer of only element for its existence.
This - together with (1) the state of the art of the place, (2) the analysis of the environmental context and (3) the analysis of the historical connections between the town and the elements of the mining heritage (used by the workers and functional to the productive phenomenon) - produced the definition of a walkable path of reconnection between urban and places of mining production, now in the inverted meaning of places of service to the city and no longer of only element, important exclusively for its existence.
The last criterion - able to define the quality of the path in presence of valuable environmental elements - was the analysis of the path's slope, calculated in a GIS environment. The analyses conducted (Table 1) showed that the paths of reconnection between Fluminimaggiore and Masua/Nebida with the respective elements of the mining heritage are the best in terms of slope, seen as traveling comfort, while in the third town (Buggerru) the slope was excessive for a structured path according to the paradigm of urban walkability.

MINING PATHS	STARTING POINT	ARRIVAL POINT	LENGTH	SLOPE
Buggerru	Miner's Museum	Entrance to the Henry Gallery	1 km	11 %
Fluminimaggiore	Church of St. Anthony of Padua	su Zurfuru Mine	2,5 km	6-8 %
Nebida/Masua	Exhibition of Mine Machines	Porto Flavia	2,9 km	6-8 %

Tab. 1 Paths of reconnection of Buggerru, Fluminimaggiore and Masua/Nebida

5 CONCLUSION

The territory of the Iglesiente has a place-based system, inherited from the mining activity and constituted by networks of connection between elements and places of the landscape, which takes a particular semantic value in the context in question. The inversion of the relationship between mining villages and places of mining production, explicit in the proposed methodological approach, constituted the operational starting point and a possible interpretation for a territory, such as that of the Iglesiente area, which is reconstructing its identity on a new reading of the mining landscape.
The extension to the rural contexts of the system of interpretative categories, based on the paradigm of urban walkability, allowed to explore operationally some minor centers of the Iglesiente, enhancing the old mining paths, as detail elements of an existing macro-path (the Mining path of Santa Barbara - *Cammino Minerario di Santa Barbara*).

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This has been pursued through the definition of privileged paths that bring the mining town closer to the places of production, reversing the consolidated relationship, of complete semantic dependence between the mining city and its production area. The reasoning on the planning and the descent of the scale remain open to make these connection lines as public spaces of use of the city. The future research proposal will start from this point, with the strategic planning of the identified paths seen as a new accessibility framework, so as to be able to include another small tourist connection to the more consolidated Mining path of Santa Barbara. In addition, the scale design descent will give authors the possibility of identifying other paths of tourist fruition.

AUTHOR CONTRIBUTIONS

This paper is the result of the joint work of the authors. 'Results', and 'Conclusions' were written jointly by the authors. Chiara Garau wrote the 'Introduction', and 'Methodology'. Gianluca Melis wrote the 'The Case Study of Iglesiente in the Region of Sardinia (Italy)'. Chiara Garau revised the whole paper and checked for its comprehensive consistency.

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AUTHOR'S PROFILE

Chiara Garau is Assistant Professor of Urban and Regional Planning at the DICAAR (Department of Civil and Environmental Engineering and Architecture) of the University of Cagliari, Italy. She was a member of the scientific and organizing committee of the YA AESOP (Young Academics—Association of European Schools of Planning, 2011–2013). She was a scientific and technical adviser for the Smart Cities Observatory of Rome (2013–2014), and in June 2015, she received the Best Paper award at ICCSA 2015 with a paper entitled Benchmarking Smart Urban Mobility: A Study on Italian Cities. In 2015, She won a national research competition (the SIR call proposal—Scientific independence of young researchers, Domain SH—of the Italian Ministry of Education, University and Research) with the GHOST project ("Governing the smart city: a governance-centred approach to smart urbanism"). She

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is author of over 70 scientific publications, including monographs, conference proceedings, and articles in books and national and international journals.

Gianluca Melis, is an environmental engineer. He took his PhD in Architecture and Planning (2010), and mainly deals with territorial information systems applied to spatial planning, impact assessment and planning. In his work as an engineer he deals with the development of innovative models in the GIS environment, especially aimed at the assessment of environmental and landscape impacts but, in general, the spatial modeling of various anthropic and natural phenomena. His main fields of interest concern the tools and techniques of wide area territorial planning implemented operationally in GIS, he usually deals with Spatial Analysis, Territorial Analysis, Landscape, Parks and Protected Areas, Environmental and territorial planning, Support Systems to decisions, geographic information systems.

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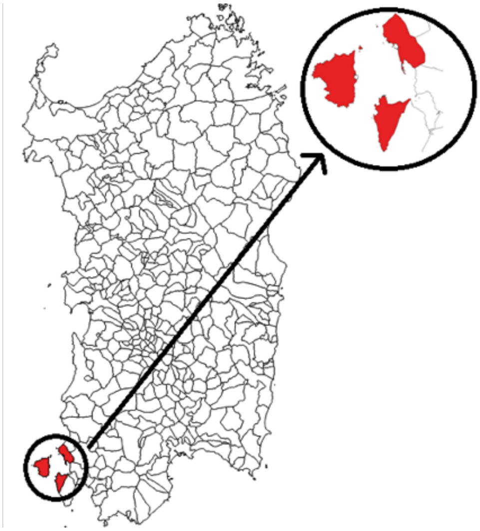

THE USE OF RECYCLED AGGREGATES IN THE IMPLEMENTATION OF MUNICIPAL MASTERPLANS AND COASTAL LAND-USE PLANS

A STUDY CONCERNING SULCIS (SARDINIA, ITALY)

FEDERICA LEONE, ANANIA MEREU

Department of Civil and Environmental
Engineering and Architecture
University of Cagliari, Italy
e-mail: federicaleone@unica.it
ananiamereu@gmail.com

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ABSTRACT

Nowadays, several plans such as municipal masterplans, coastal land use plans and management plans of Natura 2000 sites focus on different aspects of the same territory. Some plans aim at social and economic development of cities, others to nature preservation. An integrated approach in the definition of these planning strategies could pursue social, economic and environmental sustainability. This study aims at defining a methodological approach to support decision-making processes in developing short, medium, and long-term strategies in relation to the issue of sustainable accessibility to coastal zones and to the inclusion of recycled aggregates in local spatial planning. In this context, strategic environmental assessment represents an important methodological framework to integrate objectives and strategic issues deriving from spatial planning and environmental management within the planning processes. Inconsistencies between plans' objectives and actions are examined, trying to define impacts on the use of recycled aggregates. Moreover, a method to quantitatively define demand for recycled aggregates based on municipal masterplans data is presented. The proposed methods are implemented in relation to three municipalities of the Sulcis area in the Sardinia Region.

KEYWORDS
Recycled Aggregates; Coastal Land-Use Plans; Natura 2000 Sites

1 INTRODUCTION

According to the European Environmental Agency (2013) around 40 percent of the European population lives within a 50-km buffer zone from the coast. In fact, coastal areas, conceived as zones where human activities interact with coastal and marine ecosystems (Papatheochari & Coccossis, 2019), have always represented a pole of attraction for humans in terms of natural resources, recreational activities and tourism, fishing, industry and transportation (Neumann et al., 2015). The high population concentration and, therefore, the exploitation of its natural resources have entailed significant socio-economic and environmental changes to dynamic and fragile coastal-marine zones (Barragán & de Andrés, 2015).

From this point of view, coastal zones can be conceptualized as a social-ecological system (Ostrom, 2009), where social and ecological dimensions are mutual dependent, by interacting on multiple temporal and spatial scales (de Andrés et al., 2018; Greg et al., 2013). On the one hand, human activities impact on ecological dynamics and, on the other hand, natural processes, such as those caused by climate change, affect the provision of ecosystem services to society (Lazzari et al., 2019). Therefore, in this perspective, ecosystem services address human wellbeing (de Andrés et al., 2018).

The interactions between environment and society require an integrated approach that combines strategies deriving from spatial planning with principles deriving from environmental management (Boulos, 2016; Pittman & Armitage, 2016).

Integrated coastal zone management (ICZM) is a process, aimed at combining social and economic development with preservation of natural and cultural resources (Pérez-Cayeiro & Chica-Ruiz, 2015). In fact, ICZM has emerged as a dynamic, multidisciplinary and interactive approach to deal with problems that affect coastal zones, by considering both fragility of coastal ecosystems and the variety of existing activities (Khelil et al., 2019).

Transport and accessibility represent two key issues in the management of coastal areas for two main reasons. First of all, transport infrastructures influence decisions on the location of goods, services and human settlements, addressing socio-economic development of an area. Secondly, accessibility influences peripherality, connecting residents and visitors. Sustainable accessibility plays an important role in the management of coastal areas because it aims at combining transport objectives with environmental protection and, therefore, it requires an integrated approach (European Commission, 1999). On the other hand, current studies and efforts focus on the reduction of road traffic and congestion without assessing the influence of accessibility and transport within local planning processes. European Union (EU) policies are mainly focused on environmental pollution reduction and on materials reuse and recycle.

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The newsletter no. 5205/2005 of the Italian Ministry for environment, land and sea protection defines recycled material as "material from post-consumer construction and demolition wastes" and includes between recycled materials "recycled aggregates obtained through treatment of post-consumer inorganic wastes deriving from infrastructures and buildings demolition and maintenance works" (article 1).
Moreover, at European and national level, different policies encourage the increase in the recycled materials use. For example, the Law enacted by Decree no. 2010/205 established that by 2020 the use of construction and demolition (C&D) wastes must increase by 70 percent in terms of weight. The Law enacted by the Decree no. 203/2003 defines rules that must be implemented by the regional government to obtain an use of recycled materials at least equal to 30 percent of the annual need for materials in relation to public administrations and for companies with a prevalent public shareholding.
However, despite these measures, the use of recycled aggregates (RA) is still limited within public works. The use of RA shows different benefits, such as preventing the overexploitation of natural aggregates that entails an economic saving and an improvement of environmental preservation, and reducing waste disposal and illegally neglected waste. RA is primarily used for sub-bases roads and embankments (Agrela et al., 2012; Poon & Dixon, 2006), as fillings of quarries and dumps, and as aggregates for concrete (Pani et al., 2016; Rao et al., 2007; Silva et al., 2014). In coastal areas, RA could be also used for the realization of foundations of new piers and for their extension, such as in the port of La Spezia, in the Northern West Italy (Legambiente, 2017).
In this context, Strategic environmental assessment (SEA) represents an important methodological framework to integrate objectives and strategic issues deriving from spatial planning and environmental management within planning processes from its starting phase, by continuously assessing planning policies and their impacts in relation to environmental protection and sustainable development (Leone & Zoppi, 2016; Sheate et al., 2001). SEA aims, contents and procedures are defined by the EU Directive 2001/42/EC, henceforth SEA Directive, and by the Law enacted by Decree no. 2006/152 that implements the SEA Directive into the Italian legislation. Moreover, in Sardinia, in 2010 the regional administration elaborated the Guidelines Manual to define a methodological approach to develop SEA-based procedures in relation to the elaboration of municipal masterplans (MMPs).
This study aims at defining a methodological approach to support decision-making processes in developing short, medium, and long-term strategies in relation to the issue of sustainable accessibility to coastal zones and to the inclusion of RA in the local spatial planning. In particular, this study analyzes and compares objectives and actions deriving from those plans that regulate coastal zones at the local level through the methodological framework of SEA in

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relation to three local municipalities, Carloforte, Portoscuso and Calasetta, located in the Sulcis area, in Southern-West Sardinia, Italy. Moreover, an assessment of the demand of RA in relation to the entire territory of each municipality is carried out. This analysis may represent a knowledge basis to address the definition of strategies and policies concerning the use of RA within the MMPs.

The study is structured as follows. The second section defines the methodological approach and describes the case studies for its implementation. Results are presented in the third section and discussed in the last section (fourth section), where, in addition, concluding remarks and directions for future research are proposed.

2 METHODOLOGY AND CASE STUDIES

The study focuses on two issues that should be taken into account by coastal areas planning: i. sustainable accessibility to coastal zones; and ii. use of RA. The methodological approach is structured into two main phases, and for each one, specific methods are defined and implemented in relation to three Sardinian municipalities, Calasetta, Carloforte and Portoscuso.

The first phase concerns the definition of a logical framework (LF) that aims at assessing the relations between the different planning tools in force within coastal areas in order to understand their degree of integration. For this reason, for each municipality the following documents were analyzed: MMPs, coastal land use plans (CLUPs) and management plans (MPs) of the Natura 2000 sites that totally or partially overlap the territory of each municipality. In particular, the methodological definition of the LF is built on previous works by Leone and Zoppi (2015a; 2015b; 2016), where objectives deriving from different spatial plans and/or environmental plans are analyzed and compared in terms of internal consistency and in relation to a sustainable-oriented objective within a methodological framework of SEA-based procedures.

In fact, the Guidelines Manual suggests that the environmental analysis should include the study of eleven environmental components. For each environmental component, one or more sustainable-oriented objectives are defined in relation to the analysis of strengths, weaknesses, opportunities and risks (SWOT analysis). In this study, we consider sustainability-oriented objectives concerning the environmental components "mobility and transport". Table 1 shows the schematic representation of the proposed LF.

In our study the LF defined by Leone and Zoppi (2015b; 2016) is further implemented by including the analysis of CLUPs (fourth column of Tab. 1.) and by evaluating the potentially unfavorable impacts of the use of RA on the MP's objectives (eighth column of Tab. 1).

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SUSTAINABILITY-ORIENTED OBJECTIVES	MMP'S SPECIFIC OBJECTIVES	THEME	CLUP'S SPECIFIC OBJECTIVES	MP'S SPECIFIC OBJECTIVES	POTENTIALLY UNFAVORABLE MMP'S ACTIONS	POTENTIALLY UNFAVORABLE CLUP'S ACTIONS	POTENTIALLY UNFAVORABLE IMPACTS OF THE USE OF RECYCLED AGGREGATES
Sustainability-oriented objectives 1	MMP's specific objective 1	Theme 1	CLUP's specific objective 1	MP's specific objective 1	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
				MP's specific objective w	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
			CLUP's specific objective k	MP's specific objective 1	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
				MP's specific objective w	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
	MMP's specific objective h	Theme j	CLUP's specific objective 1	MP's specific objective 1	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
				MP's specific objective w	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
			CLUP's specific objective k	MP's specific objective 1	Action 1 Action x	Action 1 Action y	Impact 1 Impact z
				MP's specific objective w	Action 1 Action x	Action 1 Action y	Impact 1 Impact z

Tab. 1 Schematic representation of the Logical Framework (LF)

The second phase concerns an assessment of the municipal demand for RA and it is based on the expected future interventions and expansions defined within the MMPs for a ten-year period (Balletto et al., 2013). However, despite some studies (Balletto, 2005) are built on experimental coefficients taken from the Sardinian regional plan of extractive activities, the methodological approach proposed in this study is based on different assumptions, presented in Tab.2.

RA QUANTITIES FOR NEW CONSTRUCTIONS	RA QUANTITIES FOR MAINTENANCE
For each zone type of the MMP, we assume that every building reaches the maximum potential height allowed by the planning implementation code of MMP.	
Quantities of demolition wastes are considered equal to quantities of construction material, from a minimum value of 1 ton/square-meter to a maximum of 2 tons/square-meter (Morabito, n.d.)	Concrete quantity for maintenance works is assumed equal to about 50-100 kilograms/square-meter (Morabito, n.d.) and the surface characterized by maintenance works is assumed equal to 12 percent of the existing surface of buildings in zones A, B and C (Altamura, 2012)
Concrete weight is assumed equal to 30 percent of construction and demolition (C&D) wastes' weight (ARPA Veneto, n.d.)	
For the aggregates quantity we assume 1.2 meter cubed of aggregates for each meter cubed of concrete	

Tab. 2 Assumptions related to the assessment of recycled aggregates in relation to new constructions and maintenance

Moreover, since the Decree of the Ministry of infrastructure and transport of 17th January 2018 approves the Technical Standards for Construction that define the maximum percentage

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of RA (30 percent) for C30/37 concrete, whereas 80 percent is conceived as a medium value of RA in order to produce less strong concretes, these two different percentages are considered in the definition of quantitative demand of RA for new constructions and maintenance. To realize road bases, 100 percent of RA may be used.

The two proposed methodological phases are both implemented in three case studies: Calasetta, Carloforte and Portoscuso (Fig. 1), three medium-size municipalities in South-western Sardinia. All municipalities are characterized by the presence of two Natura 2000 sites.

Moreover, in order to determine RA demand for new road bases, we consider the relative transfers of land according to Municipal Masterplans' provisions and regional planning policies.

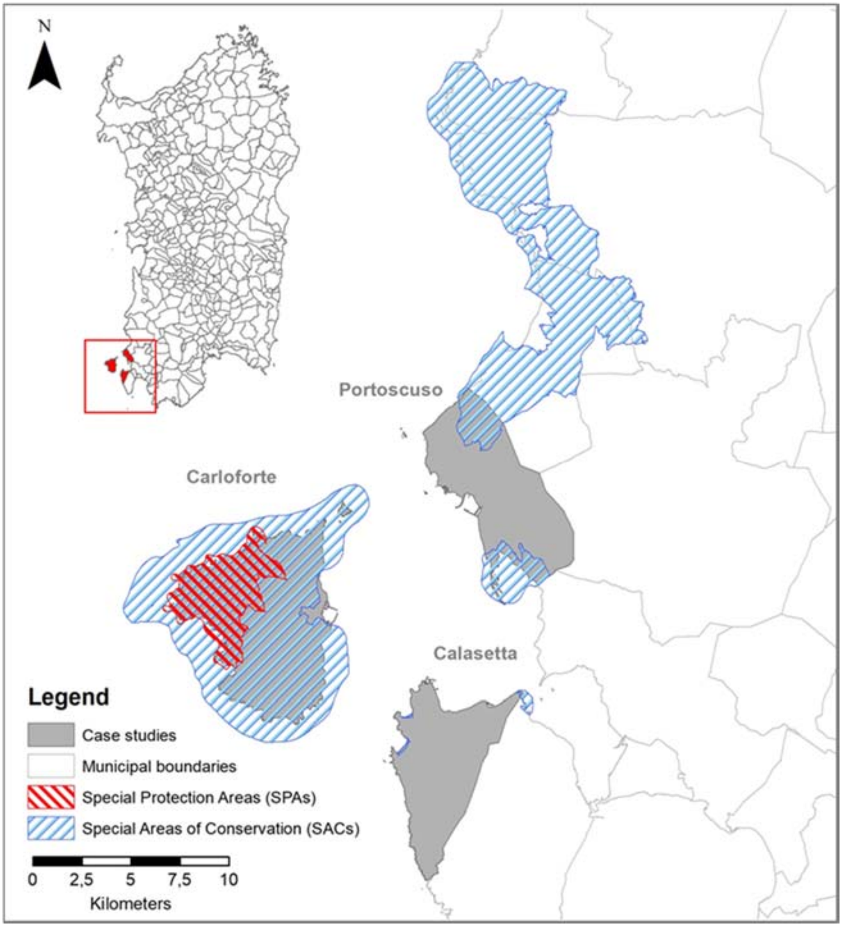

Fig. 1 The study area

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3 INTEGRATION BETWEEN SPECIFIC OBJECTIVES RELATED TO MMP, CLUP AND MP

The Tab. 3, 4 and 5 show an extract of the LF in relation to Carloforte, Calasetta and Protoscuso, respectively.

All the LF present a general consistency between the MMPs', CLUPs' and MPs' objectives in terms of sustainable-oriented goals. However, potential conflicts or potentially unfavorable impacts of MMPs' and/or CLUPs' actions on MPs' objectives occur in few cases. Moreover, all LFs do not show potentially negative impacts on the use of RA in relation to the MP's objectives. As regards the municipality of Carloforte, in relation to the theme "environmental protection" no CLUP's objectives are defined, despite the presence of a corresponding MP's goal. It could be due to different aspects that the two plans investigate. In fact, MPs focus on the environmental protection and preservation within the site, whereas CLUPs examine the coastal areas in relation to its tourism and recreational uses. Significant inconsistencies concern the relationship between the actions AMMP 1.1 and AMMP 1.2 and the MP's goals OMP 1 and OMP 3. The first is related to the theme "services", whereas the second to "accessibility". In relation to the objective OMP 1, tourist services should be managed without compromising environmental protection, whereas actions AMMP 1.1 and AMMP 1.2 aim at identifying residential and tourist expansion areas also in those zones characterized by significant environmental peculiarities. Similarly, although MP promotes a sustainable use of the site and its resources (OMP 3), the MMP defines tourist expansion zones. These new settlements may worsen the conservation status of environmental peculiarities of those areas. Similar considerations concern the inconsistency between the objective OMP 3 and the action AMMP 1.2. In fact, the identification of new urbanized areas may entail a further degradation of habitats with a consequent loss of biodiversity. A third and a fourth inconsistencies concern actions AMMP 1.1 and AMMP 1.2 and objective OMP 4, and action ACZ 4.1 and the objective OMP 4. The definition of new residential and tourist zones, as well as the provision of the minimum service level in support of tourism in the most popular sandy and rocky beaches, reflect a particular choice of the local municipality that obviously is in contrast with habitats and species protection. In relation to RA, actions AMMP 1.1 and AMMP 1.2 offer an opportunity for their use. At the moment, aggregates derived from C&D wastes have various uses such as land fillings, road bases material or as filler material for pavement bases (Wijayasundara et al., 2015), service areas' foundations, material for piers. A less common use is related to aggregates for concrete. In the last decades, researchers have studied the potentialities of RA as aggregates for concrete, by comparing their futures to natural aggregates characteristics. New expansion areas, as those defined by the MMP of Carloforte, may

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represent an opportunity to use RA for concrete and for roads' foundations. In the case study concerning the municipality of Calasetta, Tab. 4 shows several inconsistencies. CLUP's action ACZ 5.1 may generate conflicts with the goal OMP 5, since a new organization of parking areas in relation to coastal area uses may transform some zones in the SAC "Punta Giunchera", entailing a loss of biodiversity. Human-induced activities is not always in line with natural preservation objectives. A further critical issue is related to the relation between MMP's actions AMMP 7.1 and AMMP 7.2 and MP's objective OMP 7, because realizing cycle and pedestrian paths to link city center and coastal areas may increase the number of tourists, and visitors in general, not avoiding an excessive anthropic load and interfering with SAC's preservation needs. In this case, accessibility has a positive value from tourist point of view and a negative impact from nature point of view. Moreover, CLUP's actions ACZ 5.1 and ACZ 6.1 are potentially in contrast with OMP 7. In fact, the installation of floating docks and a new organization of parking areas that takes into account only the issue of accessibility may increase human presences in beaches causing a consequent obvious degradation of natural resources. New parking areas implicitly entail the use of cars. On the other hand, promoting the use of non-petrochemical vehicles may encourage more eco-friendly coastal tourism developments (Davenport, Davenport, 2006). Installation of floating docks (action ACZ 6.1) may expose marine areas, characterized by the presence of Posidonia oceanica, to degradation (Objective OMP 6) because this action may entail an increase in the number of boats, causing a deterioration of water characteristics.

Considering LF of Calasetta, no negative impacts on the use of RA is defined. Action AMMP 7.2 may have a potentially positive impact on the use of C&D wastes for building foundations of cycle paths. As regards the municipality of Portoscuso, Tab. 5 shows a general consistency between MMP's objectives, CLUP's objectives and MPs' objectives. Moreover, no inconsistency between MMP's actions and MP's specific objectives is present, probably because conservation measures defined by MPs are included within the MMP. For example, the MMP of Portoscuso classified the area of the SAC "Punta S'Aliga" as "H2" zone type, defined by the Regional Landscape Plan (PPR) as landscape assets where only protection and conservation interventions are allowed. On the other hand, two inconsistencies between CLUP's actions and MP's objectives occur. The first inconsistency concerns the installation of ten floating docks for leisure fishing (action ACZ 4.1) and the objectives OMP4 and OMP5. Both specific goals focus on the protection of habitats and species of community interests by reducing impact factors (OMP4) and by promoting spontaneous recovery processes (OMP5).

The installation of ten floating docks may impact on habitats and species conservation by increasing the potential number of visitors and boats. Moreover, concrete blocks are often used to anchor floating docks to seabed that may be damaged by these blocks, as well as

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marine habitats and species. The second inconsistency concerns the realization of new pedestrian and cycle paths (action ACZ 4.2) and the objectives OMP4 and OMP5.

In fact, although pedestrian and cycle mobility entail numerous advantages, such as reduction of CO2 emissions, the realization of new paths may cause a further fragmentation of habitats. In relation to RA, similarly to Calasetta, the realization of new cycle path (action ACZ 4.2) may entail the use of RA. On the other hand, in relation to action ACZ 4.1 the use of concrete blocks may threaten habitats and species of community interests. In the LF, this potential conflict is not emphasized because the impact factor is the concrete in general and not the use of RA deriving from C&D wastes.

SUSTAINABILITY-ORIENTED OBJECTIVES	MMP's SPECIFIC OBJECTIVES	THEME	CLUP's SPECIFIC OBJECTIVES	MP's SPECIFIC OBJECTIVES	POTENTIALLY UNFAVORABLE MMP's ACTIONS	POTENTIALLY UNFAVORABLE CLUP's ACTIONS	POTENTIALLY UNFAVORABLE IMPACTS ON THE USE OF RECYCLED AGGREGATES
Protection and enhancement of morphologic, landscape and environmental features of the territory in terms of environmental sustainability	Improvement of coast uses through the connection of almost isolated urban settlements and rehabilitation of the sea front in order to increase public space quality and tourism offer	Services	**OCF 1** Planning beach-related services and activities, consistently with landscape and environmental protection goals **OCF 2** Management and organization of state concessions in order to allow the free accessibility of coastal areas	**OMP 1** Enhancement of tourism services in order to improve beach uses without compromising its environment peculiarities	**AMMP 1.1** Classification of completely or partially unbuilt areas as "F2 – tourist expansion zones" **AMMP 1.2** Classification of completely or partially unbuilt areas as "C3 – residential expansion zones"		None
		Accessibility	**OCF 3** Organization of the access point system and of the parking sites in order to balance public access to beaches and coastal areas	**OMP 3** Promotion of a sustainable use of the sites and its resources	**AMMP 1.1** Classification of completely or partially unbuilt areas as "F2 – tourist expansion zones" **AMMP 1.2** Classification of completely or partially unbuilt areas as "C3 – residential expansion zones"		None
	Protection and enhancement of landscape and environmental elements and resources in order to mitigate and prevent critical processes concerning environmental and hydrological aspects	Environmental protection		**OMP 4** Conservation and enhancement of ecological and environmental peculiarities of the site, such as reefs, swamps, dunes, lakes, heaths, scrubs habitats, rocks, forests habitats, flora and fauna, and *Caretta Caretta*, a species of community interest	**AMMP 1.1** Classification of completely or partially unbuilt areas as subzone "F2 – touristic expansion zones" **AMMP 1.2** Classification of completely or partially unbuilt areas as subzone "C3 – residential expansion zones"	**ACZ 4.1** Provision of the minimum service level in support of tourism in the most popular sandy and rocky beaches	None

Tab. 3 Extract of the logical framework (LF) of the integration of the MMP, of the CLUP and of the MP concerning the town of Carloforte

SUSTAINABILITY-ORIENTED OBJECTIVES	MMP's SPECIFIC OBJECTIVES	THEME	CLUP's SPECIFIC OBJECTIVES	MP's SPECIFIC OBJECTIVES	POTENTIALLY UNFAVORABLE MMP's ACTIONS	POTENTIALLY UNFAVORABLE CLUP's ACTIONS	POTENTIALLY UNFAVORABLE IMPACTS ON THE USE OF RECYCLED AGGREGATES
Promotion of a balanced development and an integrated management of coastal areas	Management and use of coastal areas in relation to the sites' peculiarities, and to the conservation status of the environment and of its components (wetlands, dunes, emerged and submerged beaches)	Integrated management (usability and protection)	**OCZ 3** Definition of rules for coastal areas management and use sin relation to the environmental system and its components, preserving Salina's damp area	**OMP 2** Promotion of a high degree of awareness and information for economic operators and local communities **OMP 4** Integration of measures aiming at cleaning beaches and at protecting coastal and marine habitats in order to prevent fires			

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				OMP 5 Management and organization of activities within the site with particular attention to protection needs		**ACZ 5.1** Identification of parking areas according to coastal areas uses	
	Definition of interventions for improving accessibility and natural enhancement of wetland and of rock coasts in order to diversify tourist offer	Improvement of usability	**OCZ 4** Definition of tourist services in coastal areas, externally to state-owned areas	**OMP 6** Protection and restoration of *Posidonia oceanica* meadows in the mooring areas		**ACZ 6.1** Installation of floating docks	None
				OMP 7 Avoiding an excessive anthropic load, mostly in summer, by reducing	**AMMP7.1** Improvement of fishing activities	**ACZ 5.1** Identification of parking areas according to	None
	and to reduce the tourist load in the beaches close to Calasetta urban center			impacts on fauna and flora and by preventing dunes degradation	**AMMP 7.2** Realization of pedestrian and cycle paths to link city center with coastal areas	coastal areas uses **ACZ 6.1** Installation of floating docks	

Tab. 4 Extract of the LF of the integration of the MMP, of the CLUP and of the MP concerning the town of Calasetta

SUSTAINABILITY-ORIENTED OBJECTIVES	MMP's SPECIFIC OBJECTIVES	THEME	CLUP's SPECIFIC OBJECTIVES	MP's SPECIFIC OBJECTIVES	POTENTIALLY UNFAVORABLE MMP's ACTIONS	POTENTIALLY UNFAVORABLE CLUP's ACTIONS	POTENTIALLY UNFAVORABLE IMPACTS ON THE USE OF RECYCLED AGGREGATES
Promotion of sustainable use of coastal areas and of its natural resources	Coordination and harmonization between industrial activities, urban settlements, tourism activities and uses, agricultural and fishing activities in order to reduce the potentially negative impacts of industrial activities on environmental system	Protection of coastal ecosystem	**OCP 1** Promotion of measures concerning protection of coastal ecosystem	**OMP 1**Reduction/elimination of pollution phenomena concerning industrial activities			None
				OMP 2 Rehabilitation of ecological systems, degraded by pollution caused by industrial activities			None
				OMP 3 Reduction of contaminant diffusion by optimizing industrial activities			None
				OMP 4 Reduction/elimination of impact factors that threaten habitat and species of community interests		**ACZ 4.1:** Installation of ten floating docks for leisure fishing and nautical tourism **ACZ 4.2**Realization of new pedestrian and cycle paths	None
				OMP 5 Improvement and/or rehabilitation of habitats and species of community interest by promoting spontaneous recovery processes of habitats		**ACZ 4.1** Installation of ten floating docks for leisure fishing and nautical tourism **ACZ 4.2** Realization of new pedestrian and	None
						cycle paths	
			OCP 2 Promotion and enhancement of environmental rehabilitation	**OMP 1**Reduction/elimination of pollution phenomena concerning industrial activities			None
				OMP 2 Rehabilitation of ecological systems, degraded by pollution caused by industrial activities			None
				OMP 4 Reduction/elimination of impact factors that threaten habitat and species of community interests		**ACZ 4.1**Installation of ten floating docks for leisure fishing and nautical tourism **ACZ 4.2**Realization of new pedestrian and cycle paths	None

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		OCP 3 Improvement of accessibility and the use of coastal areas in order to contrast erosion and degradation of beaches	**OMP** **4**Reduction/elimination of impact factors that threaten habitat and species of community interests	**ACZ** **4.1**Installation of ten floating docks for leisure fishing and nautical tourism **ACZ** **4.2**Realization of new pedestrian and cycle paths	None
	Integration between coastal activities	**OCP 4** Integrated management of services and activities located in coastal areas in order to promote sustainable development also in relation to the rest of the territory	**OMP 6** Promotion of tourism and recreational activities consistent with conservation measures making the site an economic resource		None

Tab. 5 Extract of the LF of the integration of the MMP, of the CLUP and of the MP concerning the town of Portoscuso

In relation to quantitative assessment of the municipal demand for RA, the study is built on the expected future interventions and expansions defined within the MMPs for a ten-year period (Balletto, 2005). The quantity of RA that could be used in the implementation of MMPs' actions is defined for each zone. Since calculations are very long, in Table 6 we only report the estimated quantities of RA in relation to each municipality.

MUNICIPALITY	RA QUANTITY [m^3] FOR NEW CONSTRUCTIONS		RA QUANTITY [m^3] FOR MAINTENANCE		RA QUANTITY [m^3] FOR STREETS
	30% OF RA	80% OF RA	30% OF RA	80% OF RA	100% for foundations
Calasetta	5,781.86	15,418.31	101.01	269.37	22,798.39
Carloforte	10,224.14	27,264.38	227.75	607.33	111,914.62
Portoscuso[1]	12,502.077	33,338.87	324.12	864.31	44,659.21

Tab. 6 Estimated quantities of RA for new constructions, for maintenance and for streets' foundations in relation to the three municipalities

As shown in Tab. 2, two different percentages of RA quantities with respect to the total amount of aggregates necessary for new constructions and maintenance are considered.
Data related to Calasetta are the most detailed. In fact, the availability of information related to port infrastructures in the Port management plan (PMP) of the municipality allows to define more accurate quantities of RA. Future enlargements of the port may imply a higher need of RA than the PMP's data. The RA quantities for new constructions in relation to both 30 percent and 80 percent calculated for Carloforte and Portoscuso are around twice the quantities calculated for Calasetta, probably because Carloforte and Portoscuso have a double number

[1] Data we used to determine RA quantity are taken from MMP of Portoscuso, considering volumetries deriving from aerial photogrammetry of 10-16/10/2009, with a 20% less.

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of inhabitants with respect to Calasetta (ISTAT, 2019). This gap becomes wider in relation to RA quantities for maintenance. In fact, the RA quantity of Portoscuso is around triple (30 percent of RA) and quadruple (80 percent of RA) of Calasetta's quantities.

Moreover, although Carloforte and Portoscuso show similar values of RA quantities, the limited data in relation to Portoscuso may determine a difference in this quantity. In fact, the MMP of Portoscuso does not establish the volume in relation to future expansions of "G" type zones, defined as collective service zones. "G" type zones include the port area; thus, calculations of RA quantities may increase in relation to future enlargement of the port.

Data related to streets are not very trustworthy, since roads' base is calculated considering a percentage of 10 percent of municipal surface. Hence, this quantity of RA is the maximum quantity that could be necessary for the total urbanization of the whole area.

4 CONCLUSIONS

The methodological approach proposed in this study aims to support decision-making processes in defining policies and strategies in order to include the use of RA in the MMPs and CLUPs. The study is articulated into two different analyses. The first one analyzes the degree of integration between MMP's, CLUP's and MP's objectives in terms of internal consistency and if and to what extent the issue of RA is considered. The second analysis quantitatively evaluates the demand for RA, in relation to each municipality.

As regards the first analysis, although CLUPs' objectives are consistent with MMPs' goals, sometimes there is not a direct relation between the CLUPs' objectives and actions. It seems that CLUP's goals are too general in relation to the specific context that its actions should address. Moreover, SEA-based procedures represent a significant methodological framework to integrate strategies and objectives deriving from different spatial plans in relation to coastal areas. For example, Partidário et al. (2009) describe the process of elaboration of the Portuguese Strategy for ICZM, where SEA-base procedure was voluntarily carried out to support the decision-making process.

In relation to RA, it is not surprising that they are not mentioned in all plans, probably due to strategies included in the RLP that promote the realization and installation of movable constructions which entail the use of light materials, such as wood. For this reason, no negative impacts on the use of RA are defined. On the other hand, the use of RA entails a reduction in overexploitation of natural aggregates and an enhancement of environmental protection. In fact, aggregates are commonly used for piers' and roads' foundations, for fillings of quarries and dumps, and in general,for concrete. European policies focus on the material reuse and recycle; therefore, RA quantitative assessment may be useful to understand the real demand for RA in relation to the construction sector, taking into account the specific

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strategies of MMPs. Although some previous works (Balletto, 2005) focus on the definition of the demand for RA considering MMPs forecasts and coefficients taken from regional plan of extractive activities and experimental coefficients, our research uses different assumptions. In fact, quantities of RA are calculated through a several-steps procedure, starting from MMPs strategies and using assumptions presented in Tab. 2.

The proposed methodology may represent a starting point for future directions for our research. In fact, the analysis of only a case study could represent a limited scenario in order to have a wider vision of the Sardinian regional context. On the other hand, the methodology proposed in this study can be easily exported in other regional and national contexts due to its flexibility that allows to adapt it for different normative frameworks and different plans such as the implementation plans of historic center.

This methodology is based on the analysis of MMPs and CLUPs. However, around 74 percent of Sardinian municipalities has an approved MMP, but only 6 percent has a MMP approved in compliance with the RLP and only 4 percent has an approved CLUP[2]. Moreover, data related to volumes, that could be helpful in the assessment of RAs' quantities for concrete, are not exhaustive for all sectors in which they can be used. In fact, considering MMPs, the most difficult estimations are related to RA use for roads' bases, fillings and so on. A more complete analysis could include on the expected future interventions and expansions defined by the MMPs, within public works' programs and other related technical documents in order to define a more accurate estimation.

NOTE

Federica Leone and Anania Mereu have made substantial contributions to the study's conception, background and design remarks of section 1, and to discussion and concluding remarks of section 4. The methodological discussion proposed in section 2 is by Federica Leone. The results presented in section 3 are by Anania Mereu.

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[2] Information on approved MMPs and CLUPs are elaborated in relation to data downloaded from the Sardinian geoportal at the following link: http://www.sardegnageoportale.it/accessoaidati/downloaddati/

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AUTHOR'S PROFILE

Federica Leone, Building engineer, is Research Doctor in Land Engineering (Italy, 2013), and MSc in International Planning and Development (UK, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Anania Mereu, Environmental engineer, is Research Doctor in Land Engineering (Italy, 2015). She is currently a research fellow for MEISAR Project at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

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RELATIONSHIPS BETWEEN CONSERVATION MEASURES RELATED TO NATURA 2000 SITES AND COASTAL LAND USE PLANS

A STUDY CONCERNING SULCIS (SARDINIA, ITALY)

FEDERICA LEONE, CORRADO ZOPPI

Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: federicaleone@unica.it, zoppi@unica.it
URL: people.unica.it/corradozoppi

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plans and land management strategies concerning coastal areas.
The methodology proposed in this study defines a theoretical and technical approach to ICZM-related planning processes at the municipal (local) level, based on integration of strategies related to different spatial scales. Municipalities adopt spatial plans which regulate land uses in the coastal areas (PLUCs), whereas the regional and national public administrations define policies concerning environmental conservation and protection. The methodological approach is implemented with reference to two coastal towns located in South-West Sardinia, in the region of Sulcis. The outcomes highlight that PLUCs and the environmental protection-oriented plans are consistent with each other as regards themes and objectives. Three specific questions are crucial as regards the integration of social and economic development goals and sustainability objectives, namely relationships between natural ecosystems and services located in the coastal areas, ecosystem conservation and protection, and accessibility of the seashore.

KEYWORDS
Natura 2000 Sites; Coastal land use plans, Management plans of Natura 2000 Sites

1 INTRODUCTION

Since the 1970s, spatial planning policy of the European Union has been characterized by a marked attention to integrated coastal zone management (Saffache & Angelelli, 2010), as per Resolution no. (73)29 (26 October 1973) of the Council of Europe, which suggests implementing a holistic approach to conservation and protection of coastal heritage.
At the moment, at the international level, integrated coastal zone management is progressively increasing its relevance in theoretical and practical terms, since it is generally assumed as a fundamental point of reference to define and implement spatial policies oriented to sustainable development (Billé, 2008). The "Protocol on Integrated Coastal Zone Management"[1] (ICZM Protocol) was adopted by the European Union (EU) Council in 2008, and ratified in 2010 (Decision no. 2010/631/EU). The Protocol defines coastal zone management as a dynamic process which implements the sustainability paradigm into management and use of the coastal areas (article no. 2), by taking account of the weakness of landscapes and ecosystems, the heterogeneous mix of ongoing activities, which include maritime activities, their interdependency, and the impacts generated as regards coastal and marine contexts. Moreover, the context-specific nature of the ICZM approach should be carefully considered (Soriani et al., 2015), since costal and marine planning issues are not questions that can be addressed on anone-size-fits-all basis.
Nevertheless, integrated coastal zone management as regards the relationship between theory and practice is still a critical issue (Burbridge & Humphrey, 2003; Soriani et al., 2015) identify two kinds of problematic questions that may arise, which, on the one hand, are related to policies and strategic approaches, and, on the other hand, are connected to the implementation phases of spatial plans.
In this conceptual context, Strategic environmental assessment (SEA) may help decision-making processes related to coastal zone management to be effective in addressing the issue at stake (Rochette & Billé, 2010). The Directive of the EU concerning SEA (no. 2001/42/EC) states (article 1) that "The objective of this Directive is to provide for a high level ofprotection of the environment and to contribute to the integration of environmental considerations into the preparation andadoption of plans and programmes with a view to promotingsustainable development, by ensuring that, in accordance withthis Directive, an environmental assessment is carried out ofcertain plans and programmes which are likely to have significant

[1] Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22009A0204(01)&from=EN.

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effects on the environment." In other words, SEA processes enhance the quality of decision-making by making consistent and integrated economic and social development objectives and sustainability goals (Leone & Zoppi, 2015).
Furthermore, SEA is effective in supporting national administrations in implementing the ICZM Protocol into strategies and plans related to coastal management (UNEP et al., 2011). Harvey (2000) analyzes the use of SEA with reference to Australian coastal management. Procedures based on SEA-related approaches are used on a voluntary basis in the definition and implementation of the "Strategy for integrated coastal zone management" of Portugal in 2008, as a decision-making tool (Partidário et al., 2009), even though a systematic technical procedure which integrates the ICZM Protocol provisions and the SEA procedure is not available at present.
The approach proposed in this study builds on SEA in order to define a methodology which supports spatial planning processes in implementing the ICZM Protocol into local decision-making procedures. The objectives identified in different plans, namely spatial plans which regulate land uses in the coastal areas (PLUCs) and plans related to management of Natura 2000 Sites[2] (PMN2s), are examined and compared as regards their mutual coherence. Their strategies are made consistent with each other and negative effects of PLUCs on PMN2s are highlighted and addressed. The methodological approach is applied to two case studies concerning two coastal towns located in South-West Sardinia, in the region of Sulcis.
In the next section, the methodology is discussed, the documents and materials, upon which the spatial analyses are based, are identified, and the two urban contexts, considered in the two proposed case studies, are synthetically presented. The third section shows the results of the implementation of the proposed methodological approach, while implications, limits and suggestions for further research are discussed in the concluding section.

2 METHODOLOGY AND CASE STUDIES

The methodology implemented and discussed in this study focuses on building mutual consistency between PMN2s and PLUCs. It is based on the integration of strategies of PMN2s and PLUCs implemented through a logical structure (LS) which makes reference to the SEA procedure. The LS builds on the conceptual category of sustainability, mutual endogeneity of spatial planning and environmental assessment and the presence of planning alternatives, which feature SEA-based procedures according to the Italian Law concerning SEA (Decree no.

[2] Three types of protected areas feature Natura 2000 Sites: Sites of community importance (SCIs) and Special areas of conservation (SACs), identified under the provisions of EU Directive 92/43/EEC (the Habitats Directive), andSpecial protection areas (SPAs), identified according to EU Directive 2009/147/EC(the Birds Directive).

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152 of April 2006), which embeds the EU Directive on SEA into the Italian legislative framework (Leone & Zoppi, 2015).
The LS was already used by Leone & Zoppi2 2015 and 2016, who proposed a comparison between the provisions of the city masterplans and the PMN2s based on the reciprocal consistency of their goals. Here, the relationships between PLUCs and PMN2s are assessed as regards sustainability goals, through the identification of the PLUCs' operations which may generate negative effects on habitats and species protection-related goals identified in the PMN2s. Tab. 1 shows the diagram of the LS. The five columns refer to: i. sustainability goals; ii. thematic issues; iii. PLUC's goals; iv. PMN2's goals; and, v. PLUCs' operations which may generate negative effects on habitats and species protection-related goals identified in the PMN2s.

SUSTAINABILITY GOALS	THEMATIC ISSUES	PLUC'sGOALS	PMN2'sGOALS	NEGATIVE PLUC'S OPERATIONS
Sustainability goal 1	Thematic issue 1	Goal 1 of PLUC	Goal 1 of PMN2	Operation 1 Operation k
			Goalj of PMN2	Operation 1 Operation k
		Goalj of PLUC	Goal 1 of PMN2	Operation 1 Operation k
			Goalj of PMN2	Operation 1 Operation k
	Thematic issue h	Goal 1 of PLUC	Goal 1 of PMN2	Operation 1 Operation k
			Goalj of PMN2	Operation 1 Operation k
		Goalj of PLUC	Goal 1 of PMN2	Operation 1 Operation k
			Goalj of PMN2	Operation 1 Operation k

Tab. 1 The framework of the Logical structure (LS)

The proposed methodological approach is applied to the towns of Carloforte & Calasetta, two spatial contexts of South-West Sardinia located in the Sulcis region (Fig. 1). The small Island of San Pietro (San Peter), where Carloforte is located, is connected to the mainland by ferryboats which depart from the Port of Calasetta. These towns were selected since they identify a consistent spatial system, whose coastal and marine areas require an integrated management approach, even though each urban area is governed by an autonomous municipal administration. Furthermore, a number of Natura 2000 Sitesare located in each spatial context.

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The planning documents used in the study are:

- the PLUC of Calasetta and the PMN2s of the following SACs: ITB042208 "tra Poggio La Salina e Punta Maggiore," ITB042210 "Punta Giunchera"and ITB042209 "A nord di Sa Salina;"
- the PLUC of Carloforte and the PMN2 of the following Natura 2000 Sites: SAC ITB040027 "Isola di San Pietro"and SPAITB043035 "Coste e Entroterra tra Punta Cannoni e Punta delle Oche – Isola di San Pietro."

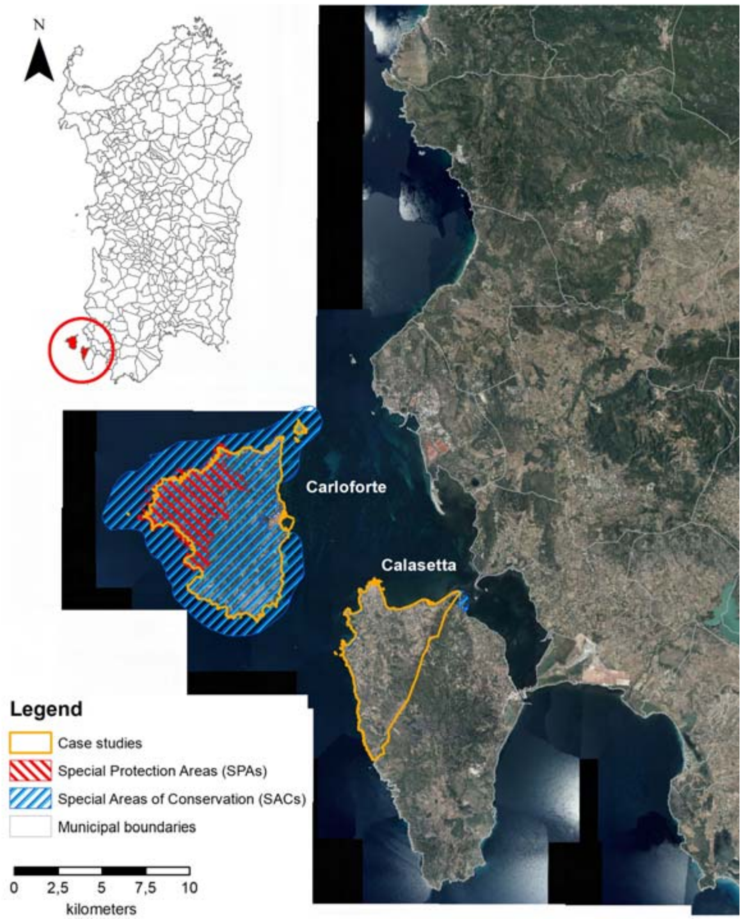

Fig. 1 The study area. (Source: elaboration by Federica Leone on an aerial photography drawn from Geoportalof Sardinian regional administration) (http://www.sardegnageoportale.it/index.php?xsl=2425&s=324505&v=2&c=14488&t=1&tb=14401)

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3 FINDINGS

The implementation of the methodological approach into the two urban contexts of the Sulcis region identifies and analyzes coastal and marine processes which combine planning strategies differentiated in terms of scale, since the local municipal administrations, which study and approve the PLUCs, and the regional and national administrations, which define and implement PMN2s, are involved at once.

The LSs concerning the PLUCs and the PMN2s related to the towns of Carloforte and Calasetta are reported in Tab. 2 and Tab. 3. Considering contents and objectives of PMN2s and PLUCs, each of the two tables shows sustainability goals concerning conservation of biological diversity, plants and animals. PLUCs and PMN2s are mutually consistent as regards goals and thematic issues. The PLUCs focus on the following thematic issues: i. relations between coastal and marine ecosystems and services provided on the beaches; ii. conservation and enhancement of coastal and marine ecosystems; and, iii. accessibility to beaches and coastal areas. For example, the objectives of the PLUC of Calasetta focus on the integration of services provided on the beaches and coastal and marine ecosystems, identifying ecosystem conservation as the core issue, whereas the goals of the PLUC of Carloforte focus on the same integration issue, assuming accessibility as the main question. This is explained by the fact that the SAC "Isola di San Pietro" overlays the municipal land of Carloforte and, as a consequence, the approval process of proposed spatial transformations is based on the Appropriate assessment procedure, established under the Habitats Directive[3], which aims at preventing negative effects of projected operations on habitats and species of SACs, SPAs and SCIs.

It has to be put in evidence that, notwithstanding PLUCs and PMN2s are mutually consistent as regards their sustainability goals, the PLUCs' planned operations can generate negative impacts on the PMN2s.

In the case of Calasetta, the coastal and marine areas are planned both as environmental resources deserving protection-oriented measures and as factors of economic development related to leisure and tourism. The PLUC focuses on the definition of a set of planning policies to exploit tourist attractiveness (GoalC2) and on prevention or mitigation of erosional processes concerning beaches (Objective C3).

[3] Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives […] [T]he competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public." (Habitats Directive, art. 6, paragraph 3).

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The planned operations aim at developing tourism and at increasing the attractiveness of the seashores (Operations AO2, AO3, AO4, AO5, AO6, AO7 and AO8). On the other hand, the goals of the PMN2 focus on limiting tourist presence on the beaches (Objective AM3), on prevention or mitigation of the negative effects generated by human activities, animals and infrastructure on dunal habitats and species (GoalAM4), and in general, on habitats and species (GoalAM1).

Two issues characterize the case of Carloforte (Tab. 3). On the one hand, preservation of coastal waters (Goal BM1) and of *Caretta caretta* (Goal BM9), identified as a protected species under the provisions of the Habitats Directive, conflict with the authorized traffic of small boat charters (Operation BO1). Indeed, these boats are allowed to sail with no license or certification concerning the technical knowledge of the boaters as regards coastal ecosystems, habitats and plants, such as Posidonia oceanica seabed and other peculiar habitats, or protected species, such as *Caretta caretta*. On the other hand, the boardwalks installation which make it easier to access the beaches (Operation BO3), and the development of parking sites close to habitats and species protected under the Habitats Directive (Operation BO4), are likely to determine negative impacts with reference to preservation of dunes and of their habitats (Goal BM3) and to protection of habitats such as thickets, phrygana and arborescent matorral (Goal BM5).

SUSTAINABILITY GOALS	THEMATIC ISSUES	PLUC'sGOALS	PMN2'sGOALS	NEGATIVE PLUC'S OPERATIONS
Preservation and enhancement of coastal ecosystems and biodiversity	Relations between coastal and marine ecosystems and services provided on the beaches	C1. Planning beach services in relation to the rural, natural or urban features	AM1. Prevention or mitigation of the negative effects generated by human activities, animals and infrastructure on habitats and species protected under the Habitats Directive	AO1. Authorization for pet-care services
				AO2. Installation of pedestrian boardwalks
			AM2. Restoration of natural coastal morphology	
		C2. Definition of a set of planning policies to exploit tourist attractiveness related to the reefs, in order to identify alternative optionsrelatedto marine and coastal tourism	AM3. Mitigation of overuse of beaches by tourists, in particular during Summer	AO3. Installation of dressing rooms and small cabanas
				AO4. Placement of beach chairs and sun loungers
				AO5. Installation of cabanas for the watchpersons
				AO6. Installation of toilets and showers
				AO7 Installation of kiosks selling beverages and snacks
				AO8. Installation of small stands in support of beach services and activities such as small boat charters, diving and sailing schools
		C3. Prevention or mitigation of erosional processes concerning beaches	AM3. Mitigation of overuse of beaches by tourists, in particular during Summer	AO3. Installation of dressing rooms and small cabanas
				AO4. Placement of beach chairs and sun loungers
				AO5. Installation of cabanas for the watchpersons
				AO6. Installation of toilet and shower facilities
				AO7. Installation of kiosks selling beverages and snacks
				AO8. Installation of small stands in support of beach services and activities such as small boat charters, diving and sailing schools

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SUSTAINABILITY GOALS	THEMATIC ISSUES	PLUC's GOALS	PMN2's GOALS	NEGATIVE PLUC'S OPERATIONS
	Conservation and enhancement of coastal and marine ecosystems		AM4. Prevention or mitigation of the negative effects generated by human activities, animals and infrastructure on dual habitats and species	AO2. Installation of pedestrian boardwalks
			AM5. Mitigation of coastal and erosional processes concerning beaches and restoration of dual systems	
			AM6. Integration of measures aiming at removing *Posidonia oceanica* deposits from the beaches and at protecting coastal and marine habitats	
		C4. Promotion of environmental rehabilitation	AM4. Prevention or mitigation of the negative effects generated by human activities, animals and infrastructure on dual habitats and species	AO2. Installation of pedestrian boardwalks
			AM1. Prevention or mitigation of the negative effects generated by human activities, animals and infrastructure on habitats and species protected under the Habitats Directive	AO1. Authorization for pet services
			AM2. Restoration of natural coastal morphology	
			AM7. Protection and restoration of *Posidonia oceanica* meadows in the mooring areas	
		C5. Conservation of the salt pan	AM6. Integration of measures aiming at removal of *Posidonia oceanica* deposits from the beaches and at protecting coastal and marine habitats	

Tab. 2 Logical structure of the integration of the PLUC and of the PMN2 concerning the town of Calasetta

SUSTAINABILITY GOALS	THEMATIC ISSUES	PLUC's GOALS	PMN2's GOALS	NEGATIVE PLUC'S OPERATIONS
Preservation and restoration of marine and coastal ecosystems, with a particular focus onspecies and habitats protected under the Habitats Directive	Relations between coastal and marine ecosystems and services provided on the beaches	R1. Planning beach-related services and activities consistently with landscape and environmental protection goals	BM1. Preservation of coastal waters	BO1. Authorizations released toboaters of small boat charters
			BM2. Conservation of reef habitats	
			BM3. Preservation of dunes and of their habitats	BO2. Provision of the minimum service level in support of tourism in the most popular sandy and rocky beaches
			BM4. Promotion of sustainable uses of sites and related environmental resources	
			BM5. Conservation of arborescent matorral, thickets and phrygana habitats	
			BM6. Conservation of important botanical species (*Astragalus maritimus, Rouyapolygama*)	
			BM7. Protection of the most significant bird species for Natura 2000 Sites in Carloforte	
			BM8. Protection of the local fauna	
			BM9. Protection of *Caretta caretta*, a species of Community interest	BO1. Authorizations released toboaters of small boat charters
	Accessibility to beaches and coastal areas	R2. Organization of the access point system and of the parking sites in order to regulate public access to beaches and coastal areas, minimizing environmental impacts	BM2. Conservation of cliff habitats	
			BM3. Conservation of dunal habitats	BO3. Boardwalks installation which make it easier to access the beaches
			BM4. Promotion of sustainable uses of sites and related environmental resources	
			BM5. Protection of habitats such as thickets, phrygana and arborescent matorral	BO4. Development of parking sites close to habitats and species protected under the Habitats Directive

Tab. 3 Logical structure of the integration of the PLUC and of the PMN2concerning the town of Carloforte

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4 DISCUSSION AND CONCLUSIONS[4]

The outcomes of the proposed methodology based on the LS show that negative effects may occur on the achievement of the goals of the PMN2s as a consequence of operations planned by the PLUCs. The LSs defined to assess the coherence of the PLUCs and PMN2s concerning the towns of Calasetta and Carloforte put in evidence that the operations planned in the PLUCs may put at risk the effectiveness of the conservation measures identified in the PMN2s, related to habitats and species, since PLUCs and PMN2s were studied and approved following independent procedures, implemented by different public administrations, that is, the municipal administrations in the case of the PLUCs, and the regional administration in the case of the PMN2s. Furthermore, the two types of plan focus on different core issues, since PMN2s deal with conservation measures regarding habitats and species of the Natura 2000 Sites, whereas PLUCs are related to sustainable coastal zone management aimed at catalyzing social and economic local development based on tourist attractiveness.

From this standpoint, this study defines, and applies to the urban contexts of Calasetta & Carloforte, a methodological approach whose scope is to integrate different plans, which take place in the local public domain, that is the Sulcis region, into a unique planning instrument which makes consistent nature protection-related and development-related objectives.

The study shows, by detailed comparative appraisals of two PLUCs and related PMN2s, that the LS-based procedure entails an enormous potential in order to build consistency and, much more important, to drive the issue of conservation and enhancement of habitats and species outside the narrow boundaries of sectoral policies concerning the Sites of the Natura 2000 Network. The application of the LS makes the issue a comprehensive and fundamental question related to the PLUCs. The implementation of the PMN2-related sustainability objectives into the PLUCs through the LS approach is based on the environmental characterization of the supporting ecosystem services (ESs) supplied by habitats and species(Millennium Ecosystem Assessment, 2003). In the first place, ESs are identified in the spatial context of the Sites of the Natura 2000 Network, and afterwards, during the application of the LS approach, they become spatial and environmental characteristics of the whole coastal and marine areas (Leone & Zoppi, 2016).

The proposed LS-based approach implements PMN2s into PLUCs and, that being so, not only is suitable to assess and drive the definition and establishment of planning decisions (ex ante phases of PMN2s/PLUCs), but also to support the planning policies to be carried out, since

[4] This Section partially reproduces a discussion proposed in a previous study of the authors (Leone, Zoppi, 2016, Section "5. Discussion and Conclusions").

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the ES-related sustainability objectives entail a monitoring system based on benchmarks concerning the environmental indicators related to the ESs.

Furthermore, it has to be stressed that the planning policies concerning supporting ESs may generate conflicts related to tourism-related ESs, whose land uses may be prevented by conservative measures entailed by the PMN2s. Therefore, LS-based procedures that imply ES-based sustainability objectives should take account of supporting ESs not only in terms of conservation and enhancement of habitats and species, but also as sources of conflict between alternative land uses related to alternative types of ESs, that is supporting and tourism-related. The conflicts are expressed by the trade-offs between protection and preservation of coastal and marine species and habitats, that is, supporting ecological systems, and the pressure for increasing the provision of services for tourists and local visitors in the coastal areas, that is tourism-related ESs, which is the main focus of PLUCs (Lai & Zoppi, 2017).

The results proposed in this essay are very robust in terms of exportability to other EU contexts, since the LS-based procedure implemented into spatial plans (PLUCs) at the municipal level is always based on the same normative framework, established by the SEA Directive. Moreover, the reference of the PMN2s is always the Natura 2000 Standard Data Form, approved by the European Commission with the Decision of 11 July 2011[5]. As a consequence, it can be applied as such in other EU countries, even though different institutional frameworks and planning practices at the national and regional levels may possibly imply more-or-less huge differences in terms of timing and duration and public authorities responsible for the PLUCs and the PMN2s' planning procedures, the quality of the participatory processes and the qualitative and quantitative size of the participating public and stakeholders.

NOTES

Federica Leone and Corrado Zoppi have made substantial contributions to the study's conception, background and design remarks of section 1, and to discussion and concluding remarks of section 4. The methodological discussion proposed in section 2 is by Federica Leone. The results presented in section 3 are by Corrado Zoppi.

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[5] Available from the European Environment Agency's at http://natura2000.eea.europa.eu/.

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fundamental or basic research for the implementation of interventions in relation to the research context of the Sulcis Plan" of the year 2015, implemented at the Department of Civil and Environmental Engineering and Architecture (DICAAR) of the University of Cagliari, Italy. This study is also presented at the AESOP Annual Congress 2019 (Venice, 9-13 July 2019), with the title "Management plans of Natura 2000 Sites and coastal land use plans: A study concerning an integrated approach to management of coastal zones in the Sulcis Area (Sardinia, Italy)," and will be published in the Congress Proceedings

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AUTHOR'S PROFILE

Federica Leone, Building engineer, is Research Doctor in Land Engineering (Italy, 2013), and MSc in International Planning and Development (UK, 2012). She is currently a research fellow at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari.

Corrado Zoppi, Civil engineer, is Doctor of Philosophy in Economics (USA, 1997), Doctor of Research in Territorial Planning (Italy, 1992), and MSc in Economic Policy and Planning (USA, 1990). He is a Professor at the University of Cagliari (Sector IAAR/20 – Spatial planning). He is presently teaching at the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari in the Undergraduate and Graduate Programs in Environmental and Territorial Engineering and in Sustainable Tourism Management and Monitoring (Regional and Urban Planning, Strategic Planning and Environmental planning).

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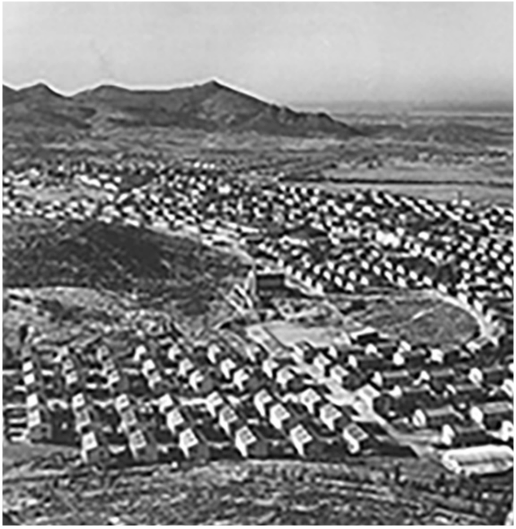

A SMART PLANNING TOOL FOR THE VALORISATION OF THE CARBONIA'S BUILDING HERITAGE VIA AN ENERGY RETROFITTING BASED APPROACH

***STEFANO PILI, FRANCESCA POGGI**
EUSEBIO LORIA

Sotacarbo SPA
e-mail: Stefano.pili@sotacarbo.it
URL: http://www.sotacarbo.it

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ABSTRACT

This paper is part of an ongoing research promoted by the company Sotacarbo spa addressed to the Carbonia'sland context. The research aims to develop a smart planning tool for supporting the definition of strategies for renovation and valorisation of the Carbonia's building stock, based on energy retrofitting approaches. Energy efficiency can be the economic driving force to promote technological improvements and renovations of the historical and modern buildings. However, improve the existing heritage, especially in a context with high historical and landscape value, is a complex multidisciplinary activity that could involve many different stakeholders (decision makers of the PA, operators of the building sector, citizens, ...). Literature reports a lot of methodological approaches that differs in objectives and purposes, tools used, the degree of complexity and the amount of required resources. However, most of them emphasize the central role of the knowledge representations and communications and suggest to develop tool based on local characteristics and resources. After a brief methodological part, the Carbonia's context is presented, and a possible methodological approach for the development of the research has been discussed.

KEYWORDS
Energy Efficiency; Urban Built Environment; Building Heritage; Smart planning

* The other authors are: Caterina Frau

1 INTRODUCTION

The protection and the valorisation of the Urban Historic Landscape play a key role in promoting tourism and in the sustainable development. The preservation of the cultural heritage is no longer considered as an independent activity focused on the constraint of the most valuable elements of the context, but it is integrated in urban policies with a holistic view of protection - enhancement, which also has positive impacts on the city economic, social and environmental aspects (Girard, 2013). The construction of a dynamic and shared cognitive process able to identify and communicate the particular aspects of the landscape context is one of the key elements of the protection process. The objective is to enhance the awareness of local communities in order to promote virtuous bottom-up processes and to create the shared knowledge that could be the base for regional marketing.

The enhancement of the quality and the reuse of the local building heritage is one of the key elements of the valorisation strategies: it constitutes the urban scenario for single cultural goods and, as a whole, it is a constitutive part of the historical urban landscape. However, it is often affected by abandonment and gentrification phenomena caused by the age of the buildings that makes them unsuitable for contemporary quality standards and uses. The energy efficiency of the building heritage is one of the driving forces that could facilitate the valorisation through technological - functional adaptation, and is also one of the main issues in the transition towards more sustainable, resilient and inclusive settlement models. However, despite the availability of very effective technological solutions, there are still strong barriers for the energy retrofit within a city context, because the problem becomes more complex and is burdened with a strong participatory dimension. The lack of knowledge is identified as a key factor because it impacts on all the stakeholders of the valorisation process: the building sector operators, the final users of the buildings, the investors and the Public Administration (PA), Decision Makers (DM). The main aspect is that a building energy retrofitting potential unlikely could be defined a priori because it is strictly dependent on the availability of economic resources, but it is also affected by barriers related to the specific characteristics of the property and its context and by technologies availability on the local market.

The research aims, therefore, the development and experimentation of a SMART planning approach for supporting a process of protection and enhancement of the building heritage based on energy efficiency issues and on the explanation of its cultural and historical significance. This kind of tools is generally based on open data, that are everyday more abundant, and through the use of appropriate representation tools and methods (maps,

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graphs, synthetic indicators, ...) could help to create the shared knowledge useful for designing scenarios and strategies and makes more effective their implementation.
Tools and methodologies for energy efficiency enhancement in urban areas generally adopt an Urban Energy Model (more or less complex) for the estimation of the building stock energy need, and procedures for estimating the potential (theoretical, technical, exploitable,) of various technologies improvement. The models and the tools differ greatly from each other about: amount of baseline data required, results reliability and detail (temporal, spatial), complexity and modelling approaches (top down, bottom up, hybrid) (Swan, 2009).
In general, complex methodologies scan assure better reliability of results, but could require a lot of baseline data and costly interpretation activities of results. Less complex models adopt several simplifying hypotheses, therefore they require less resources and usually have more repeatable procedures, but the results are burdened by the uncertainty of initial assumptions (Keirstead, 2012). One of the most used simplification is the "typological" approach, which concern the study of a representative sample of the building heritage and the use of an appropriate methods (analytical, statistical) to apply the results to all similar elements present in the urban context.

2 METHODOLOGY APPROACH

The methodology is developed for the Municipality of Carbonia, ie taking into account the local availability of resources and baseline data, but the outlined general framework can also be exported to other contexts. The methodological approach can be subdivided into three main activities strongly related to each other, but that follow a logical sequential articulation (Fig. 1): analysis of the context, knowledge representation; communication methodology and tool. The research is actually performing the first phase of context analysis and is studying the building heritage through a typological approach.
The first phase is the preliminary activity that underlies the structure of the whole methodology. It focuses to the clarification of the values of heritage and its relationship with the context (landscape, environment, socio-economic context). In particular, the collection and study of regulatory constraints related to construction activities is a key element in order to define the degree of transformability of the building heritage and therefore the energy retrofitting potential. After a context preliminary analysis, some energy audit of a sample of buildings defined according to the local typologies, have to be implemented. In our case it is necessary to develop specific procedures for the public heritage for services (schools, offices, exhibition buildings, ...) and for residential building stock (public and private). The purpose is to develop some survey activities in order to complete the available geographic data that are consistent with local resources and with the objectives of the study.

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The typological characterization of the heritage allows the development of an abacus of the building structures and of the most widespread plant technologies in the local context. The abacus could embrace the physical-thermal specifications, but also documentations of the most common degradation phenomena and of the available recovery and renovations solutions. At the same time, the analysis activity focuses to define a summary sheet for each building that collects the main information available and the results of the analysis (building type, degree of transformability, degradation, energy retrofitting potential). This form will be more detailed for public buildings, where the consumption data and documentations of building characteristics are often available, while for the residential heritage, it will contain more typological information.

The representation methodology is strongly linked to the capability of the tool to involve the stakeholders in the process of heritage valorisation and renovation. The methodology will adopt a geo-visualization approaches (Goodchild, 2010) based on a geographical knowledge architecture and GIS infrastructure. Leaving the details of the representation at the research further steps, four types of geographical contents can be preliminary identified: the local context, the thematic layers of public and private buildings, the summary indicators.

The local context, collects the spatial layers (regulatory constraints, environmental asset, socio-economic context, settlement asset) that could be relevant to outline strategies or to calculate some summary indicators. It is an open set of information, that can be improved according to new representation needs.

The layers of the buildings (both public and private) contain the related information that could be the basis for stakeholders interaction. Are search goal is to define a repeatable procedure that allows the passage from the knowledge "obtained by building type" to all the local buildings stock. It can be a simple assignment of the type to each building, or can be developed a proper Urban Energy Model. Amain topic in the disciplinary debate is the developing a procedure to link the geographic information, typically managed by GIS tools, to the three-dimensional one related to the single building that is proper to the BiM approaches (Deng, 2016). In particular we have to define: the type of integration between the two instruments (complementary, partially integrated, or totally integrated), the building elements level of detail (LoD 1, 2, 3 ...) and, of course, the procedure of our specific study.

The experimentation of an effective set of indicators is a relevant research topic. There are numerous sets of indicators developed for sustainability aspects or to preserve historical and cultural values (Hiremath, 2013), and there is a notable diffusion of methodologies that use multi-disciplinary aggregated indices aimed at favouring the comparison between different contexts for the dissemination of good practices: as could be the environmental certification protocols (GBC LEED, ITACA, CASBEE, BREEAM) or other projects (Kılkıs, 2015). However,

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many of these approaches may require resources that are not compatible with the purposes of the case study, or simply not to be properly focused and meaningful for the local context. Therefore, are search purpose is to choose whether to adopt a consolidated reference protocol (national or international) that has the advantage of bringing the city in a wider scientific debate but which may require significant resources, or develop a set of local indicators that emphases to simplification and specificity (Mascarenhas, 2010).

The third phase focuses on the definition and implementation of a tool to represent and share the knowledge based on a multi-users web infrastructure (WebGIS / GEOBlog portal), capable of involving the different types of stakeholders of the urban valorization on process. It could be configured with the user's interface (GUI) to consult information but also provide feedback and personal contribution. As a preliminary statement, it could have the following contents: documentations and educational materials, case studies and virtuous practices, the abacus of the recurring structures and typological elements, lists of local available technologies for energy retrofitting, statistics and indices on the energy performance of the building stock, statistics and data on the monitored energy consumption and projects implemented on public buildings and local context. The focus of this phase is the classifications of the stakeholders and the setting up of some appropriate GUI. It is also necessary to define a participatory methodology suitable for the tool experimentation.

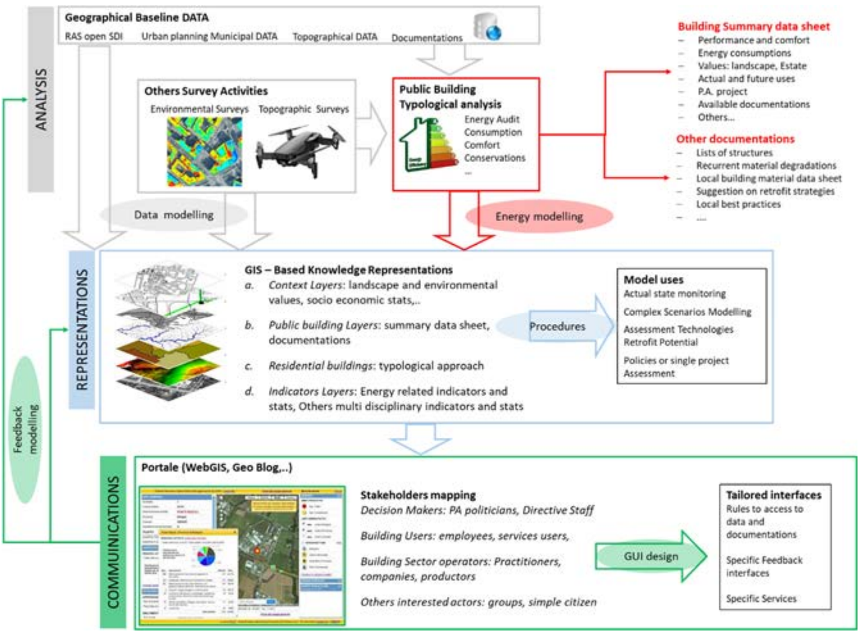

Fig. 1 Methodology Framework

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3 THE CARBONIA'S CONTEXT

A quick overview of the case study is here presented; more detailed results will be subject of further more extensive publications when this research step will be finalised. Carbonia is a fascist's new town (1938) built as a support of the mining activities of the "*Grande Miniera di Serbariu*" (Grand Mine of Serbariu). It is one of the main centres (about 28200 inh. ISTAT 2018) of South - Western Sardinia (Italy), which, after the conclusion of mining activities, is been affected by a heavy economic depression and a constant decrease of the population especially of the young age classes (about 0.5-1.0% yearly decrease) (Fig. 2).

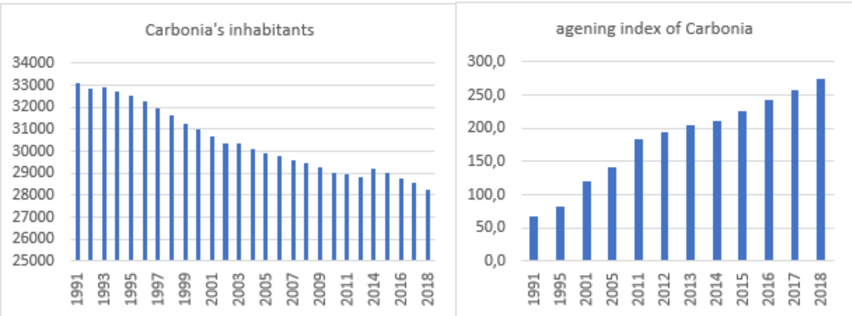
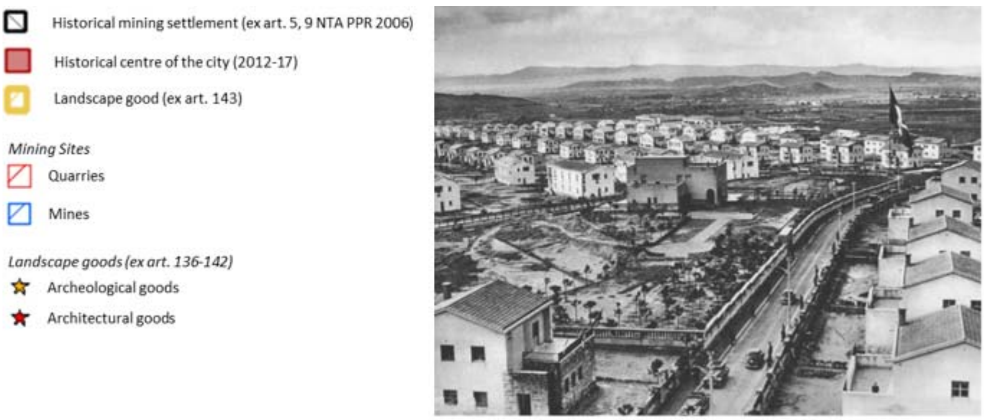


Fig. 2 Some Graphs on population trend (data from http://demo.istat.it/archivio.html)

The context is characterized by high landscape and environmental quality that is combined with the signs of past mining activity (Fig. 3). The whole area is considered as a landscape good (area of the Mining Organization Settlement - Articles 5 and 9 of the NTA of the PPR2006), most of the building stock falls in the Historical Centre and some past mining sites (Quarries e the Grand SerbariuMine) are close the urban settlement.



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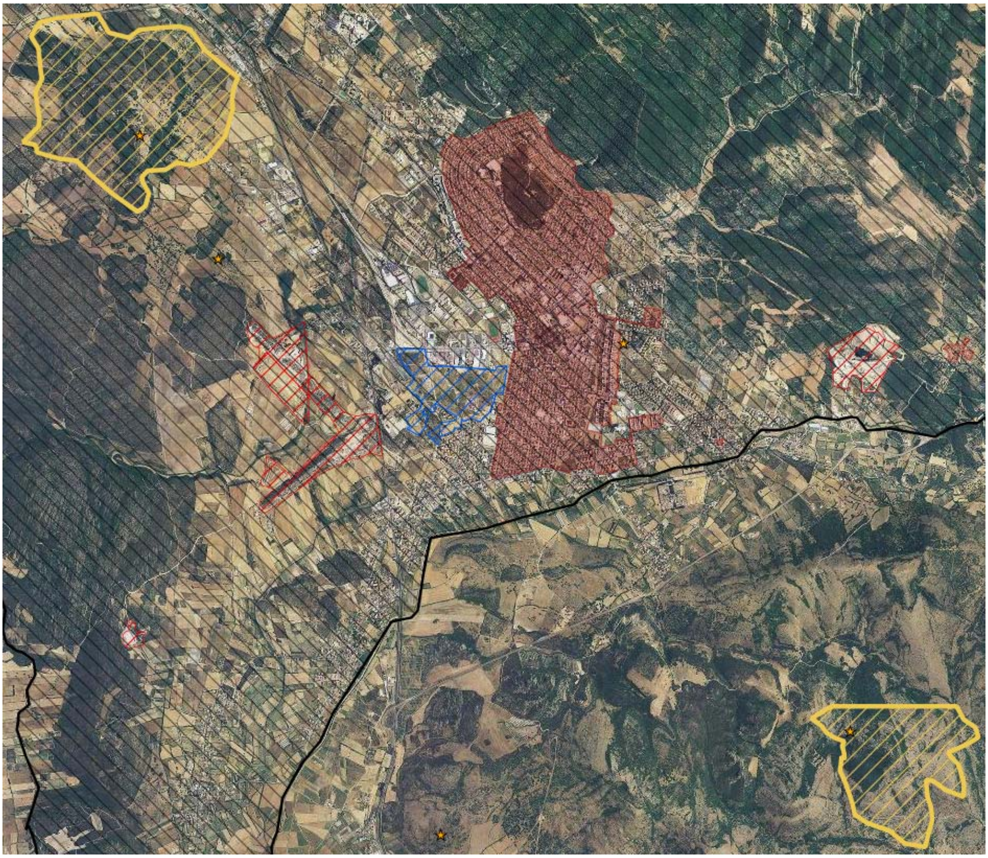

Fig. 3 Landscapecontext and historic picture of Carbonia

Almost all of the building stock is used (96%, ISTAT 2011) and about 86% of it is for residential purposes. About 40% of the heritage can be considered historical because it was built before 1950, or interested by local landscape values. More than 70% of the residential building heritage is made of load-bearing masonry, and 50% of the residential units were built before 1945 (ISTAT 2011) so it can be considered made in historic stone masonry (Fig. 4). The historical structures can be summarized as follows: masonry bearing trachyte and reinforced concrete and hollow tiles floor, mainly wood windows and roofing coppers (Sanna, 2009). There is a low incidence of housing ownership (about 70% in 2011 and 60% in 1991) in comparison to the provincial and regional averages (more than 85%); moreover, about 20% of residential buildings are in poor conservation conditions (Fig. 4).

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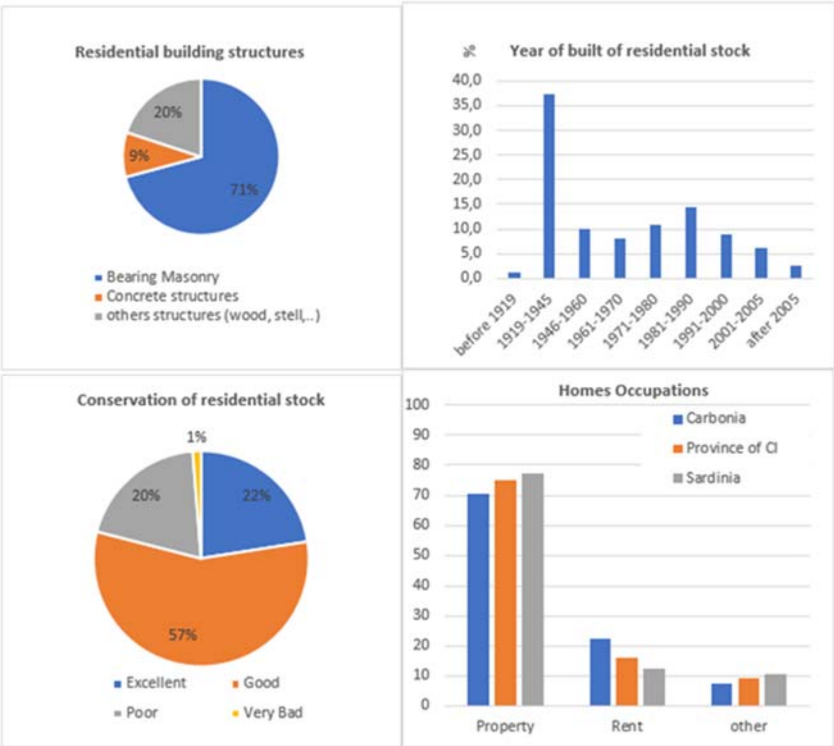

Fig. 4 Some Graphs on Building stock characteristics (data from Census Survey ISTAT 2011)

The local authority has shown interest in the landscape quality with the redevelopment project of the Grande Miniera di Serbariuthat won the European Council Landscape Award (2011). Furthermore, the technical offices have started, since some years,a systematic collection of documentation of the public buildings and are monitoring the electricity consumption (Fig. 5).

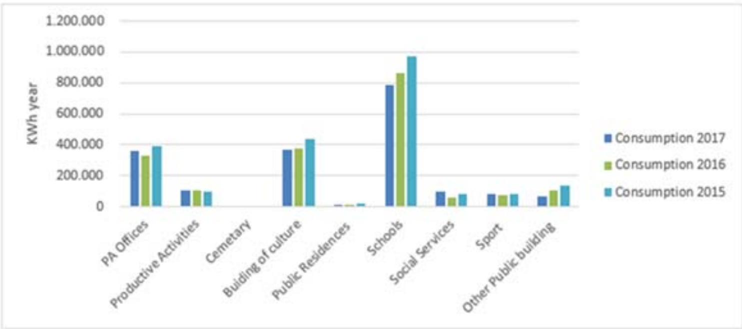

Fig. 5 Electricity consumption of the Carbonia's PA buildings (source Carbonia's DB)

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The school buildings account for about 40% of consumption, 20% respectively for Public offices and culture buildings (museums, libraries, theatres,.), the residue is divided by the other sectors. Combining these data with the building stock construction periods (Fig. 6),

	Years of construction								
Building use	*Before 1919*	*1919 - 1945*	*1946 - 1960*	*1961 - 1970*	*1971 - 1980*	*1981 - 1990*	*1991 – 2000*	*2001 – 2005*	*after 2005*
Schools		T1	T2	T3					
Cultural buildings									
PA offices		T4							
More kind of building									

Fig. 6 Typology definition via combining the Building use and years of construction

the most representative typologies of buildings of the public heritage are being identified. Some energy audit of these building are being carried out in order to study the recurring characteristics of the building - plant system and its profile of use (Fig. 7).

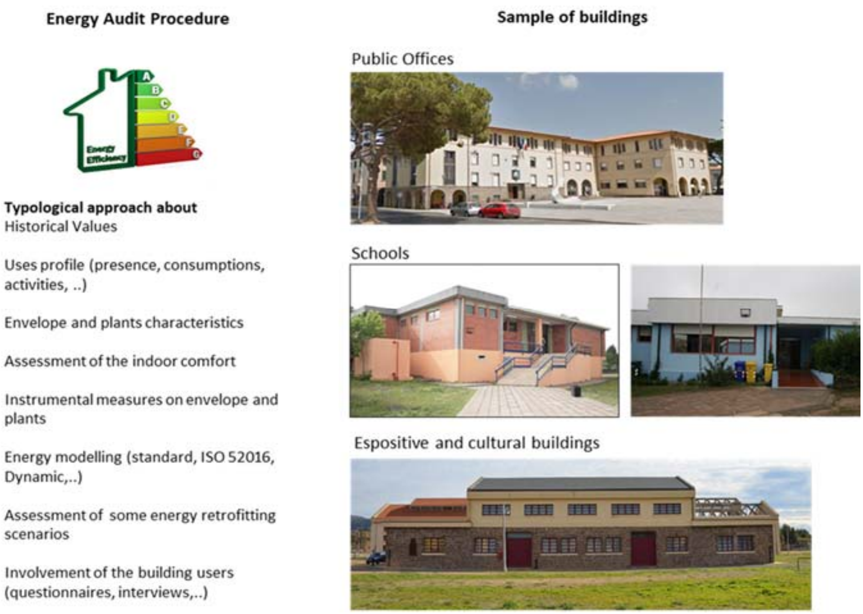

Fig. 7 Some building sample and typological aspects accounted on the Energy Audit process

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The Energy Audit aren't presented here, we briefly recall some general results useful to address the overall methodology. The municipal data base shows some lack and incoherence of data: often the consumption time series are not adequately complete and separate for energy services, and the other energy source are still missing (gpl, oil). This requires the study of an Energy Audit procedure that fills the lack of data without burden too much the survey phase. Some buildings don't reach the indoor comfort conditions, this could produce mistakes on the estimation of retrofit potential, so it is necessary to define a methodology that also considersthe comfort indoor.

4 CONCLUSION AND FURTHER RESEARCH

The general approach and the methodology framework outlined for the development of the research has been presented with a brief theoretical context. Currently the research activity focus on the development and testing of an Energy Audit procedure suitable for the purpose, developing some case studies for each typology of building identified in the urban context. Furthermore, a methodology to synthesize the results of the energy audit on the structures abacus is under development.

The city of Carboniacould be considered a proper context for the methodology experimentation because it is characterized by a rather than homogeneous building heritage about the material - constructive aspect and the local stakeholders seems to have an interest in landscape quality management.

The results of this first phase will produce adjustments and clarifications to the framework here presented. Before the actual implementation of the instrument, the following aspects have to be defined:

- the Building Stock Energy Modellingprocedures, ieitconcerns the integrationbetween typological information and geographic dimension;
- a low-cost, geographical based monitoring system (consumption and comfort) for PA buildings;
- the adoption of a set of indicators and the procedures for their calculation and representation;
- the types of local stakeholders to be involved according to the typology of buildings classified;
- the participatory process to define and test the communication tool contents and the feedback interfaces.

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AUTHOR’S PROFILE

Stefano Pili, graduated in Architectural Engineering and Environmental Engineering at the University of Cagliari. In 2012 reached PhD on Landscape and Urban Planning, with a thesis about Urban planning tools to improve the building heritage energy efficiency. After some post doc grants, now works as a temporary researcher on energy efficiencyat the Sotacarbo SPA.

Francesca Poggi, graduated in Chemical Engineering at the University of Cagliari. Since 2014 she works in Sotacarbo as a researcher aimed at low-carbon energy conversion technologies and carbon dioxide separation technologies. She is involved with the Energy Efficiency team in activities based on energy diagnosis and environmental monitoring process of historic and public buildings.

Eusebio Loria, graduated in Chemical Engineering at the University of Pisa. Since 2004 he works in Sotacarboas a researcheraimedat low-carbon energy conversion technologies and carbon dioxide separation technologies. He is involved with the energy efficiency team in activities based on diagnosis and monitoring process of historic and public buildings.

Caterina Frau, Graduated in Chemical Engineering, joined the Sotacarbo’s team in 2005. She experienced in different fields of cleantechnologies to power, especially in sulphurcaptureprocesses. Since 2014 she is interested in energy efficiency technologies with regards to green policies. At the moment she works as chiefresearcher on energy efficiencyat the Sotacarbo SPA.

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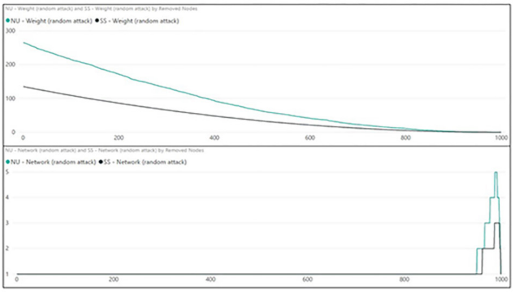
RESILIENT ECOLOGICAL NETWORKS

A COMPARATIVE APPROACH



***ANDREA DE MONTIS[a], AMEDEO GANCIU[b]**
MAURIZIO MULAS[a]

[a] Department of Agricultural Sciences
University of Sassari
e-mail: andreadm@uniss.it
dottamedeoganciu@gmail.com
URL: www.uniss.it

[b] Department of Agricultural Sciences
University of Sassari
e-mail: amedeo.ganciu@iret.cnr.it

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ABSTRACT

The resilience is an overarching concept concerning the capacity of complex system to react to severe crisis by self-organization, innovation and learning and to attain more robust settings than in the original condition. While the theory on resilience has exploded in the last decades, its operationalization is less practiced. A possible way out is the selection of appropriate variables able to measure the behavior of a system, when it is subject to important stresses. Resilience has been applied to the study of socio-ecological system, including ecological networks. Ecological networks can reconnect fragmented landscapes through a web of patches intertwined by environmental corridors. In this paper, we aim at assessing the resilience of two ecological networks designed for the towns of Nuoro and Sassari, Italy. The ecological networks are built on the ecological properties of two vegetal target species (i.e. Quercus Ilex and Olea Europaea) and their seed dispersal through the corresponding frugivorous animal vector species. We have studied the behavior of the ecological network under differenttypes of attacks to the patches: at random or according to a deterministic choice. Our method allows to compare the dynamic pattern of resilience (i.e. along the process of elimination of patches) and to observe typical behaviour reported in other cases but also interesting peculiarities.

KEYWORDS
Ecological networks; resilience; random attack; deterministic attack

* The other authors are: Matteo Cabras, Antonietta Bardi, Valentina Peddio, Simone Caschili, Pierangelo Massa, Chiara Cocco

1 INTRODUCTION

Resilience can be defined as the ability of complex systems to resist to very critical disturbances, keep the original characteristics, self-organize and adapt, and eventually evolve by achieving further and stronger conditions (Balsas, 2014; Christopherson et al., 2010; Handmer & Dovers, 1996; Shaw, 2012). The concept was introduced by Holling (1973), who started from the evidence that living systems have multiple basins of attraction and focused on the capacity of ecological ensembles to resist in the face of severe environmental changes by attaining new and unexpected configurations. Along with the integration between ecology and social science, resilience thinking, i.e. the attitude to embed resilience in political discourse, has been referred not only to pure natural but also to broader intertwined socio-ecological systems (SES) (Folke et al., 2010), where the inexplicable traits of society and ecology are key to the description of identity and potential. SES are not just made by the sum of social and ecological characteristics (Cumming, 2011); they "exhibit a range of unique emergent properties and have their own varieties of complex behavior" (Westley et al., 2002). Resilience represents the last key concept after other items that have attracted the interest of scholars interested in sustainability issues: carrying capacity, i.e. the ability of environmental systems to sustain a given charge produced by human settlements and activities (Cohen, 1995), and, as counterpart, ecological footprint, i.e. the Earth space necessary to produce goods and services capable to sustain human ensembles at a certain rate of development (Rees, 1996). But the concept of resilience even in the initial definitions had more to do with proactivity and road mapping paths towards future possibilities to adapt to critical changes by exploiting the best elements even in front of very severe destabilizations. Thus, resilience thinking has soon become a reference framework for studying complex adaptive systems in inter- and transdisciplinary research (Folke, 2016) encompassing ecology, sociology, psychology, economics, and engineering. The exportability of the approach is one of the main drivers of the success of the concept, which is witnessed in the last two decades by an avalanche of studies. While Folke (2016) reports 250 publications in 2000, the number jumps to nearly 8,000 in February 2019 (Web of Science core collection). Annual citations have transitioned from less than 100 in 1995 (Folke, 2016) to 26,000 circa in 2018. As for the penetration in the grey literature, a recent Google web search with the keys resilience and environment has yielded more than 96 million items. According to Collier et al. (2013), the discourse about resilience attained first rural landscape analysis, planning and management (Naveh, 2000; Palang et al., 2000), while only recently and sparsely it is starting to concern urban domains. Collier et al. (2013) affirm that "urban green space policy is increasingly being used as a tool to enhance urban resilience and sustainability". A paramount example is offered

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by ecological networks (Ings et al., 2009; Opdam et al., 2006, Janssen et al., 2006) and, in broader terms, green infrastructures (Benedict & Mcmahon, 2002; Meerow & Newell, 2017; Matthews et al., 2015), which act as intertwined systems of habitat patches connected with each other by material and immaterial corridors. These systems are employed to give or restore continuity in fragmented landscapes, where large patches have become smaller and more isolated than in the original condition. In addition, they serve the cause of maintaining system identity through the relations among the nodes, thus, ultimately, contribute to increasing the resilience of the overall ensemble (Cumming et al., 2005).
While research on resilience is mature, its operationalization -i.e. the transition from resilience theory to practice- is much less explored. At the same time, few studies deal with the promising issue of assessing the resilience of SESs. Given the complex nature of SESs, it is very difficult to set up methods and tools able to measure directly the resilience. Those complex systems can be just evaluated indirectly through surrogates, a term adopted instead of the more common "indicators" to stress the choice of indirect measurement (Carpenter et al., 2005). In this respect, the analysis and design of ecological networks can be approached by invoking graph theory and the last advances of complex networks analysis (CNA). CNA provides scientists, planners, and managers with an elegant and powerful set of tools able to disentangle several real-life systems by classifying and characterizing their topological and weighted properties, starting from basic variables (number of nodes and edges), centrality measures, assortativity indexes, etc. (Albert & Barabási, 2002; Dorogovtsev et al., 2003). The literature on the application of CNA and graph theory to the assessment of ecological networks is very rich (Fall et al., 2007; Hagen et al., 2012; Urban et al., 2009), while relatively less endowed is the study of the behavior of ecological networks in the face of critical and adverse situations. In general terms, the resilience of a network depends on its topological structure and is assessed by monitoring the behavior of some key variables, when the nodes are subject to random and targeted (centrality based) fatal attacks. Crucitti et al. (2004) have demonstrated that random networks show a similar resilience to both the kinds of attacks, while scale free networks are resilient to random attacks but quite vulnerable to targeted attacks. This confirms (and assesses) an intuition: complex networks need to be developed by protecting their most central nodes. Similarly, Gao et al. (2015) choose "the integral size of the giant component during the whole attacking process" as a measure of resilience. They also stress three methods/policies for increasing the robustness of networks: increase the share of central nodes, design dependency links connecting nodes with similar centrality, and protect the central nodes. Also, Gutfraind (2012) develops on the need to act on the overall connectivityto "prevent the failure of a single node from causing a far-reaching domino effect". According to the same author, connectivity is the property that triggers resilient behaviors by

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"dissipating nascent cascades". Other authors focus on planning and management and propose an adaptive management cycle (AMC) for implementing a resilient ecological network (Isaac et al., 2018). They start from spatial network theory and apply it to multispecies ecological networks. The key component of the AMC is the set of indicators, which are referred to the need to achieve Better, Bigger, More, and joined (BBMJ) habitat patches. These indicators will enter a monitoring system able to report on the status of the ecological network, identify plausible conservation actions, and verify their effectiveness.

The aim of this paper is to assess the resilience of two ecological networks designed for the towns of Nuoro and Sassari, Sardinia, Italy. We extend the comparative approach to the study of centrality proposed by De Montis et al. (2019) with an application of the AMC recalled above for ascertaining which ecological network is more resilient. The remainder of this essay develops as follows. In the next section, the methodology is presented. In section 3, results are reported and commented, while in section 4 concluding remarks and outlook ideas are elaborated.

2 METHODOLOGY

We extend the approach adopted by De Montis et al. (2016), who assessed the resilience of the ecological network (EN) designed for the town of Nuoro, Italy. This EN is built taking into account the properties of the colonization of the two target species Olea Europaea and Quercus Ilex through the dispersal of the seeds realized by the corresponding vector animal species (mostly, birds). They evaluated the ability of that EN to maintain the original properties (i.e. identity) under random and deterministic attacks, which mimic errors and targeted failures. Targeted failures are conceived as deterministic attacks to the patches, which are simulated to disappear according to their betweenness centrality (BC), i.e. the percentage number of shortest paths passing through a node with respect to the total number of shortest paths in the EN, and the planning perturbation index (PPI), which measures the risk that a patch is jeopardized by local land uses. In Table 1, the types of attacks are reported.

TYPE OF ATTACK	DESCRIPTION
Random	Patch are deleted randomly
Deterministic 1	Patch are terminated, according to inverted order of BC
Deterministic 2	Patch are terminated, according to inverted order of PPI

Tab. 1Types of attacks simulated (after De Montis et al., 2016)

We reframe the method proposed by De Montis et al. (2016) along three main issues. The first consists in the larger size of the EN, which in the beginning included 236 and now

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embraces 1,000 patches. The second regards the transition from a single focus to a comparative framework, where in this case two -but prospectively many- ENs are assessed. The third attainsthe inclusion of a larger number of variables (surrogates) for resilience assessment. As for the latter issue, we have studied the resilience of the ENs picking four variables, according to the AMC framework proposed by Isaac et al. (2018), with reference to indicators able to describe (BBLJ) habitat patches. In Tab. 2, we report the variables studied in our investigation. Note that in the last column, we substitute "more" with the reciprocal "less"; thus, we insert the acronym BBLJ, as the identity is maintained, when the corresponding variable is smaller.

VARIABLES	CODE	DESCRIPTION	BBLJ INDICATOR TYPE
Quality	Q	Sum of the patch degree of vegetal development of the target species	Better
Area	A	Sum of the extension of the patch surface area	Bigger
Components	N	Number of disconnected network giant components	Less
Dispersal	F(T)	Sum of the weights (probability of seed dispersal among the patches)	Joined

Tab. 2 Variables adopted to assess the resilience of ENs

The quality indicator refers to the level of affirmation of the target species in each patch: the higher this value, the more resilient becomes the EN. The area indicator mirrors the rationale that more extended ENs are likely more resilient. The indicator N stands for the number of disconnected giant components. Clearly, the smaller this number the more resilient the EN is. The dispersal indicator consists of the sum of the weights, which are calculated according to the probability that vectors disperse the seeds in a certain distance. The higher F(T), the higher the relational capacity (thus, the resilience) of the EN. For easy of comparison, except for N, all indicators have been normalized according to the min/max transformation.

3 RESULTS

In this paper, for space restrictions we assess the resilience of the ENs under study by presenting the behaviour described through the last two indicators reported in Tab. 2: number of disconnected giant components and sum of the weights related to the probability of seed dispersal. In Fig. 1, 2, and 3, we plot these two variables, with respect to the number of patches eliminated in the cases of random and deterministic attacks. As for the random attack described in Fig. 1, the ENs display a very good resilience. They remain organized in one giant component even when more than 90% of the patches is deleted. Nuoro's EN breaks in two

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sub-networks slightly earlier than Sassari's. The residual dispersal capacity decreases gradually and according to an exponential trend and approaches zero, when roughly the 80% of the patches is eliminated. F(T) is always larger for Nuoro's EN: a clear sign of a higher resilience of this EN with respect to the other. With reference to the deterministic attack 1 operated thorough the elimination first of the highest BC patches, Fig. 2 neatly indicates that both the ENs are weaker than under random attack. Both the ENs start the subdivision into many networks, when roughly 30% of the patches is terminated. Sassari's EN breaks slightly earlier that Nuoro's EN. The residual dispersal capacity decreases at relevant and stepwise paces and tends to zero after 35% of the patches is deleted. Nuoro's EN almost always shows a higher resilience with respect to Sassari's EN. As for the deterministic 2 attack directed to the patches first with highest risk of disappearance due to aggressive planned land uses, Fig. 3 demonstrates that both the ENs react exceptionally well. Almost until the total deletion of the patches, the ENs maintain a structure consisting in a unique connected component. The ENs are more resilient in this case than under random attack. For both the ENs, total residual dispersal capacity decreases according to a linear behaviour; thus, the decay is slower than the corresponding trend obtained in the case of random attack. Also in this case, Nuoro's EN maintains a higher total residual dispersal capacity (i.e., is more resilient) that Sassari's EN.

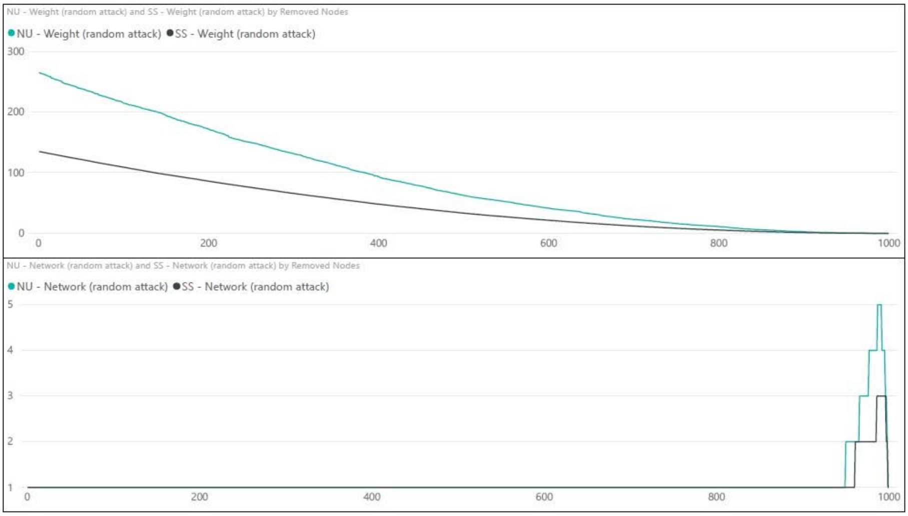

Fig. 1 Comparative resilience analysis of the ENs under random attack: number of giant components (on the bottom) and total residual dispersal capacity (on the top) are plotted vs the number of patches deleted. Green and black lines describe the variation of the variables for the EN of Nuoro and Sassari

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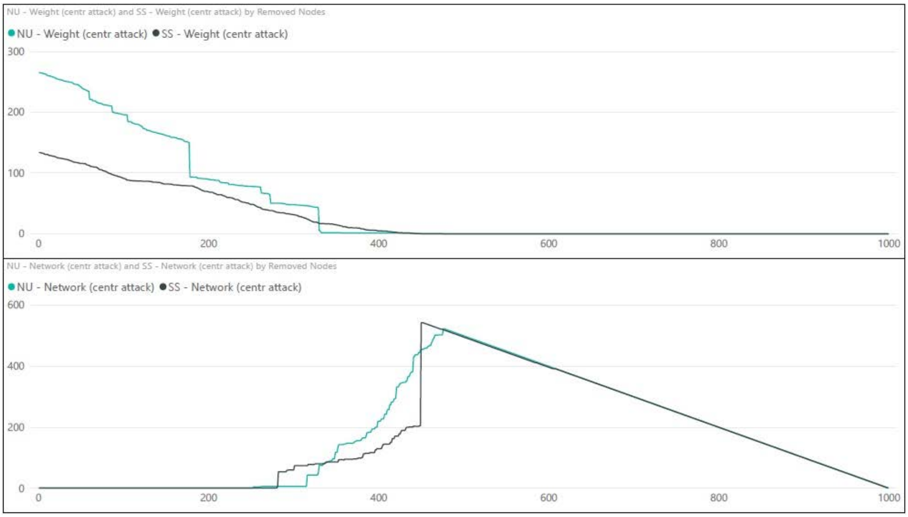

Fig. 2 Comparative resilience analysis of the ENs under deterministic 1 attack: number of giant components (on the bottom) and total residual dispersal capacity (on the top) are plotted vs the number of patches deleted. Green and black lines describe the variation of the variables for the EN of Nuoro and Sassari

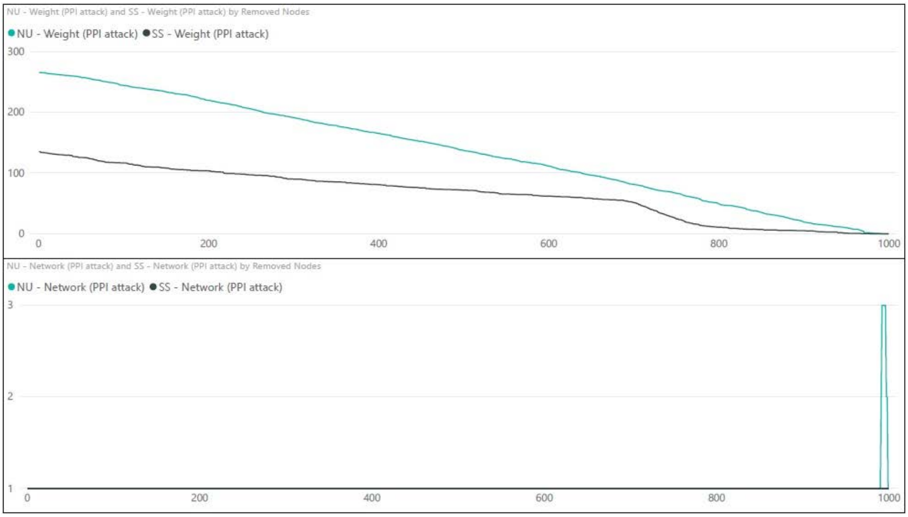

Fig. 3 Comparative resilience analysis of the ENs under deterministic 2 attack: number of giant components (on the bottom) and total residual dispersal capacity (on the top) are plotted vs the number of patches deleted. Green and black lines describe the variation of the variables for the EN of Nuoro and Sassari

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3 DISCUSSION AND CONCLUSION

In this paper, we have demonstrated that resilience can be operationalised, starting from the selection of appropriate variables as surrogates able to measure the capacity to react of ENs under different kind of attacks. In addition, we have developed on the concept of comparative evaluation of resilience, in the perspective to assess the behaviour of two ENs.Some major results emerge. The first regards the confirmation that both the ENs are more resilient in the face of random attacks to the patches than against targeted elimination of most central patches. This corresponds to an intuitive concept: the best way to increase the resilience of an EN is taking care of for emostly the high BC patches, which act as central hubs providing useful nodes for shortcuts (easy ways to the dispersal of seeds). The second issue attains the evidence that Nuoro's EN is more resilient than Sassari's EN. This is due to the better condition of colonization and development of the vegetal species in Nuoro than in Sassari. A third important result regards the very good reaction of the ENs to the deterministic 2 attack, simulated according to the inverted level of interference between planned land uses and patches. This clearly means that spatial planners of the towns of Nuoro and Sassari have protected the landscape -even unconsciously- so that the designed ENs are more resilient than in the case of random attack (mimicking the absence of planning). Two more issues emerge, when we compare these results to those obtained by De Montis et al. (2016) for a smaller (i.e. with 236 patches) EN in Nuoro. As the size increases from 236 to 1,000 patches, the EN confirms its higher resilience, in front of random attacks, with respect to attacks directed to high BC patches. By contrast, the larger EN displays a much greater resilience, in the face of deterministic 2 attacks. This is a clear sign that size matters, when it comes to the selection of landscape defragmentation and protection policies, in the perspective of healthier ENs.

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AUTHOR'S PROFILE

Andrea De Montis is a civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural development at the Department of Agriculture, University of Sassari. He is principle investigator of a research project on Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Amedeo Ganciu, research doctor in Landscape and Environment at Sapienza, University of Rome, currently works at the Research Institute on Terrestrial Ecosystems (Rome), National Research Council. He focuses his research on the application of GIS science to environmental and landscape analysis.

Maurizio Mulas is Associate Professor of Arboriculture at the University of Sassari (Italy), and selection, ecophysiology and use in the urban environment of woody plants of the Mediterranean climate are among his main research fields.

Matteo Cabras holds a PhD in Sciences of Agricultural and Forestry Eco-systems and Food Production at the University of Sassari. A part of his research interest focuses on ecological networks, as he held a scholarship in the research project Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Antonietta Bardigot a master's degree in Forestry and Environmental Systems at the University of Sassari. Shehas held a scholarship for developing activities in the research project Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Valentina Peddio earned a master's degree in Forestry and Environmental Systems at the University of Sassari. She has held a research scholarship for the analysis and design of the ecological network of Nuoro funded by the Consorzio per glistudiuniversitari, Nuoro.

Simone Caschili is a Data Strategist at LaSalle Investment Management in Chicago (USA) where he develops data driven solutions to inform LaSalle's real estate investment decisions. Simone holds a PhD in Land Engineering. His academic research interest has focused on a variety of spatial networks spanning from commuting to international trade networks.

Pierangelo Massa is graduated in Construction Engineering (University of Cagliari, 2012) and holds a PhD in Land Engineering (University of Cagliari, 2016). His research interests concern the study of innovative spatial analysis methods for the use of Volunteered Geographic Information (VGI), and

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Social Media Geographic Information (SMGI), as support for analysis, design and decision-making in urban and regional planning.

Chiara Cocco is currently a PhD candidate in Civil Engineering and Architecture at the University of Cagliari and temporary visiting scholar at San Diego State University, California, USA. Her research concerns the application of geospatial techniques in urban-regional planning and the development of geodesign methods and process analytics.

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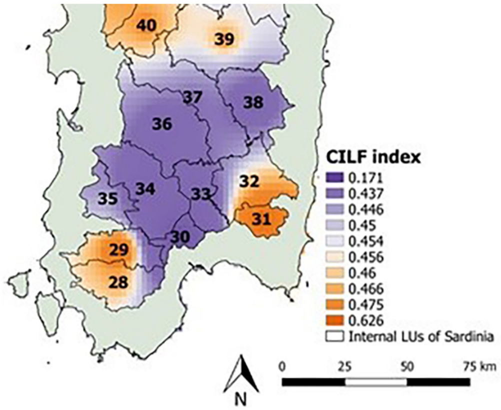

A COMPLEX INDEX OF LANDSCAPE FRAGMENTATION:

AN APPLICATION TO ITALIAN REGIONAL PLANNING

ANDREA DE MONTIS[a], AMEDEO GANCIU[b]
VITTORIO SERRA[a]

[a] Department of Agricultural Sciences
University of Sassari, Sassari, Italy
e-mail: andreadm@uniss.it
vittorio.serra1986@gmail.com

[b] Research Institute on Terrestrial Ecosystems
National Research Council, Rome
e-mail: amedeo.ganciu@iret.cnr.it

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ABSTRACT

Indicators of landscape fragmentation are various. They are designed to capture the effects brought by a single specific determinant of the pulverization of the landscape in smaller and more isolated habitat patches. So, the infrastructural fragmentation index considers the effect of transport and mobility infrastructures, the urban fragmentation index the outcomes of human settlements and the effective mesh size the number and extension of the patches. In this paper, we investigate on the design of a unique index, namely the composite index of landscape fragmentation (CILF), which can reflect simultaneously the effect of those three determinants. CILF is obtained as a linear combination of the three indices and applied to the assessment of landscape fragmentation of the so-called internal landscape units prepared (and not approved yet), in the frameworkof the Regional Landscape Plan of Sardinia, Italy. The indication of the CILF are powerful, as they allow politicians and decision-makers to understand to which landscape units de-fragmentation policies should be addressed first.

KEYWORDS
Landscape fragmentation; Regional Landscape Plan; composite indicator; de-fragmentation policy

1 INTRODUCTION

Landscape fragmentation (LF) is the process, according to which originally large patches (i.e. fragments) of landscape become smaller and more isolated than in the initial condition (EEA, 2011). LF has a negative impact on landscape connectivity (LC), because it hinders animal movement between a higher number of disconnected patches (Bissonette & Adair, 2008; Červinka et al., 2015), increases the risk of diminution of biodiversity (Henle et al., 2004), triggers the decline of populations of animal and vegetal species due to the loss of ecological functionality (Harrison et al., 2012) and causes a smaller resilience of habitats due to a reduced variety of ecosystems (Kettunen et al., 2007).

The literature on LF is rich and includes contributions focusing on theoretical and empirical issues. As for the last aspects, a prominent stream of studies attains the design and application of indicators able to measure LF (Battisti & Romano, 2007; Biondi et al., 2003; Bruschi et al., 2015; De Montis et al., 2017 and 2018; Romano, 2002). These works are important, since they represent a major step toward the operationalization of LF counteractions, i.e. defragmentation interventions, which should be directed to reconnect landscape fragments back into larger habitat pieces. In this respect, ecological networks and broader green infrastructures are major actions (Lafortezza et al., 2013). In this paper, we aim at constructing and applying a composite index of landscape fragmentation (CILF) to the assessment of LF change of the twenty-four internal landscape units of the Regional Landscape Plan of Sardinia from 2003 to 2008.

CILF is based on a combination of three major indicators of LF: thus, it considers the effects of transport and mobility infrastructures, human settlements, and the geometry of the patches. The argument is exposed as follows. In the next section, the methodology is presented with a focus on the structure of CILF and its components. In section 3,CILF is applied for a case study and results are reported and commented. In section 4, concluding remarks and outlook ideas are elaborated.

2 METHODOLOGY

The assessment of LF is based on the use of a variety of indicators, which are often designed with a focus on typical characteristics of the phenomena at hand. Our aim is to construct a composite index that allows scientists to approach LF simultaneously under three aspects. To do so, we consider three well-known indices of LF, namely the Infrastructural Fragmentation Index (*IFI*), the Urban Fragmentation Index (*UFI*) and the effective mesh size index (m_{eff}). IFI considers the process of division of the patches due to the development of transport and

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mobility infrastructures, which impede the movement of animal species usually hindering their crossing roads and railway traits (Battisti & Romano, 2007; Biondi et al., 2003; Bruschi et al., 2015; De Montis et al., 2017 and 2018; Romano, 2002). IFIobeys to the following equation

$$IFI^{*}=\frac{\left(\sum_{i=1}^{i=n}L_i\cdot O_i\right)\cdot N\cdot P}{A} \qquad (1)$$

where (*) stands for the reference year, L_i for the length in meters of the road or railway trait with the exclusion of discontinuities (viaducts, bridges, tunnels), O_i for a (dimensionless) occlusion coefficient, A for the extension in squared meters of the landscape unit (LU) area; P for the perimeter in meters of the LU, and N for the number of patches. We consider patches larger than 0.20 hectares to eliminate the distortion due to fictitious parts (Bruschi et al., 2015; Lega, 2004). O_i varies, according to the difficulty that the fauna has in crossing the transportation infrastructure (Bruschi et al., 2015): it is equal to 0.30 for municipal and local roads, to 0.50 for national and provincial roads, and to 1.00 for national four (or more) lane roads and railway. According to Romano and Zullo (2013); Battisti and Romano (2007), the UFI obeys to the following equation

$$UFI^{*}=\frac{\sum_{i=1}^{i=n}S_i}{A}\cdot\frac{\sum_{i=1}^{i=n}p_i}{2\sqrt{\pi\sum_{i=1}^{i=n}S_i}} \qquad (2)$$

where S_i stands for the extension in squared meters of the i-th urban area, p_i for the perimeter in meters of the i-th urban area. The first term of equation 2 quantifies the incidence of urbanized areas on the LU surface; the second term is the ratio between the perimeter of the urban area and the circumference of the equivalent circle (Romano & Zullo, 2013). UFI* is again calculated at the scale of LU and ranges between zero (for absence of urban areas) and the value of the second term of equation 2 (Battisti et al., 2013). According to Jaeger (2000),meff obeys to the following equation

$$m_{\text{eff}}(j)=\frac{1}{A_{tj}}\sum_{i=1}^{n}A_{ij}^{2} \qquad (3)$$

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Where *n* stands for the number of patches, A_{tj} for the total surface area of the LU, and A_{ij} the surface area of the patches.
We have designed the *CILF* as an unweighted average of the three LF indices, according to the following simple formula

$$CILF = (IFI + UFI + m_{eff})/3 \quad (4)$$

In this preliminary definition, we consider that the three indices offer an equal contribution, i.e. we hypothesise that LF is equally triggered by transport and mobility infrastructures, urban settlements and pattern of the patches. Since we are interested in the description of LF dynamics, we will focus on the percentage change of the variables considered in a certain time period. Also, we will use the necessary transformations (i.e. normalizations) to smooth the different size and unit of measure of each variable.

3 APPLICATION TO A CASE STUDY AND RESULTS

We have applied the LF assessment framework proposed above to the study of LF dynamics in the twenty-four so called internal LUs prepared by the Autonomous Region of Sardinia. These LUs are not officially in force, since so far no approval has been undertaken. This approval is encouraged by professionals and academics, as in this way the overall framework of the Regional Landscape Plan -including at the moment only twenty-seven coastal LUs- would be completed. We have applied the CILF to the assessment of the variation of LF from 2003 to 2008. We use data freely available online (RAS, 2003, 2008). In order to apply the IFI, we implemented a GIS and use data in shapefile format. Tunnels and bridges were excluded from roads and railways traits. Then, we obtained and counted the number of landscape fragments.As for the UFI, we use data in shapefile format relating to urbanized areas, including urban and suburban industrial areas, rural buildings, and so on.Microsoft Excel 2013 has supported the GIS analysis.
In Tab. 1, we report the results of our calculations.
The analysis of the absolute values reveals a variety of sizes and measure adopted to assess LF according to the three indices. Further elaboration is needed to construct the CILF that is elaborated as unweighted mean of the normalized variation of the three indices in the time period from 2003 to 2008. In Tab. 2, we report these results.
CILF is obtained through a linear combination of the three simple indices consisting in the growth rate of IFI, UFI and m_{eff}. This can be accepted, as the correlation analysis (with values smaller than 0.30) confirms that the three variables are not correlated each other. Variation values have been normalized, according to the usual min-max algorithm, since the normal

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test (verified if: the asymmetry's absolute value is smaller than 2 and the median corresponds to the mean) suggests that only one (UFI's growth rate) out of three variables is distributed according to the Gaussian probability function. For easy of understanding the geographical distribution of the results, in Fig. 1 CILF is plotted for the internal LUs.

N	Name of the LU	IFI2003	IFI2008	UFI2003	UFI2008	m_{eff} 2003	m_{eff} 2008
28	Sulcis	2679.59	6432.79	0.19	0.32	463.31	452.89
29	Valle del Cixerri	6071.53	10229.96	0.23	0.46	390.88	384.89
30	Basso Campidano	8867.67	28327.83	1.33	1.66	68.36	37.04
31	Serpeddi' - Monte Genis	13.20	85.83	0.01	0.02	190.73	190.31
32	Gerrei	4405.99	5293.74	0.05	0.07	595.53	594.13
33	ParteollaTrexenta	7198.76	13585.12	0.47	0.71	324.35	315.21
34	Campidano	94095.88	93966.55	0.54	1.02	516.48	460.15
35	Monte Linas	12588.74	12588.74	0.18	0.27	175.45	174.93
36	Regionedellegiarebasaltiche	234267.94	234264.79	0.39	0.49	176.48	175.62
37	Flumendosa - Sarcidano - Araxisi	30532.98	30532.98	0.23	0.29	661.68	660.59
38	Regionedeitacchicalcarei	4569.10	5193.44	0.06	0.06	517.75	517.39
39	Gennargentu e Mandrolisai	12213.46	14836.63	0.10	0.11	977.16	975.71
40	Media valle del Tirso	16512.00	17105.17	0.18	0.33	369.59	365.06
41	Altopiani di Macomer	23428.41	24485.28	0.17	0.27	638.45	635.82
42	Valli del Rio Isalle e Liscoi	48216.14	56231.62	0.39	0.49	826.88	821.92
43	Supramontiinterni	794.90	1145.40	0.05	0.05	340.86	340.42
44	La valle del Rio Mannu	1738.25	1846.10	0.03	0.05	351.79	351.25
45	Altopiani e Alta Valle del Tirso	8708.60	9170.81	0.06	0.10	1117.98	1114.47
46	Marghine - Goceano	9693.29	9693.29	0.15	0.16	379.63	379.31
47	Meilogu	15511.60	15511.65	0.17	0.35	552.63	546.32
48	Logudoro	24911.33	25140.31	0.22	0.47	521.24	510.42
49	Piana del Rio Mannu di Ozieri	22654.14	23217.59	0.38	0.51	820.47	815.95
50	Anglona	5761.68	5824.36	0.24	0.36	367.64	365.73
51	Massiccio del Limbara	11178.48	12211.20	0.42	0.47	875.31	872.30

Tab. 1 LF analysis, according to IFI, UFI and m_{eff} in 2003 and 2008

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N	Name of the LU	IFI (ng)	UFI (ng)	m_{eff} (ng)	CILF
28	Sulcis	0.25	0.60	0.95	0.60
29	Valle del Cixerri	0.12	0.88	0.97	0.66
30	Basso Campidano	0.40	0.22	0.00	0.21
31	Serpeddi' - Monte Genis	1.00	0.88	1.00	0.96
32	Gerrei	0.04	0.35	1.00	0.46
33	ParteollaTrexenta	0.16	0.45	0.94	0.52
34	Campidano	0.00	0.78	0.76	0.52
35	Monte Linas	0.00	0.44	1.00	0.48
36	Regionedellegiarebasaltiche	0.00	0.23	0.99	0.41
37	Flumendosa - Sarcidano - Araxisi	0.00	0.23	1.00	0.41
38	Regionedeitacchicalcarei	0.03	0.00	1.00	0.34
39	Gennargentu e Mandrolisai	0.04	0.09	1.00	0.38
40	Media valle del Tirso	0.01	0.73	0.97	0.57
41	Altopiani di Macomer	0.01	0.52	0.99	0.51
42	Valli del Rio Isalle e Liscoi	0.03	0.23	0.99	0.41
43	Supramontiinterni	0.08	0.00	1.00	0.36
44	La valle del Rio Mannu	0.01	0.59	1.00	0.53
45	Altopiani e Alta Valle del Tirso	0.01	0.59	0.99	0.53
46	Marghine - Goceano	0.00	0.06	1.00	0.35
47	Meilogu	0.00	0.93	0.98	0.64
48	Logudoro	0.00	1.00	0.96	0.65
49	Piana del Rio Mannu di Ozieri	0.00	0.30	0.99	0.43
50	Anglona	0.00	0.44	0.99	0.48
51	Massiccio del Limbara	0.02	0.10	0.99	0.37

Tab. 2 Pattern of CILF and LF indices (normalised growth rate) for the twenty-four internal Lus

3 DISCUSSION AND CONCLUSION

In this paper, we have demonstrated that it is possible to combine some LF indices into a unique composite indicator, namely CILF, able to consider simultaneously LF processes triggered by transport and mobility infrastructures, human settlements, geometrical pattern of the patches. The LU with the higher value of CILF is Serpeddi' - Monte Genis, while Basso Campidano has the lowest CILF value. The first LU has the highest values of IFI and m*eff* normalized growth rate. Spatial pattern of CILF indicates that northern internal LU have experienced clearly a higher increase of LF, while in southern Sardinia many LU with the lowest values of CILF cluster. A major analysis regards the variation of LF measures (typically, the IFI) compared to the variation of the surface area of LUs. In Fig. 2, we plot the trend of the ratio between CILF and LU surface area versus the LU surface area.

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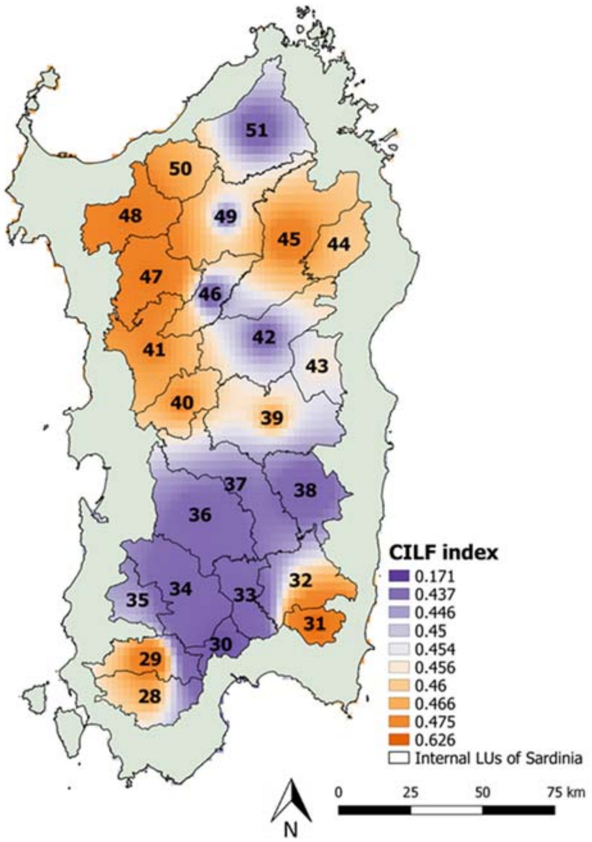

Fig.1 Map representation of the analysis of CILF for the internal LUs of Sardinia

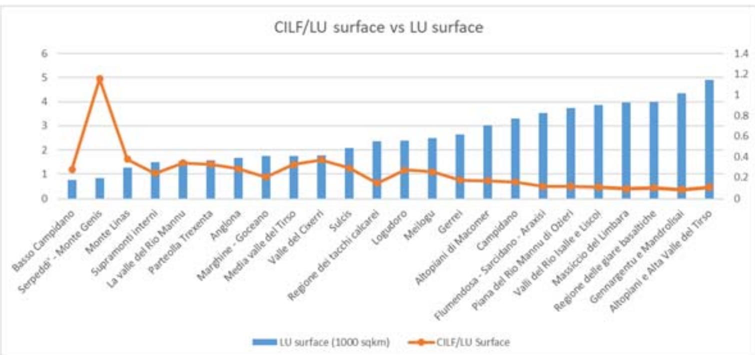

Fig.2 Interplay between CILF per unit of LU surface area and LU surface area

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It is possible to observe that CILF per unit of LU surface area fluctuates around the unit (except for Serpeddì – Monte Genis), even though the LU surface area varies significantly. This is a clear sign that CILF can be considered a stabile indicator of specific (i.e. per unit of surface area) LF.

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AUTHOR’S PROFILE

Andrea De Montis is a civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural development at the Department of Agriculture, University of Sassari. He is principle investigator of a research project on Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Amedeo Ganciu, research doctor in Landscape and Environment at Sapienza, University of Rome, currently works at the Research Institute on Terrestrial Ecosystems (Rome), National Research Council. He focuses his research on the application of GIS science to environmental and landscape analysis.

Vittorio Serra, master’s degree in forestry and environmental system, University of Sassari, Phdstudent in Civil Engineering and Architecture, University of Cagliari. His researchinterests focus on historic rural buildings, rural areas and landscapes, and landscape planning, landscapefragmentation and defragmentationmeasures.

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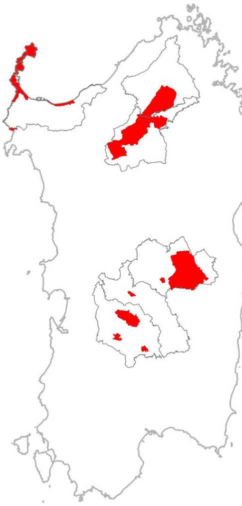

$$RBFI = N * \cdot \frac{\sum_{i=1}^{i=n} S_i *}{A^2} \cdot \frac{\sum_{i=1}^{i=n} p_i *}{2\sqrt{\pi \sum_{i=1}^{i=n} S_i *}}$$

(1) Golfo dell'Asinara	ZSC ITB010002, ITB010003, ITB011155, ITB010043, ITB010082; SPA ITB010001, ITB013012, ITB013011	0.004	0.054
(2) Massiccio del Limbara	SCI ITB011109	0.125	0.176
(3) Piana del Riu Mannu di Ozieri	SCI ITB011113, SPA ITB013048	11.908	36.208
(4) Gennargentu and Mandrolisai	SPA ITB022217, SCI and SPA ITB021103	0.003	0.004
(5) Flumendosa - Sarcidano – Araxisi	SCI ITB032240	-	-
(6) Regione delle Giare Basaltiche	SCI ITB041112, ZSC ITB042237, SPA	-	0.001

$$s_{eff} = \frac{1}{m_{eff}} \cdot 1000$$

$$m_{eff} = A_t * C = \frac{1}{A_t} * \sum_{i=1}^{n} {A_i}^2$$

THE EFFECT OF BUILDINGS ON LANDSCAPE FRAGMENTATION IN NATURA 2000 SITES

A QUANTITATIVE AND COMPARATIVE ASSESSMENT

ANTONIO LEDDA[a], ANDREA DE MONTIS[a,b]
VITTORIO SERRA[b]

a Department of Agricultural Sciences
University of Sassari, Sassari, Italy
e-mail: antonioledda@uniss.it
andreadm@uniss.it

b Department of Civil and Environmental Engineering and Architecture
University of Cagliari, Italy
e-mail: vittorio.serra1986@gmail.com

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ABSTRACT

Landscape fragmentation - i.e. the process where habitat patches tend to become smaller and more isolated over time – is mainly due to human activities. Such a phenomenon has effects on biodiversity, and influences ecosystem balance and ecological networks. Thus, new rules and planning approaches are called todefine proper protection and management measures. Urbanized areas - including suburban and rural sprawl - and transport and mobility infrastructures have effects on landscapes and habitats quality, and biodiversity too. Landscape fragmentation can affect conservation areas defined according to Habitats and Birds Directives. In the light of the foregoing considerations, this study focuses on landscape fragmentation in Natura 2000 sites. We measure landscape fragmentation in Special Protection Areas, Sites of Community Importance and Special Areas of Conservation in six landscape units ofSardinia (Italy) by applying the rural buildings fragmentation index (RBFI) and the effective mesh density (Seff). Then, we propose a comparative analysis and report on the least and the most fragmented Natura 2000 sites. Finally, we assess if there is correlation between RBFI and seff. In this study, RBFI and seff provide conflicting outcomes and, according to the Pearson correlation coefficient, the metrics appear slight related each other.

KEYWORDS
Rural landscapes; Rural buildings; Landscape fragmentation; Fragmentation index; Comparative approach

1 INTRODUCTION

Human actions can negatively affect landscape quality as consequences of deforestation, land conversion for agricultural uses, and urbanization, with effects on habitats and biodiversity. Negative effects include landscape fragmentation (LF) - i.e. the process where habitat patches tend to become smaller and more isolated (EEA, 2011). LF mainly depends on anthropogenic causes (Harrisson et al., 2012) and is particularly evident in urbanized areas, where network of transport and mobility infrastructures (EEA, 2011) and urban development (Battisti & Romano, 2007) are the main drivers. LF affects habitats, flora, and wild fauna (Astiaso Garcia et al., 2013) in both the short and long term and at worst can lead to extinction processes. Urbanized areas have effects on ecological networks (De Montis et al., 2016) in that it contributes in increasing soil consumption and LF. Rural buildings can characterize peri-urban and rural areas and, in the form of suburban and rural sprawl (Gonzalez-Abraham et al., 2007), contribute in increasing LF. Metrics able to quantify LF caused by rural buildings are scarcely discussed in scientific literature. Thus, in this work we focus on such a type of phenomenon. We measure LF in Natura 2000 sites included in six landscape units (LUs) setby the regional landscape plan (RAS, 2006) of Sardinia (Italy) and apply the so-called rural buildings fragmentation index (RBFI, De Montis et al., 2017a). In addition, we measure the effective mesh density (s_{eff}) and verify if RBFI and s_{eff} are related each other by using the Pearson correlation coefficient (PCC). In the next section, we report on Natura 2000 sites and LF in rural contexts. In the third section, we illustrate the method and data used. In the fourth section, we show and discuss the findings. Finally, in the fifth section we report on the concluding remarks.

2 LANDSCAPE FRAGMENTATIONIN NATURA 2000 SITES

The 'Habitat Directive' (Directive 92/43/EEC; EEC, 1992) aims at protecting European biodiversity, preserving natural habitats of wild flora and fauna. The Directive establishes the Natura 2000 network, which sets special conservation areas and includes special protection areas according to the so-called 'Birds Directive' (Directive 2009/147/EC; EC, 2009). Natura 2000 sites embraces Special Areas of Conservation (SACs), Sites of Community Importance (SCIs), and Special Protection Areas (SPAs). SPAs have been designated under the Birds Directive, while SCIs and SACs under the Habitats Directive. Scientific literature is focusing on Natura 2000 sites in Sardinia (Cannas & Zoppi, 2017; Floris & Ruggeri, 2017; Lai & Zoppi, 2017), where56 SACs have been designed, according to the Decree of the Ministry of the Environment (MEPLS, 2017).Protected areas can be negatively affected by human

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infrastructures and urbanized areas, which contribute to LF significantly (Battisti & Romano, 2007; Astiaso Garcia et al., 2013). LF is also known as factor able to adversely affect biodiversity (Harrisson et al., 2012).We consider suburban and rural sprawl as factors that contribute in increasing LF. Sub urban sprawl shows higher housing density (housing units/km^2) than the rural sprawl (Radeloff et al., 2005). However, rural sprawl affects "much larger areas than suburban sprawl" (Radeloff et al., 2005) as for forest fragmentation, in that rural sprawl shows significant negative environmental effects per house, given that "it occurs in less-altered areas" (Radeloff et al., 2005). According to Hansen et al. (2005), "many native species have reduced survival and reproduction near homes" in low-density rural home development (from 6 to 25 homes/km^2).Theobald et al. (1997) define as 'disturbance zone' the surface of degraded habitat occupied by buildings and their surrounding area. Also McKenzie (2011)point out that rural buildings have ecological effect son habitats, such as loss of habitat and LF caused by rural sprawl (Gonzalez-Abraham et al., 2007; Radeloff et al., 2005). Finally, Theobald et al. (1997), quoted by Gonzalez-Abraham et al. (2007), argue that at"a given building density, habitat fragmentation is highest when buildings are dispersed". LFdue to buildings can be measured through metrics such as "proportion of undisturbed area, decrease in largest patch area, decrease in median patch area, and change in total edge" (Gonzalez-Abraham et al., 2007), while De Montis et al. (2017) proposed and applied the RBFI for measuring such a type of LF in six LUs of Sardinia.Some authors studied LF in Natura 2000 sites. Hernando et al. (2017) focus on the importance of map resolution as a key element, when the habitat conservation status needs to be assessed. The authors "assess how fragmentation and connectivity vary depending on three different resolution forest cover maps" (Hernando et al., 2017).

Piquer-Rodríguez et al. (2012) consider landscape fragmentation and connectivity in land use models in order to assess - in the context of protected area networks - the influence of land use changes on the connectivity. Tomaselli et al. (2012) apply a set of landscape metrics in three coastal wetlands included in the Natura 2000 network "in order to investigate [the performance of the metrics] in assessing fragmentation and spatial patterns of habitats" (Tomaselli et al., 2012).

3 METHOD AND DATA

Sardinian rural landscapes are often characterized by isolated buildings or small clusters of rural buildings such as in the historical regions of Gallura and Nurra, in Northern Sardinia (Sanna, 2008). Thus, in this work we focused on LF caused by rural buildings and applied the Rural Building Fragmentation Index (RBFI; De Montis et al., 2017a), an index obtained by modifying the urban fragmentation index (UFI) (Romano & Zullo, 2013).

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The RBFI obeys to the following equation 1:

$$RBFI = N * \cdot \frac{\sum_{i=1}^{i=n} s_{i*}}{A^2} \cdot \frac{\sum_{i=1}^{i=n} p_{i*}}{2\sqrt{\pi \sum_{i=1}^{i=n} s_{i*}}} \quad (1)$$

where *N**stands for number of rural buildings built-up within the Natura 2000 site, *A* for surface area of the Natura 2000 site, and S_i* and p_i* for area and perimeter of the surface occupied by rural buildings.

The RBFI considers the so-called Urban Dispersion (URD), an index able to measure the distribution of urban nucleus (Romano & Tamburini, 2006). The URDis conceived as a superficial density of urban settlements and, thus, obeys to the following equation 2:

$$URD = \frac{N}{A} \quad (2)$$

Where *N* stands for the number of urban nucleus centroids and *A* for the reference area.Furthermore, we are interested in assessing the correlation between RBFI and other well-known metrics able to measure LF. The effective mesh size (m_{eff}) is a well-tested index (EEA, 2011; Jaeger, 2000) and it "is based on the probability that two randomly located points (or animals) in an area are connected (or in the same patch) and are not separated by a barrier" (Jaeger, 2015). However, in this study we consider the effective mesh density (s_{eff}) because it is more suitable than m_{eff} for revealing trends and changes in trends (EEA, 2011; Jaeger, 2000).

The s_{eff} provides us with the effective number of meshes per square kilometre (EEA, 2011). According to the EEA (2011), it "is often more convenient to count the effective number of meshes per 1000 km^2 rather than per 1 km^2".

Thus, we express the values of s_{eff} in meshes (or landscape patches) per 1000 km^2. When the LF increases the s_{eff} increases as well (EEA, 2011; Jaeger, 2015). The s_{eff}obeys to the following equation 3 (EEA, 2011):

$$s_{eff} = \frac{1}{m_{eff}} \quad (3)$$

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Where m_{eff} obeys to the following equation 4:

$$m_{eff} = A_t * C = \frac{1}{A_t} * \sum_{i=1}^{n} {A_i}^2 \quad (4)$$

Where n stands for number of patches, A_i for surface area of n patches and A_t for extent of the Natura 2000 site. We used land use map data freely available on-line through the website of the Autonomous Region of Sardinia (RAS, 2016a, 2016b), ESRI ArcGIS 10 and Microsoft Excel 2010. We applied the metrics in Natura 2000 sites falling within six LUsof similar extent (Fig. 1).

Fig. 1 Geographyc context. A: in gray, the region of Sardinia. B: in gray, the six LUs: (1)Golfo dell'Asinara, (2)Massiccio del Limbara, (3)Piana del RiuMannu di Ozieri, (4) Gennargentu and Mandrolisai, (5)Flumendosa - Sarcidano – Araxisi, and (6)Regione delle Giare Basaltiche; in red, the Natura 2000 sitesincludedwithin the sixLUs

The Natura 2000 sites cover significant surface area of Gennargentu and Mandrolisai (44.7% of the LU) and Piana del RiuMannu di Ozieri (30.3%). Piana del RiuMannu di Ozieri shows the highest absolute values of built-up area (more than 186 ha in 2003; more than 271 ha in 2008).

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LUs	(*A*) AREA LU (ha)	SAC, SCI, OR SPA CODE	(*B*) AREA NATURA 2000 SITE (ha)	RATIO (*B*)/(*A*)	(*C*) RURAL BUILT-UP AREA (ha)	RATIO (*C*)/(*B*)	(*D*) RURAL BUILT-UP AREA (ha)	RATIO (*D*)/(*B*)
					2003		2008	
(1) Golfo dell'Asinara	80713	SAC ITB010002, ITB010003, ITB011155, ITB010043, ITB010082; SPA ITB010001, ITB013012, ITB013011	15589	19.3%	6.6	0.04%	16.9	0.10%
(2) Massiccio del Limbara	92400	SCI ITB011109	16624	18.0%	25.0	0.15%	27.5	0.17%
(3) Piana del RiuMannu di Ozieri	87048	SCI ITB011113, SPA ITB013048	26403	30.3%	186.2	0.71%	271.4	1.03%
(4) Gennargentu and Mandrolisai	101022	SPA ITB022217, SCI and SPA ITB021103	45186	44.7%	10.0	0.02%	10.6	0.02%
(5) Flumendosa - Sarcidano – Araxisi	82079	SCI ITB032240	493	0.6%	-	-	-	-
(6) Regione delle Giare Basaltiche	92609	SCI ITB041112, SAC ITB042237, SPA ITB043056	8001	8.6%	-	-	2.4	0.03%

Tab. 1 Characterization of LUs and Natura 2000 sites

In the next section we measure RBFI and s_{eff}, and their variation according to the following equations (5), (6), (7), and (8):

$$\Delta \mathrm{RBFI} = \mathrm{RBFI}_{2008} - \mathrm{RBFI}_{2003} \qquad (5)$$

$$\mathrm{dRBFI} = \frac{\mathrm{RBFI}_{2008} - \mathrm{RBFI}_{2003}}{\mathrm{RBFI}_{2003}} \qquad (6)$$

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$$\Delta Seff = Seff_{2008} - Seff_{2003} \quad (7)$$

$$\mathrm{d}Seff = \frac{Seff_{2008} - Seff_{2003}}{Seff_{2003}} \quad (8)$$

4 RESULTS AND DISCUSSION

Natura 2000 sites in Piana del RiuMannu di Ozieri show the highest values of RBFI in both 2003 (about 12) and 2008 (about 36), while in Flumendosa – Sarcidano – Araxisi the rural buildings do not contribute to LF. Regione delle Giare Basaltiche shows the lowest RBFI (0.001 in 2008). Piana del RiuMannu di Ozieri has the highest difference (ΔRBFI) of RBFI from 2003 to 2008 (24.3). Golfo dell'Asinara and Piana del RiuMannu di Ozieri have the highest increase (dRBFI) of RBFI from 2003 to 2008 (1271.0% and 204.1%, respectively), while Gennargentu and Mandrolisai has the lowest one (32.9%).

Natura 2000 sites in	RBFI		$\Delta RBFI_{03-08}$	$dRBFI_{03-08}$	s_{eff} (meshes per 1000 km^2)		$\Delta s_{eff03-08}$	$ds_{eff03-08}$
	2003	2008			2003	2008		
(1) Golfo dell'Asinara	0.004	0.054	0.050	1271.0%	26.210	26.450	<0.000	0.9%
(2) Massiccio del Limbara	0.125	0.176	0.051	41.2%	6.088	6.092	<0.000	0.0%
(3) Piana del RiuMannu di Ozieri	11.908	36.208	24.300	204.1%	3.843	3.895	<0.000	1.3%
(4) Gennargentu and Mandrolisai	0.003	0.004	0.001	32.9%	3.532	3.532	<0.000	-0.0%
(5) Flumendosa - Sarcidano – Araxisi	-	-	-	-	-	-	-	-
(6) Regione delle Giare Basaltiche	-	0.001	-	-	19.056	19.059	<0.000	0.0%

Tab. 2 RBFI and s_{eff} and their variation from 2003 to 2008

Natura 2000 sites in Golfo dell'Asinara and Regione delle Giare Basaltiche show the highest values of s_{eff} (about 26 and 19 meshes per 1000 km^2, respectively), while Gennargentu and Mandrolisai shows the lowest one (about 3.5). The variations of s_{eff} are not significant from 2003 to 2008. According to the RBFI, Natura 2000 sites in Piana del RiuMannu di Ozieri appear as the most fragmented, while according to the s_{eff} the most fragmented Natura 2000 sites are localized in Golfo dell'Asinara. The values of s_{eff} confirm the results of previous studies: coastal areas often result more fragmented than the inland areas. We could explain such conflicting results by considering that the RBFI provides raw information on LF. Finer

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assessment of that measure would require the integration of information connected to many more aspects. Future research will investigate such an issue. Finally, we assess the relationship concerning RBFI,dS_{eff}, and the area occupied by Natura 2000 sites within the LUs (Tab. 3). We find out that dRBFI and dS_{eff} are weakly positively correlated(PCC= 0.46) and the dRBFI is weakly negatively correlated to the areas covered by the Natura 2000 sites (PCC = -0.48).This confirms the intuitive concept that the larger the area included in Natura 2000 sites, the lower the effect of buildings on LF. The institution of Natura 2000 sites constitutes an important limitation of built-up areas.

		PCC		
		$dRBFI_{03\text{-}08}$	$dS_{eff03\text{-}08}$	Ratio area Natura 2000 site/area LU
PCC	$dRBFI_{03\text{-}08}$	—	0.46	-0.48
	$dS_{eff03\text{-}08}$	0.46	—	0.08
	Ratio area Natura 2000 site/area LU	-0.48	0.08	—

Tab. 3 Correlation analysis of the metrics

However, the number of analyzed areas need to be increased in future research to provide a more credible comparison between RBFI and S_{eff}. In other terms, the sample of areas examined in this study is limited to be considered statistically representative of certain phenomena.

5 CONCLUSION

Scientific literature has scarcely dealt with LF caused by rural buildings. Then, this manuscript reports on the findings we obtained by using RBFI and s_{eff}, two metrics able to quantify LF due to the built-up rural dimension. The RBFI is a relatively new index, which is rooted in the UFI. The RBFI has specifically been proposed for measuring LF in rural areas where dispersed rural buildings can characterize the geographical context. The RBFI has been used in few scientific works and this study pointed out its *pro* and *cons*. We applied the metrics in Natura 2000 sites falling within six LUs in Sardinia (Italy) and assessed the LF from 2003 to 2008. Natura 2000 sites in Piana del RiuMannu di Ozieri appear as the most fragmented according to the RBFI, but according to the s_{eff} the most fragmented onesare in Golfo dell'Asinara.The s_{eff} supports the results of previous studies where the coastal areas were more fragmented than the inland areas. RBFI and s_{eff} show slight correlation according to the PCC.As concluding remarks, we stress strengths and weaknesses of this study. The RBFI provides a quantitative measure of LF and allows the assessment of the degradation of habitats in space and in time. Furthermore, it provides politicians and planners with information about the need to preserve or reconnect rural areas, aiming at preserving wild fauna and flora, and recovering ecological

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corridors. As for the weakness, the data used in this study were incomplete and scarcely accurate, with respect to the actual regional scenario. In other words, many rural buildings are not recorded in the regional land use map and often the built-up area could be overestimated, as it does not include just rural buildings but also their surrounding unbuilt surface. Secondly, the RBFI does not consider the (clustered, random or dispersal) built-up pattern, i.e. the reciprocal location and distance among rural buildings (centroids). Different patterns may imply different effects on ecosystems and biodiversity. Rural buildings affect their surrounding areas with different 'disturbance zone'. In addition, more dispersed buildings imply more roads (and more vehicular traffic), thus a higher LF. Furthermore, the RBFI should cover areas of approximately the same extent to provide comparative findings, while in this study we consider Natura 2000 sites of different extent. As alternative, we could relate the RBFI to a grid with predefined cell size and obtainmore comparable findings.In this study, the RBFI is assessed without a precise consideration of the barrier effect, measuring how specific target species perceive the built-up dimension. The same road may be perceived as an insuperable obstacle by certain species or as an easily crossable trait for other species. Finally, a sensitivity analysis should be performed to assess how RBFI varies when its components vary.We are aware of *pro* and *cons* of this study, but it should be considered as one of the few attempts aimed at including the dispersion of rural buildings as key factor in LF processes. The RBFI needs to be tested in other contexts for assessing its usefulness in measuring LF.

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AUTHOR'S PROFILE

Antonio Ledda, Ph.D. in Civil Engineering and Architecture,he is assistant professor at Department of Agriculture, University of Sassari. His research interest focuses on rural buildings, rural areas and landscapes,landscape planning, landscape fragmentation and defragmentation measures.

Andrea De Montis, Civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural developmentat the Department of Agriculture, University of Sassari. His research interests concern regional and landscape analysis and planning, strategic environmental assessment, and, recently, the strategy for the adaptation to climate changes.

Vittorio Serra, Master's degree in forestry and environmental system, University of Sassari, Phdstudent in Civil Engineering and Architecture, University of Cagliari. His research interests focus on historic rural buildings, rural areas and landscapes, and landscape planning, landscape fragmentation and defragmentation measures.

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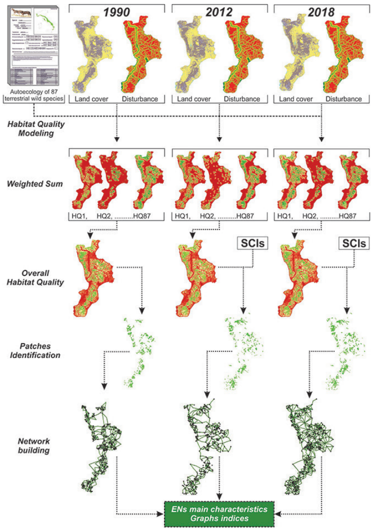

REGIONAL ECOLOGICAL NETWORKS: THEORETICAL AND PRACTICAL ISSUES

GIUSEPPE MODICA, SALVATORE PRATICÒ
LUIGI LAUDARI
CARMELO RICCARDO FICHERA
SALVATORE DI FAZIO

Department of Agricultural Sciences
University of Reggio Calabria
e-mail: giuseppe.modica@unirc.it
salvatore.pratico@unirc.it
luigi.laudari@unirc.it
crfichera@unirc.it
salvatore.difazio@unirc.it
URL: www.agraria.unirc.it

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ABSTRACT

In the present paper, practical and theoretical evidences arising from the multi-temporal analysis of ecological networks (ENs) are provided. A case study based on the implementation of EN in Calabria (Italy) in three different years (1990, 2012 and 2018), is discussed. In the first paragraph, we provided a synthesis on the concept of landscape connectivity based on the most relevant scientific literature. Therefore, the second paragraph deals with the description of the main methodological steps and on the adopted software packages to design and measure spatial characteristics of ENs. The resulting ENs consist of nodes, patches (i.e., functional patches), edges, linkages, and corridors (designed taking into account the landscape permeability to the animal movement) and to measure the landscape fragmentation. Moreover, to highlight ENs robustness, the spatial comparison of the three ENs was also performed on the basis of landscape graph theory. To this end, a consistent set of indices (both binary and probabilistic) has been calculated. Moreover, the landscape morphological spatial pattern analysis (MSPA) was also applied.

KEYWORDS
Ecological networks; Landscape connectivity; landscape graphs model; multi-temporal assessment

1 INTRODUCTION

Landscape connectivity is a key element of landscape structure and can be defined as the degree to which each components of landscape structure facilitates or impedes the movements among existing patches (Taylor et al., 1993). A congruous number of studies has been published about the Ecological Network (EN) issue (Bennet, 1998; Boitani, Falcucci et al., 2007; Fahrig, 2013; J.-C. Foltête, 2019; Gippoliti & Battisti, 2017; Opdam et al., 2006; Vimal et al., 2012). Modelling an EN is a key for analyzing functional connectivity and biodiversity preservation (Taylor et al., 2006). Moreover, the diachronic analysis of ecological connectivity allows to highlight the changes occurred in the landscape structure. Since landscape connectivity reflects a basic form of interaction between species and their environment, the modelling of ecological networks is currently an important issue for researchers and practitioners on the field of landscape planning management (Gurrutxaga et al., 2010), also linked with other important issues as the effects of climate changes on species behavior and habitat fragmentation (Opdam & Wascher, 2004). Despite from field observation is no easy to measure actual functional connectivity, it is possible estimate a potential functional connectivity in many ways (Adriaensen et al., 2003; Boitani et al., 2015; Calabrese & Fagan, 2006; Cook, 2002; Drielsma et al., 2007; McRae et al., 2008; Moilanen & Hanski, 2001; Tischendorf & Fahring, 1975; Urban & Keitt, 2001). Among these, landscape graphs model is a spatially explicit model that is good for conservation planning issue (Galpern et al., 2011). Graphs can be created using a set of nodes to indicate the habitat patches and a set of links to indicate their potential connections. In this work, we present the results concerning the implementation of three ecological networks, obtained by the same method on the whole territory of the Calabria region (Italy), and referring to years 1990, 2012 and 2018. The research focus is on the evolution of landscape connectivity developing a multi-temporal assessment that accounts for landscape evolution trends. Our main objectives are the analysis of ecological network’s robustness and the investigation of the role of landscape fragmentation interpreted through changes in spatial articulation of physical constituents (i.e., the different land uses) and qualitative constituents (distribution of habitats and bio-permeability quality classes).

2 METHODOLOGY

For the three times under investigation (1990, 2012 and 2018) the respective ENs have been built using the Functional Connectivity (FunConn) model (Theobald et al., 2006; 2011) according to Fichera et al (2010). FunConn is a toolbox working on ArcGIS® environment that

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allows to identify movement patterns and the landscape connectivity for each single faunal specie under investigation. As synthetized in Fig. 1, the following base data have been used: land cover (LC), i.e. the CORINE land cover at third level of detail; human disturbance (HD), modelled starting from built-up and road and railroad networks data (information about population density and road-railroad typology was taken into account); autecological information of each of the 87 terrestrial species considered target species. To obtain each EN, the following four steps have been implemented:

- defining the habitat-quality (HQ) map for each of the considered 87 terrestrial faunal species;
- defining the overall HQ map;
- defining functional patches (FPs);
- connecting all functional patches taking into account landscape permeability to the animal movement and the HD sources.

HQ ranges between 0 and 100 when referred to unsuitable to optimal habitats. For each target species, HQ calculation requires the definition of the following parameters:

- resource quality, obtained indexing each LC class ranging from unsuitable to optimal habitat, and based on habitat preferences of each target species;
- functional patch structure, that accounts for the so-called 'edge effect' by evaluating proximity to patch edge to define suitable areas;
- distance from the HD sources, that quantifies the effects of LC disturbance on HQ.

The overall HQ maps is a multi-species habitat quality surface, obtained by means of a weighted sum procedure that takes into account the different ecological importance of each considered target species. In more details, the inclusion of a target specie in a Site of Community Interest (SCI) of the so-called Natura 2000 European network, as well as in the IUCN Red list of threatened species, determines a different weight for that species in obtaining the overall HQ map. The delineation of functional patches was based, for each organism, on the minimum foraging requirements and on the possibility of movement among different patches (Girvetz & Greco 2007). This process is leaded by the overall HQ map and two main organism-specific parameters guide this process: maximum foraging radius and minimum patch size. The maximum foraging radius is a measure of how far target species move seeking out forage while the minimum patch size represents the smallest biologically relevant patch size for each of the target species selected. In defining the three ENs that are not species-specific but multi-species (Fichera et al., 2015), the maximum foraging radius has been imposed at 100 m (corresponding to the minimum foraging radius of the target species) while the minimum patch size at 10 ha. Moreover, in the 2012 and 2018 ENs, the obtained FPs were

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integrated with the SCIs boundaries that are designed in Italy since 1997. As a result, we obtained a network of integrated patches (IPs). The last step is the generation of the landscape network that represents the habitat patch connectivity. The resulting EN consists of nodes, patches (i.e., functional patches), edges, linkages, and corridors (designed taking into account the landscape BP to the animal movement). In order to investigate the occurred changes in the spatial configuration of the three defined ENs, the landscape fragmentation was analyzed by means of the free software Guidos v2.5(Vogt & Riitters, 2017). Moreover, to highlight the EN's robustness, the spatial comparison of the three ENs was performed by means of the free software Conefor v2.6 (Saura & Torné, 2009). To this end, the number of nodes and core areas as well as the overall index values (OIVs) and the Betweenness Centrality (BC) were analyzed. For the three ENs the gradient of landscape fragmentation was calculated on the following landscape indexes calculated as a function of spatial entropy (Shannon, 1948; Vogt, 2016) and mapped as binary data:

- Bio-Permeability (BP) - Areas with BP>66 that represent the priority areas for the construction of the ecological network's (EN) corridors;
- Habitat Quality (HQ) - Areas with HQ>66 that represent territories most suitable to wild fauna and under the lower effect of the human disturbance;
- Ecological Networks' Patches (ENs' P) - Core areas of the three ENs that represent the structural elements of the reticular systems.

Subsequently, landscape fragmentation was analyzed by means of the morphological spatial pattern analysis (MSPA) (Vogt et al., 2006; Soille et al., 2009) that allows to qualitatively describe the fragmentation through the morphology of its different constituents: core, islet, perforated, edge, loop, bridge and branch.

3 RESULTS AND DISCUSSIONS

Like all spatial graphs, landscape graphs are suitable for connectivity metrics computing (Laita et al., 2011). All metrics applied to landscape graphs, at various scale, are called connectivity metrics but they are not merely limited to explain topological relationships, providing helpful information about the strength of a ENs that can be used to improve the planning and monitoring activities (J. C. Foltête et al., 2014; Rayfield et al., 2011). In this paper, a consistent set of indices (both binary and probabilistic) has been calculated to provide helpful information allowing the three ENs comparing. All calculated indices has been provided and synthetically described in Tab.1. Referring to the analysis of ENs robustness, evidence shows a general decrease in the connectivity levels in 2012 and a reprise in 2018 highlighting a general consistent rearrangement of the components towards a more disjointed structure. An

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insularisation process can be inferred analysing the high increase (from 1 to 8 for the time span 1990÷2012 and then again 1 in 2018) of the NC index.

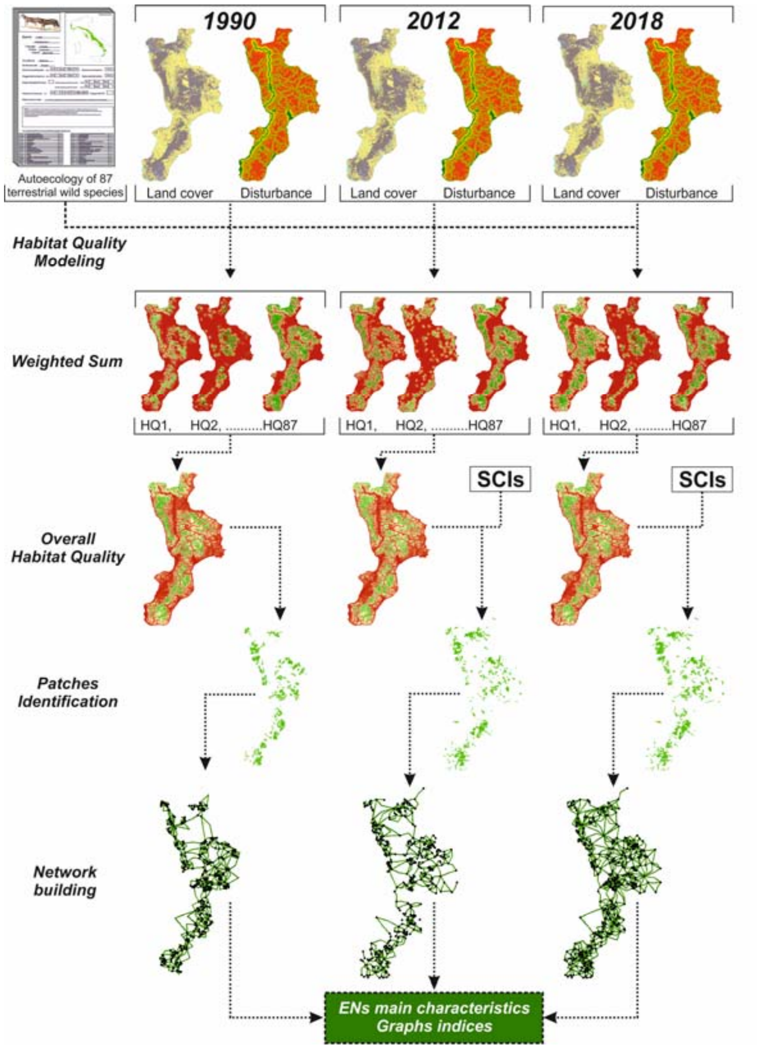

Fig. 1 Logical schema of the proposed methodology aimed at the spatial analysis and comparison of the three ecological networks (ENs)

Moreover, the increase of BC describes the tendency to construct clusters including a higher number of patches that act as bridges and provide short cuts. The results of the analysis of the landscape fragmentation process with MSPA approach are synthesized in Fig. 2.

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Particularly interesting appears the analysis of the different patches (FPs and IPs) that represent the core areas from which the three ENs are built.

In addition to the progressive decrease of the fragmentation values linked to the increase of forestry areas from 1990 to 2012 and 2018, it is evident that the integration of the SCIs in building the 2012 and 2018 ENs is able to improve significantly the compactness and the spatial distribution of the core areas on the study area. The ENs' P graphshows a constant increasein core areas class values with a slice increase from 1990 to 2012 and 2018. Both the other graphs (HQ and BP) show similar values for the core areas class in 1990 and 2012, but also a great increase in 1990. Vice versa, for the other classes can be noticed a decrease during the time interval under investigation.

Indices	**Description**	**1990**	**2012**	**2018**
Number of Links (NL)	Number of connections between habitat nodes in the landscape	781	577	1078
Number of Components (NC)	Number of nodes in which exist a path between every pair of nodes	1	8	1
Harary index (H)	Sum of reciprocals of distances between all pairs of vertices of a connected graph	9701.40	7333.84	14503.13
Landscape Coincidence Probability (LCP)	Probability that two points randomly located within the landscape belong to the same habitat component	0.39	0.25	0.47
Integral Index of Connectivity (IIC)	Habitat availability on a binary connection model	0.04	0.02	0.06
Flux (F)	F index gives information on dispersal probability within patches	1562	1154	2156
Probability of Connectivity (PC)	Probability that two points randomly placed within the landscape fall into habitat areas that are reachable from each other (interconnected)	0.39	0.25	0.47
Betweenness Centrality (BC)	Centrality measure based on shortest paths in a graphs	0.03±0.06	0.04±0.08	0.02±0.04

Tab. 1 Ecological Networks (ENs) indices.

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4 CONCLUSIONS

Starting from the analysis of the recent land-use dynamics occurred in the study-area, we scrutinised the performance and changes of the landscape connectivity analysing the period between 1990, 2012and 2018 comparing the three different ENs. This is a step of a multi-temporal analysis that widely showed its significant role in the sustainable landscape planning. Moreover, several future research directions are outlined: the analysis of intermediate years (2012 in this case), a deepening on the dynamics of fragmentation and their effects on landscape connectivity, and the impact of new built-areas.

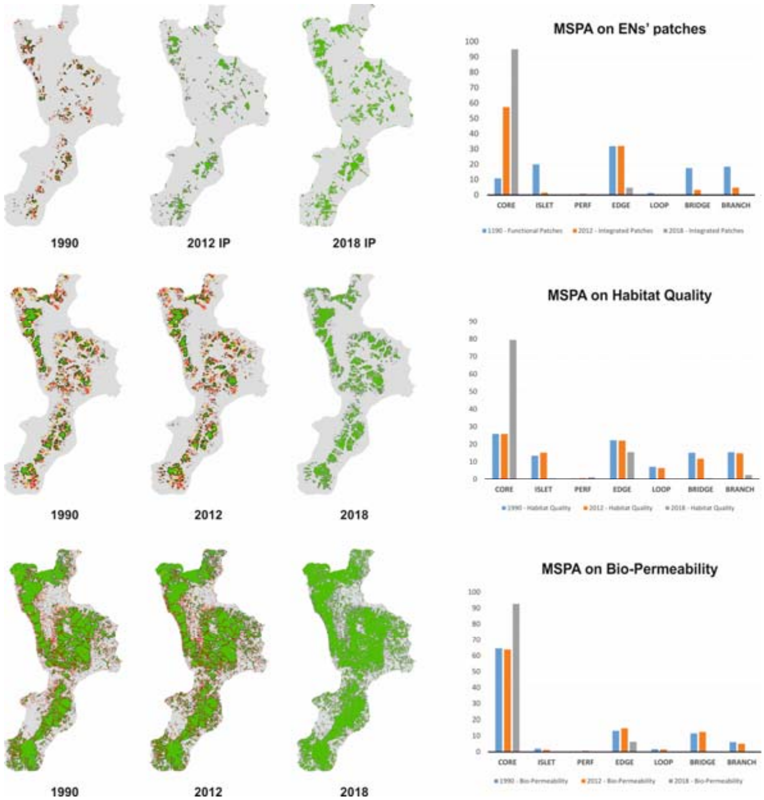

Fig.2 Synthesis of the landscape morphological spatial pattern analysis (MSPA) performed on Ecological Networks' patches (ENs' P), habitat quality (HQ) and Bio-Permeability (BP)

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AUTHOR’S PROFILE

Giuseppe Modica, Ph.D. in Environmental and Agro-forestry Engineering, researcher and assistant professor in Rural Buildings and Rural Landscape at the Department of Agraria of the Mediterranea University of Reggio Calabria (Italy). Member of AIIA (Italian Association of Agricultural Engineering), CIGR (Commission International du Génie Rural) and AgEng (International Association of Agricultural Engineers). His main research interests focusing on sustainable landscape planning, landscape services, geospatial information in decision support systems, multi-criteria evaluation, Remote sensing applications in Agro-Forestry. He is author of more than 70 publications in these research fields.

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Referee for several international journals and member of scientific committee in several international conferences.

Salvatore Praticò, graduate cum laude in Forestry and Environmental Sciences at “Mediterranea” University of Reggio Calabria (Italy). PhD in Agricultural, Food and Environmental Sciences and Technologies. Postdoctoral Researcher in “Rural buildings and agro-forest landscape planning” (AGR/10) at “Mediterranea” University of Reggio Calabria (Italy). His main research interests focusing on sustainable landscape planning and management, Land Use/Land Cover (LU/LC) dynamics and changes, landscape services, geospatial information in decision support systems, remote sensing and photogrammetry applications in Agro-Forestry, Unmanned Aerial Vehicles (UAVs) and their application in precision agriculture.

Luigi Laudari, Ph.D. in Environmental and Agro-forestry Engineering and research fellow at the AGROMATER-LAB Laboratory of the Mediterranea University of Reggio Calabria. Research interests: Geographic information systems; Landscape ecological planning; Ecological networks.

Carmelo Riccardo Fichera, former full Professor in "Rural Building and Landscape Planning" at the Department of Agraria, “Mediterranea” University of Reggio Calabria, Italy. Past president of the II Technical section of the Italian Society of Agricultural Engineering (AIIA). Member of GIGR (Commission International du Génie Rural), AgEng (International Association of Agricultural Engineers), SIFET (Italian Association of Topography and Photogrammetry), RURALIA (Italian Association for re-utilization of agricultural sites). Author of over 130 scientific publications dealing with the following subjects:Technical innovation and sustainability in farm building; Landscape planning; Geographic Information Systems for rural planning;Infrastructures for an integrated use of rural landscape and protected areas.

Salvatore Di Fazio, full Professor in Rural Architecture and Landscape at the Department of Agraria, “Mediterranea” University of Reggio Calabria, Italy. In the same Department is member of the teaching staff (courses in charge: “Forestry building and Landscape"; “Landscape planning and agroforestry infrastructures”; “Agricultural buildings and plants”) and coordinator of the Postgraduate Master Programme in “Forestry and Environmental Science”. Director of the CRTA Laboratory and Research Unit. Member of the Editorial Board of JAE (Journal of Agricultural Engineering). Research fields: sustainable design of farm buildings; valorisation of the rural architectural heritage; landscape analysis and planning; territorial infrastructures for agriculture and forestry.

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COMPARATIVE ECOLOGICAL NETWORK ANALYSIS

TARGET AND VECTOR SPECIES AND OTHER NATURALISTIC ISSUES

MAURIZIO MULAS, MATTEO CABRAS
ANDREA DE MONTIS

Department of Agricultural Sciences
University of Sassari
e-mail: mmulas@uniss.it
matteocabras80@gmail.com, andreadm@uniss.it
URL: www.uniss.it

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ABSTRACT

Urban settlements produce strong alteration of natural environments and of their ecological structures. Land fragmentation and lack of vegetation in most of the soil space create an unsuitable environment for a large quantity of animals normally living in the region. The ecological networks can be classified among the territorial devices able to guarantee the functional and spatial connectivity between the environmental and landscape components, ensuring the continuity of flow in the matrices and contrasting the processes of fragmentation. These strategies are finding wide applications especially in the peri-urban and urban-rural transition zones characterized by the presence of residual ecosystems, which still preserve natural values and facilitate the dispersal processes of plant and animal populations. In this work, two pilot areas located in the peri-urban fringe areas of the cities of Sassari and Nuoro are identified, analyzed and compared. The presence of agricultural areas, gardens and tree-lined avenues offers the possibilities for the realization of ecological networks that are studied according to the theory of complex networks and starting from the characteristics of the two most widespread plant target species in these areas: the Holm oak and the Olive tree. European jay (Garrulusglandularius) and the common starling (Sturnus vulgaris) have been considered as vector animal species. Combining the study of the green areas (patches distribution and size) and the potential distance of dissemination by birds (corridors), two ecological networks were built for the towns of Nuoro and Sassari.

KEYWORDS
Ecological networks, target plant species, vector animal species, plant spreading, natural patches, ecological corridors.

1 INTRODUCTION

The development of human settlements exerts interference on the balance and on the functional dynamics of the environment and the landscape. The construction of a variety of urban centers (from metropolitan areas to small villages) and the necessary transport and mobility infrastructure resulted in numerous obstacles. These artificial buildings act as interpositions and interrupt the continuity originally observed in large natural areas. Landscape fragmentation (LF) is the phenomenon according to which the very large initial parts of the habitat (also called patches) are progressively cut and divided into even smaller and more isolated fragments (Fichera et al., 2015). LF has many deficiencies, such as reduced animal mobility and seed dispersal activity, and should be neutralized to achieve healthier landscapes in contemporary peri-urban settlements. An important strategy to decrease LF is the design and implementation of structures capable of reconnecting patches into larger and more robust assemblies. In this regard, ecological networks (EN) are documented to serve the cause, as they allow the reunification of patches through the different parts of an urban settlement from the core to the periphery (Bennett & Mulongoy, 2006). An important method to support the design of EN is the analysis of the ecological network (ENA), which allows the construction and analysis of ENs starting from their relational and functional properties (Schramski et al., 2011). ENA consists of the application of network analysis to the study of ecological systems. Network analysis is a scientific field that studies complex systems by projecting their properties on a graph that includes single entities (modeled as nodes) interconnected by links. Our study focuses primarily on mutualistic networks, such as relationships within ecosystem services such as pollination and seed dispersal. These are the cases of frugivorous nets, in which the plants interact with their animal dispersants of seeds (Ings et al., 2009). One of the main advantages of network analysis is that it allows the comparison of apparently different systems by adopting very simple metrics, so it adds a unifying perspective to the study of similarities and differences and their motivations. Many authors have used network analysis in comparative approaches to the study of ecological systems (Théau et al., 2015). In this work, we aim to apply complex network analysis to support the design of two ENs for the cities of Sassari and Nuoro, in Italy (Fig. 1). We compare these systems by setting the same patch number and focusing on naturalistic characterization and centrality properties. We develop the analysis of centrality in a comparative perspective by comparing two systems of similar size and characteristics. These systems consist of the proposed ENs for the cities of Sassari and Nuoro, in Sardinia, Italy. The ENs consist of a series of physical earth patches (the nodes of the system) that host plant-based species and are intertwined by a set of exclusively aerial connections (the edges) corresponding to the seed

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dispersion activities provided by volatile species of vectors (Guimarães & De Deyn, 2016). As proposed by Ings et al. (2009), selected ENs can be classified as mutual networks (MW). In fact, their modeling is adapted to the dispersion of the seeds of two Mediterranean plant target species (Holm oak, *Quercus ilex* and Olive, *Olea europaea*) through the frugivorous activity and the movement of some volatile vectors species (including European jay, *Garrulusglandarius* and the common starling, *Sturnus vulgaris*).

2 METHODOLOGY

The study started with the identification of two target plant species (*Quercus ilex*, *Olea europea*). Holm oak and Olive tree are considered prevalent in peri-urban ecosystems and in some urban contexts (treelinedavenues, public and private gardens). For every plant species, oneor more animal seed dispersal species were selected based on the realistic possibility to observe them undisturbed in the urban environment. For the Holm oak, the most active vector in the seeds dispersal is theEuropean jay (*Garrulusglandularius*) (Gómez, 2003; Pons & Pausas,2007). The average dispersal distance of the bird is 250 m, with a recorded maximum of 1000 m. Some rodents like *Apodemussylvaticus* and *Eliomysquercinus* (Gómez et al., 2008) also contribute but are less effective n the dispersal of the seed. Rodents are also active in the seed dispersal of *Olea europaea* but the maximum distance of dispersal of these vectors is a few meters. Moreover, rodents are frequently controlled in the urban environment by means of specific poison substances.

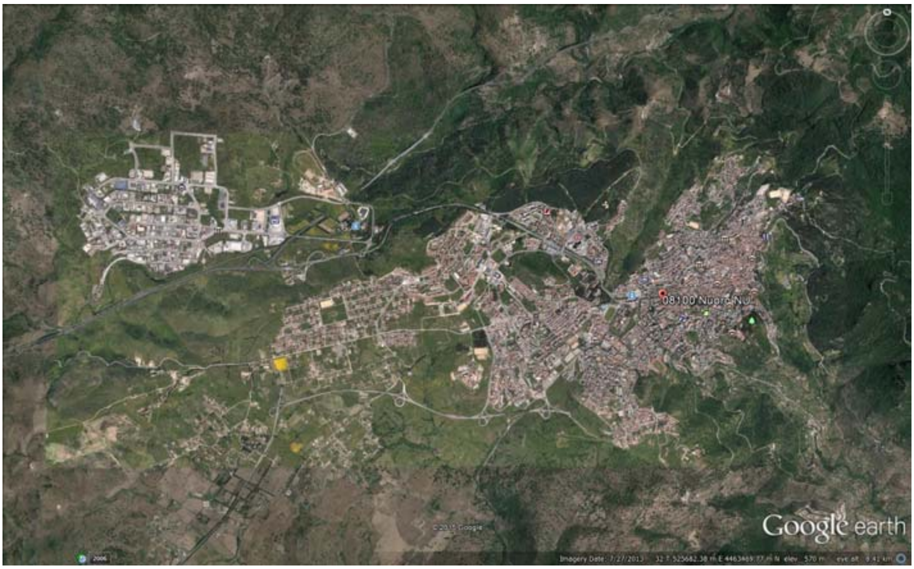

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Fig. 1 Aerial view of the towns of Nuoro (above) and Sassari (below)

More efficient as Olive seeds disperser are many frugivorousbirds, such as the Common Starling (*Sturnus vulgaris*), Song Thrush(*Turdusphilomenos*), Blackcap (*Sylvia atricapilla*), Sardinian Warbler(*Sylvia melanocephala*) (Rey,Alcántara, 2000; Alcántara & Rey,2003). These species eat the fruit and regurgitate stones 20–50 min later with a mean dispersal distance of 100m (Bass et al., 2006).

Even large wild mammals and livestock, such as pigs, sheep, goat sand cattle, feed on Holm oak and Olive trees. However, these vectors effectively disperse only the Olive seeds and their presence in the urban environment is occasional. Because of these considerations, we selected the European jay as vector of Holm oak seeds and the frugivor ous birds as vector of Olive seeds (De Montis et al., 2016). Rodents and other potential terrestrial vectors usually active mostly in rural areas have been excluded, because of their absence or effective control in urban areas. This is the reason why streets and road fencing did not affect patch fragmentation. However, we know by direct observation that the two vectors are abundantly present, as well as reported also by experts of bird watching (personal communication). Moreover, the theoretical nature of the study does not imply a quantification of vectors but

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only of the potential distance of their dispersal action. Thus, in this paper no ecological data have been reported on the populations of these vector species; but their conspicuous presence in the urban area and the occurrence of natural plant communities surrounding the city make them realistically active seed vectors.

3 RESULTS

In the cities of Nuoro and Sassari, the extension of the patches varied in the transition from the peri-urban context to the urban context (Fig. 2). In both cases, the greatest percentage of green areas is attached to the class of small size patches, but Sassari shows by far a higher figure (48.5%), because of the presence of a variety of small urban gardens. Much lower values were found for the remaining size classes with slightly larger figures reported for Nuoro.

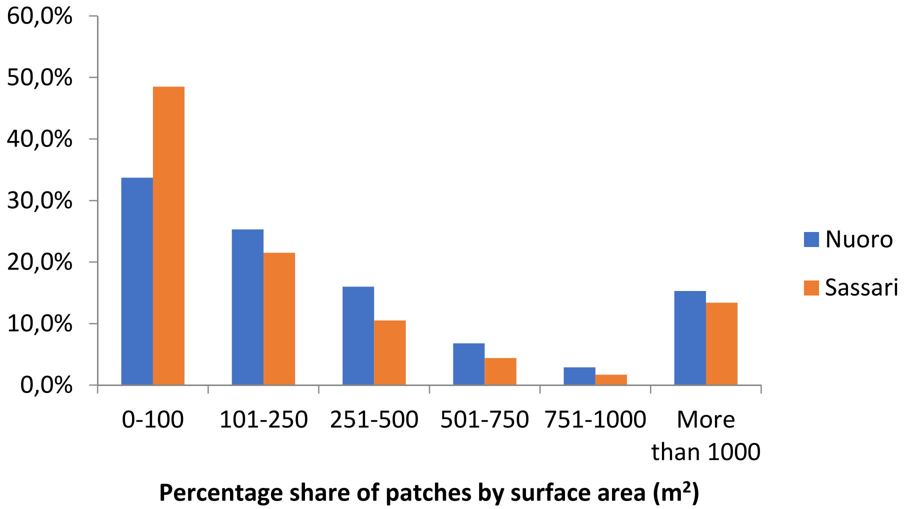

Fig. 2 Analysis of the percentage share of patches by surface area

The largest patches were observed for both the towns in not negligible shares and usually correspond to peri-urban areas, where agricultural areas are intertwined with zones in the past devoted to the cultivation of the Olive tree.

In Fig. 3, the results of the naturalistic characterization of the patches showed a homogeneous distribution of the target species. In both the towns, the two target species were absent in a very important share of patches (more than 50%).

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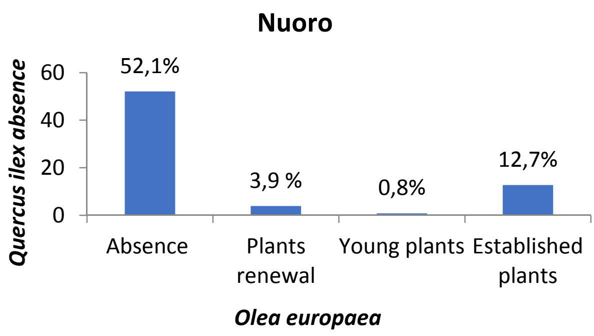

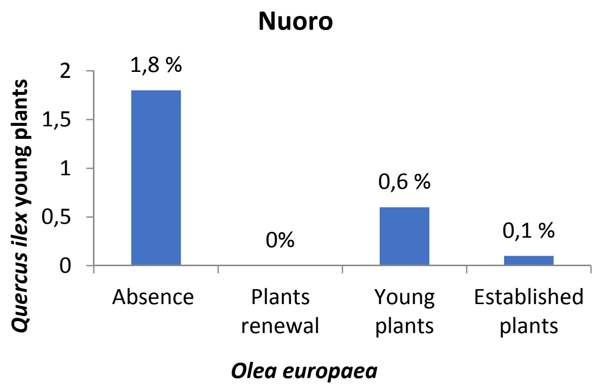

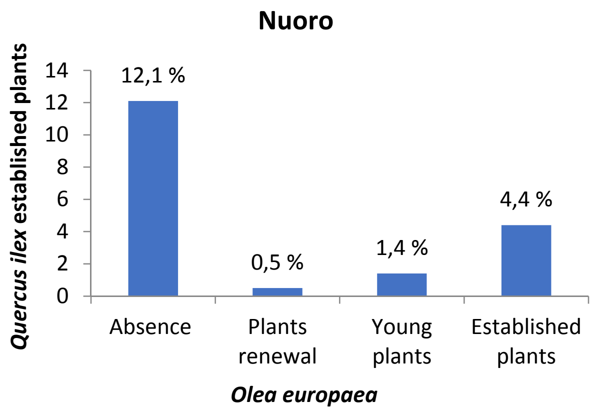

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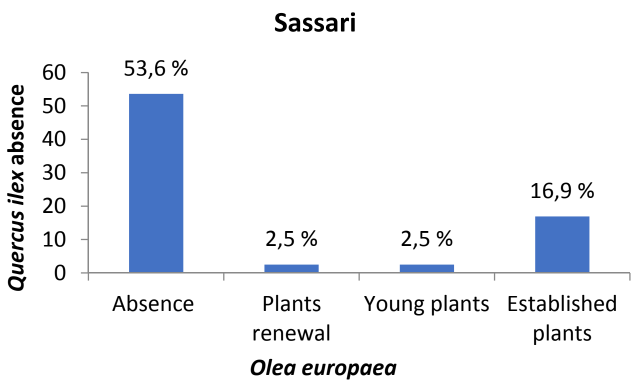

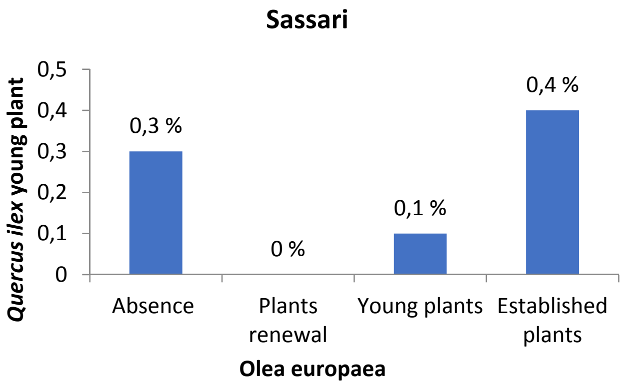

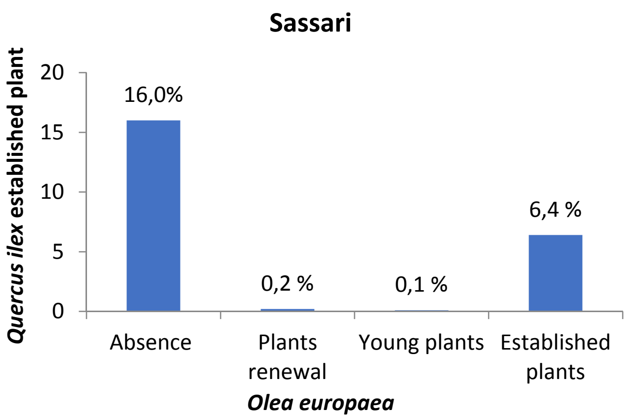

Fig.3 Analysis of the characterization of patch development phases for Nuoro and Sassari

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Significant values were reported for the patches, in which there are established plants of Olive trees in the absence of Holm oaks (12.7% for Nuoro and 16.9% for Sassari). The patches in which there were established plants of Holm oak in the absence of Olive trees represented the 12.1% for Nuoro and the 16.0% for Sassari (De Montis et al., 2019).We generally observed a greater human control over cultivated and spontaneous vegetation in Sassari.

In this town, we observed patches, where the presence of the Olive tree was typical of areas characterized by semi-natural zones. In these environments, we also observed processes of settlement of a diversified and specialized flora (degraded urban areas).

Few Olive trees were present in private and public gardens, characterized by artificial and homogeneous environments. In these contexts, the regular care taken by private individuals prevented the growth of the Olive tree renewal. Regarding the distribution of Holm oak, the species occurred on public areas (schools, public parks or sports facilities), where vegetation referred to very anthropized environments, parking lots, flowerbeds, road trees and in uncultivated marginal areas. The Holm oak shows a remarkably poor renewal, probably due also in this case to the periodic treatments carried out by the gardeners.

In the case of Nuoro, urban parks are characterized by the presence of Holm oak and Olive trees. In the past, these species have been used in urban green. In fact, there are numerous road trees, in which the Holm oak appears. In the case of Nuoro, there is also a greater wealth of the target species within the selected patches, due to less anthropic control, facilitating the renewal process of the Olive tree and the Holm oak.

The direct correlation between the absence of Holm oak and the dominance of Olive tree is more evident in Nuoro than in Sassari. While the Holm oak is found at the stage of young and established plants, a renovation is very difficult for the Olive tree, which instead asserts itself in the absence of the Holm oak. This evolution is expected, according to the ecological successions (Mulas et al., 2003).

In Fig. 4, we report on a comparative analysis of the land use patterns affecting the EN in the two towns, as per the zoning of the correspondent municipal master plan.

While in Nuoro the patches fall mostly (roughly 72%) in the completion (B) and expansion (C) residential zones, in Sassari they correspond broadly (roughly 51%) to neighborhood (S) and general (G) service delivery zones. In both the towns, a very small share of patches was found in the most aggressive industrial (D) and in the environmentally protected (H) zones.

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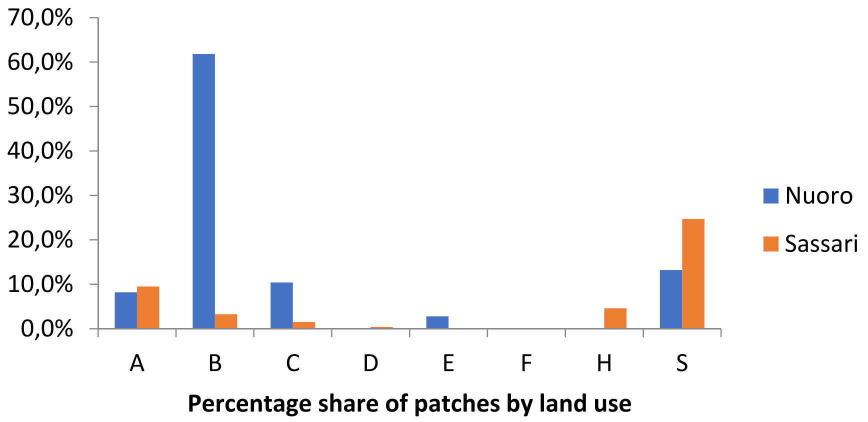

Fig. 4 Analysis of the percentage share of patches by land use type (A: historic district; B: completion residential zone; C: expansion residential zone; D: industrial; E: farming area; F: touristic area; G: services; H: environmentally protected; S: neighborhood)

3 DISCUSSON AND CONCLUSION

The analysis of the distribution of the target species showed the presence of monumental plants in the patches of interest for the functioning of the EN. These patches were found in areas of historical-cultural importance of the city of Sassari, such as the area of the public gardens or the rows of Holm-oaks around the public schools. The Olive growing areas have been incorporated by urban expansion and represented areas of transition towards the countryside. In these interface situations, peri-urban green areas represented a link between rural areas and the green elements of urban patches. Through natural dissemination processes, the peri-urban area, between the urban and rural landscapes, presenting accentuated natural features, represented a source area receiving strong inputs from the rural area. Among the species present in the area, the Olive tree was predominant. The presence of Holm oak was low and was favoured by natural dissemination from adjacent rural areas. Within the urban area, there were some seminatural contexts. These areas, representing natural urban gaps, sometimes left abandoned, were easily colonized by natural vegetation. These areas, without a specific function, had a high degree of floristic richness with species typical of natural environments. In the case of Nuoro, inside the city there are no abandoned areas that allow the uncontrolled spread of the target species. However, even in the case of Nuoro, the dissemination process is favoured by the presence of a natural plant community close to the city and by the strong presence of target species that allow the spread of seeds.

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The numerous urban parks keep within them numerous examples of Holm oak and Olive trees that were used in the past, together with other species, in the urban green.

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AUTHOR'S PROFILE

Maurizio Mulas is Associate Professor of Arboriculture at the University of Sassari (Italy), and selection, ecophysiology and use in the urban environment of woody plants of the Mediterranean climate are among his main research fields.

Matteo Cabras holds a Ph.D. in Sciences of Agricultural and Forestry Eco-systems and Food Production at the University of Sassari. A part of his research interest focuses on ecological networks, as he held a scholarship in the research project Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

Andrea De Montis, Civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural development at the Department of Agriculture, University of Sassari. He is principle investigator of a research project on Ecological networks and landscape planning: case studies in Sardinia funded by Fondazione di Sardegna.

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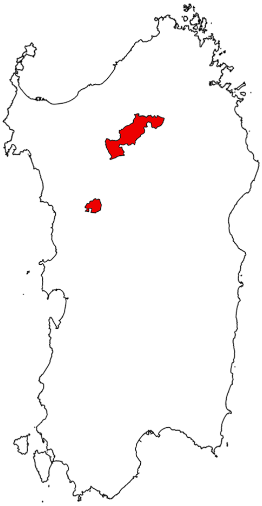

MEASURING CONNECTIVITY IN NATURA 2000 SITES

AN APPLICATION IN SARDINIA

VITTORIO SERRA[a], ANDREA DE MONTIS[ab]
ANTONIO LEDDA[b]

[a] Department of Civil and Environmental Engineering and Architecture, University of Cagliari, via Marengo, 2 – 09123 Cagliari, Italy
e-mail: vittorio.serra1986@gmail.com

[b] Department of Agraria, University of Sassari
viale Italia, 39 – 07100 Sassari, Italy
e-mail: andreadm@uniss.it
antonioledda@uniss.it

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ABSTRACT

Landscape fragmentation (LF) is a process where natural and semi-natural environments tend to divide into several smaller separate fragments. LF is largely caused by roads and railways, as well as urbanized areas. The most evident effects of LF consist of isolation of animal and plant species, reduction of biodiversity and loss of connectivity between habitats. Several indicators for measuring LF are available in literature. In this work, we use the connectivity indicator (CIx) for Natura 2000 sites. CIx is part of a more complex indicator - the City Biodiversity Index (CBI), or Singapore Index on Cities' Biodiversity Index –which is useful for measuring connectivity of natural areas. We apply CIx to Natura 2000 sites, where the Tetrax tetrax (Little Bustard) has its habitat. We (i) consider the Tetrax tetraxas target species in that it is a near threatened species, according to the 'International Union for Conservation of Nature and Natural Resources' Red List, and (ii) assess the connectivity between habitats and propose defragmentation measures able to reconnect isolated or scarcely connected patches.

KEYWORDS

Water Infrastructure; Riverfront Development; Tourism; Protected Ecosystem; the Danube; the Iron Gates

1 INTRODUCTION

Landscape fragmentation (LF) is a relevant process, where large habitat areas -called patches- become smaller and more isolated with respect to its original condition (EEA, 2011; Jaeger, 2000). LF depends on natural and anthropogenic factors (Battisti & Romano, 2007). This process can be caused by linear transport and mobility infrastructures (TMIs), such as railways and roads and by urbanised surfaces, and reduces the free movement of animal species and landscape connectivity (Bissonette & Adair, 2008).The effects of environmental fragmentation are highly species-specific (Celada,1995; Davies et al., 2001). For example, niche width, size of the home-range, use of elements in the environmental mosaic, ability to disperse, need to be considered to assess the sensitivityof wildlife to LF (Bright, 1993; Dooley & Bowers, 1996). LF is measurable through several indices. In this work, we assess the reciprocal phenomenon of LF, i.e. the landscape connectivity (LC), by developing on the connectivity index (*CIx*). This index provides with information on the connectivity of wilderness areas in cities and is a component of the City Biodiversity Index (CBI) -also known as Singapore Index- which is a combination of 23 indicators (Deslauriers et al., 2017). Connectivity is defined as "the degree to which the landscape facilitates or prevents movement between patches [and can be] measured by the probability of movement between all points or areas of intervention of a landscape" (Taylor et al., 1993).We applied *CIx*in two Natura 2000 sites in Sardinia (Italy):(1) 'Campo di Ozieri e pianure comprese tra Tula e Oschiri' and (2) 'Altopiano di Campeda'.

The 'Habitat Directive' (Directive 92/43/EEC; EEC, 1992) aims at the protection of European biodiversity, preservation of natural habitats, wild flora and fauna, and sets the 'Natura 2000' network, which consists of special conservation areas, including special protection areas according to the 'Birds Directive' (Directive 2009/147/EC; EC, 2009). The Natura 2000 network includes Special Areas of Conservation (SACs), Sites of Community Importance (SCIs), and Special Protection Areas (SPAs). In detail, the Birds Directive defines the network of SPAs, while SCIs and SACs are set under the Habitats Directive. In Sardinia, 89 SCIs and 37 SPAs have been defined, and six SCIs coincide with as many SPAs (MEPLS, 2012).

Conservation areas designed for biodiversity protection can be negatively affected by LF due to TMIs and urbanized areas (Saunders et al., 1991; Serrano et al., 2002; Biondi et al., 2003; Battisti & Romano, 2007; Neri et al., 2010; EEA, 2011; Harrisson et al., 2012; Battisti et al., 2013; Romano & Zullo, 2013; Astiaso Garcia et al., 2013).

CIx is a measure of LC, considering intra and inter patch movement. We consider as target species the *Tetrax tetrax*, species at risk of extinction and still present in the Natura 2000 sites considered in this study.

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This paper unfolds as follows. In the next section, we present the method adopted to measure LF. In the third section, we apply the method and show and discuss the findings. In the fourth section, we report on the concluding remarks.

2 METHODOLOGY

In the last decades, scholars have proposed several metrics for measuring LF and LC. In this work, we focus on LC and adopt the *CIx*. According to the last modification introduced in 2012,this index describes -beyond the usual inter-patch connectivity- also the intra-patch connectivity (Chan et al., 2014). This is relevant, as the survival of many species depends on their ability to move between and within habitat areas (La Point et al., 2015; Rudd et al., 2002). *CIx* obeys to the following Equation 1:

$$\mathrm{CIx} = \frac{1}{A_{tot}}(A_{G1}^2 + A_{G2}^2 + \cdots + A_{Gn}^2) \rightarrow CIx = \frac{\sum_i A_{Gi}^2}{A_{tot}} \quad (1)$$

where AGi stands for the size of group i of connected patches, and Atot is the total extent of natural areas. Connectivity of each individual group of patches includes intra- and inter-patch connectivity. The indicator allows us to consider the total area of connected habitats, where species are free to move, and the movement is made possible by inter patch connectivity invarious scenarios of ecological connection, as shown in Equation 2:

$$CIx = CI_{Intra} + CI_{Inter} \quad (2)$$

where CI_{Intra} stands for intra-patch connectivity and CI_{Inter} for inter-patch connectivity. They are obtained, according to the following Equations 3 and 4:

$$CI_{Intra} = \frac{(\sum_i A_{GiPi}{}^2)}{A_{tot}} \quad (3)$$

$$CI_{Inter} = \frac{\sum_{i,j}(2 \times A_{GiPi} \times A_{GjPj})}{A_{tot}} \quad (4)$$

where A_{GiPi} and A_{GjPj} stand for the area of any single patch in each group A_{Gi}.

The City Biodiversity Index(CBI) Manual (Chanet al., 2010) recommends a 100 meters threshold distance for designation of related patches. However, the distance may be changed to meet specific research requirements; for example, for species specific studies, where dispersion distances are known (Deslauriers et al., 2017). In this study, we choose the Little Bustard (Tetrax tetrax L.) as target species.The Little Bustard -Tetrax tetrax (Linnaeus, 1758)

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- has been classified as 'Near Threatened' species, according to the 'International Union for Conservation of Nature and Natural Resources' (IUCN) Red List (BirdLife International, 2018). In Europe, 250 Natura 2000 sites have been designated for the Little Bustard in Bulgaria, France, Italy, Latvia, Portugal, Slovakia, and Spain (EEA, 2019). This species is protected in 24 Natura 2000 sites in Italy and especially (16) in Sardinia (EEA, 2019). We calculate CIx for two Natura 2000 sites, which are described in Tab. 1and Fig. 1.

LUs	Code	Area (ha)
Campo di Ozieri e pianure comprese tra Tula e Oschiri	IS1	27,513.97
Altopiano di Campeda	IS2	4,671.33

Tab.1 The landscape units (LUs) selected in this study

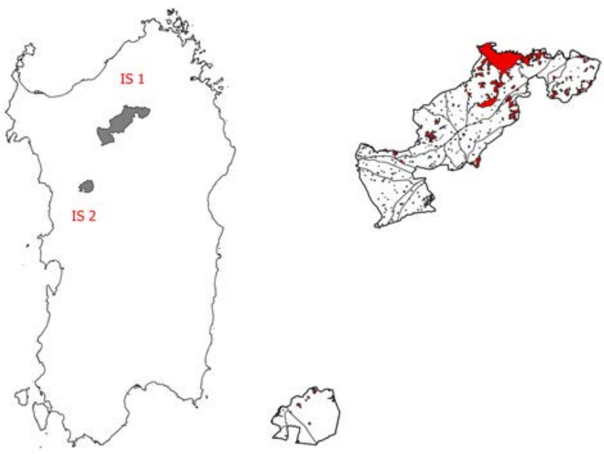

Fig.1 On the left, geographical locations of the LUs under study (in grey). On the right, habitat fragmenting elements are marked (in red)

3 RESULTS

We use a Geographic Information System (GIS) to perform the study. Various GIS tools have proved useful in spatial analysis and in measuring landscape (habitat) fragmentation (De Montis et al., 2018; De Montis et al., 2017). We use open-acces data (RAS, 2008). *CIx* was obtained by implementing GIS analyses and using data in the shapefile format. Tunnels and bridges were excluded from TMI straits. According to the road type, we have applied different buffers (Tab. 2).

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TMIs	Buffer
‘Major roads’	2 x 10 m
‘Secondary roads’	2 x 5 m
‘Railroads’	2 x 2 m

Tab.2 Buffer (in metres) depending on different types of linear infrastructures

Resulting polygons were merged with the polygons of urbanized areas, in order to obtain the final geometry of fragmentation (EEA, 2011; Jaeger, 2000). We consider natural areas that often host the little bustard, i.e.cultivated areas and pastures. Unsuitable areas for little bustard include urban areas, TMIs, and forests, which are perceived as barrier by the target species(barrier effect) (Concas & Petretti, 2012). The little bustard is a sedentary species (limited home range), then we have considered three possible connectivity scenarios at different distances (buffer width:50,100 and 200 m).
In Tab. 3, we report on the values of *CIx*.

	Connectivity	IS 1 (ha)	Ratio (CIx/Area)	IS 2 (ha)	Ratio (CIx/Area)
Total Area (ha)		27,513.97		4,671.33	
Buffer width (m)					
50	CIIntra	163		60.81	
	CIInter	5,950.30		2,957.82	
	CIx	6,113.30	22%	3,018.63	64%
100	CIIntra	163.58		60.81	
	CIInter	6,849.38		2,961.15	
	CIx	7,012.97	25%	3,021.96	64%
200	CIIntra	163.58		60.81	
	CIInter	6,980.38		2,961,25	
	CIx	7,143.96	26%	3,022.07	65%

Tab.3 Assessment of LC:CIx and superficial CIx

According to the results, ‘Campo di Ozieri’shows a constantintra-patch connectivity value (equal to163) in all the three connection patterns; it has an inter-patch connectivity that varies from 5,950.30 (50 m buffer scenario) to 6,980.38 (200 m buffer scenario). ‘Altopiano di Campeda’shows an inter-patch connectivity equal to 60 ha, while the inter-patch connectivity varies from 2,957.82 (50 m buffer scenario) to 2,961,25 (200 m buffer scenario). ‘Campo di Ozieri’ has the highest connectivity (7,143.96 hectares for the 200 m buffer scenario), while ‘Altopiano di Campeda’shows the lowest one (3,018.63 for the 50 m buffer scenario). The ratio between CIx (total area of the connected patches) and total area of Campo di Ozieri is 25%, while for Altopiano di Campeda it is 64%. The greater connectivity found in the

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Campeda SCI is due, as shown in Fig. 1, to the scarce presence of fragmenting elements within the habitat. The flat SCI of Ozieri presents a greater fragmentation, partly made up of the scattered building, and linear infrastructures, such as roads and railways

4 CONCLUSION

In this paper, we have assessed LF by studying the reciprocal phenomenon of LC. We have considered the *CIx* as a relevant measure of connectivity and applied a comparison between two Natura 2000 sites located in Sardinia (Italy). We have measured the intra and inter patches connectivity of landscape areas constituting the habitat of the Little bustard, a species classified as 'Near Threatened' due to the reduction of its habitat. We have discovered that 'Altopiano di Campeda'is less fragmented, as the percentage of the various connection scenes on the total area is equal to 64%, while in the Campo di Ozieri in the hypothesized scenarios the same index is equal to 25%. This suggests that the site 'Altopiano of Campeda'is more favourable for our target species.

These results can be useful to planners in order to provide mitigation measures for landscape fragmentation that support habitat connectivity.

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AUTHOR'S PROFILE

Vittorio Serra, Master's degree in forestry and environmental system, University of Sassari, Phd student in Civil Engineering and Architecture, University of Cagliari. His research interests focus on historic rural buildings, rural areas and landscapes, and landscape planning, landscape fragmentation and defragmentation measures.

Andrea De Montis , Civil engineer, Ph.D. in Urban planning Sapienza, University of Rome and Master of Science in Economic and Planning, Northeastern University, Boston USA, he is associate professor in rural development at the Department of Agriculture, University of Sassari. His research interests concern regional and landscape analysis and planning, strategic environmental assessment, and, recently, the strategy for the adaptation to climate changes.

Antonio Ledda, master's degree cum laude in Planning and Management of Environment and Rural Land, PhD in Civil Engineering and Architecture (Doctor Europeaus), is assistant professor at Department of Agricultural Science, University of Sassari. His research interest focuses on rural buildings, historic rural buildings, rural areas and landscapes, strategic environmental assessment in urban, regional, and landscape planning, landscape fragmentation and defragmentation measures, and governance processes in climate adaptation strategies.

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Carmela Gargiulo is full professor of Urban Planning Techniques at the University of Naples Federico II. Since 1987 she has been involved in studies on the management of urban and territorial transformations. Since 2004, she has been Member of the Researcher Doctorate in Hydraulic, Transport and Territorial Systems Engineering of the University of Naples "Federico II". She is Member of the Committee of the Civil, Architectural and Environmental Engineering Department of the University of Naples "Federico II". Her research interests focus on the processes of urban requalification, on relationships between urban transformations and mobility, and on the estate exploitation produced by urban transformations. On these subjects she has co-ordinated research teams within National Project such as Progetto Finalizzato Edilizia - Sottoprogetto "Processi e procedure" (Targeted Project on Building – Subproject "Processes and procedures), from 1992 to 1994; Progetto Strategico Aree Metropolitane e Ambiente, (Strategic Project Metropolitan Areas and Environment) from 1994 to 1995; PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market" from 2011 to 2013. Principal investigator of the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015. Scientific Responsible Unit Dicea Project by Fondazione Cariplo "MOBILAGE. Mobility and aging: daily life and welfare supportive networks at the neighborhood level" 2018-2020. Scientific Responsible Unit TeMALab Dicea ERASMUS+ Key Action2: Project "Development of a Master Programme in the Management of Industrial Entrepreneurship for Transition Countries" (MIETC), partners: University of Santiago de Compostela (leading organization), University of Ljubljana, Academy of Science of Turkmenistan, Karaganda Economic University of Kazpotrebsouz (2020-2022). Author of more than 130 publications. Since 2008 Associate Editor of TeMA Journal of Land Use, Mobility and Environment.

Corrado Zoppi, Civil engineer, is Doctor of Philosophy in Economics (Northeastern University, Boston, Massachusetts, United States, 1997), Doctor of Research in Territorial Planning (University of Reggio Calabria, 1992), and Master of Science in Economic Policy and Planning (Northeastern University, 1990). Since October I 2015 he is Professor (Full Professor, Scientific Disciplinary Sector ICAR/20 Urban and Regional Technique and Planning)) at the Department of Civil, Environmental Engineering and Architecture. In the past, he taught at the Faculty of Engineering of the University of Cagliari, and at the Faculties of Architecture of the Universities of Rome "La Sapienza" and Sassari-Alghero. He is presently the Official Professor of the Module of Strategic Planning of the Integrated Course of Strategic Environmental Planning and of the Course of Regional and Urban Planning at the Faculty of Engineering of the University of Cagliari, and the Coordinator of the Undergraduate and Magisterial Degree Programs at the Faculty of Engineering and Architecture of the University of Cagliari. He was the Coordinator of the Panel for the Assessment and Evaluation of Public Investments of the Sardinian Regional Administration in the period 2007-2013. He was the Coordinator of the Graduate Committee of Environmental and Territorial Engineering of the University of Cagliari in the period 2012-2015. He is the President of the Faculty Committee of Engineering and Architecture of the University of Cagliari.

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