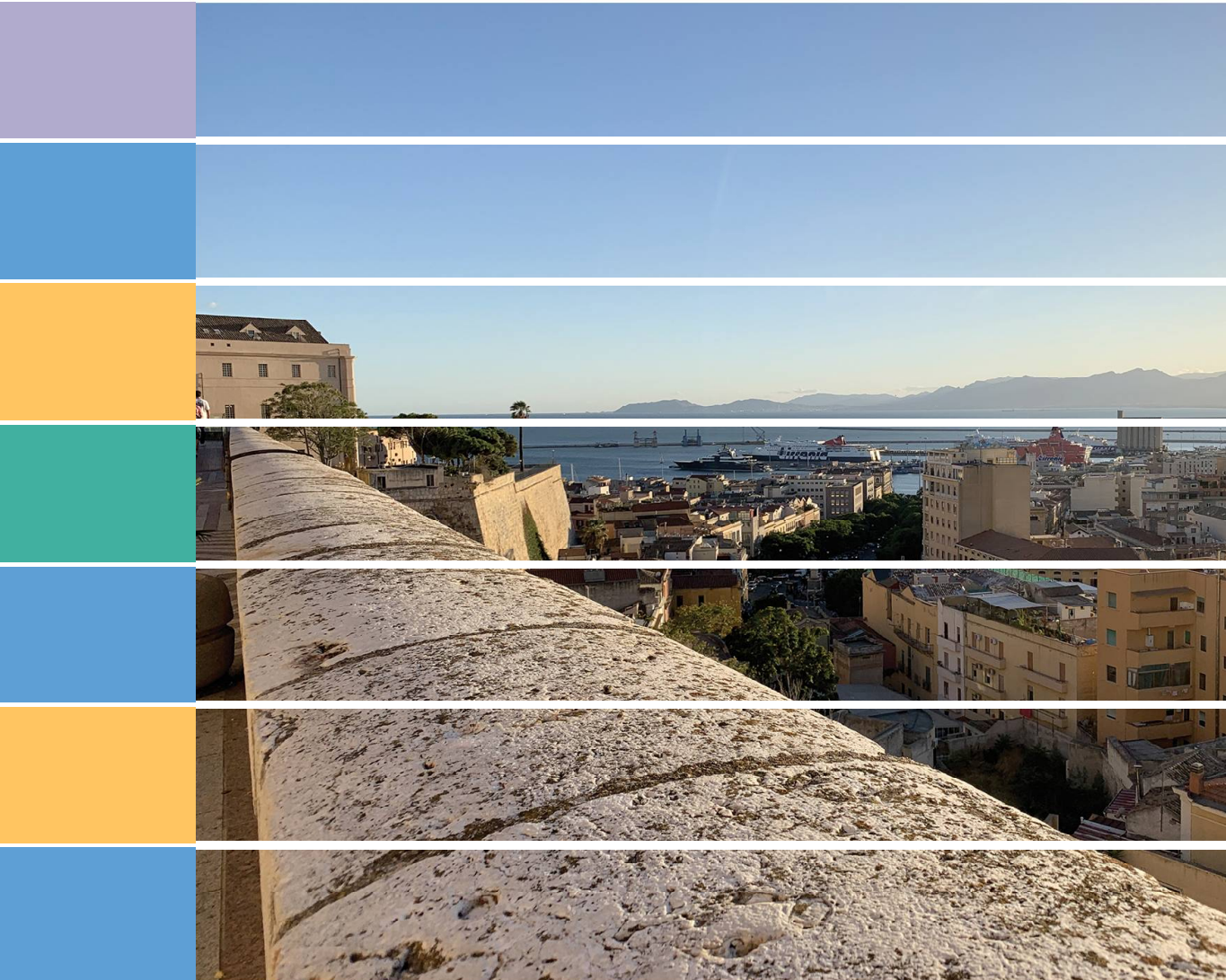


Carmela Gargiulo Corrado Zoppi
Editors

Planning, Nature and Ecosystem Services



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Scuola Politecnica e delle Scienze di Base

Smart City, Urban Planning for a Sustainable Future

5



Carmela Gargiulo Corrado Zoppi
Editors

Planning, Nature and Ecosystem Services

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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.

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- Rosaria Battarra;
- Gerardo Carpentieri;
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- 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

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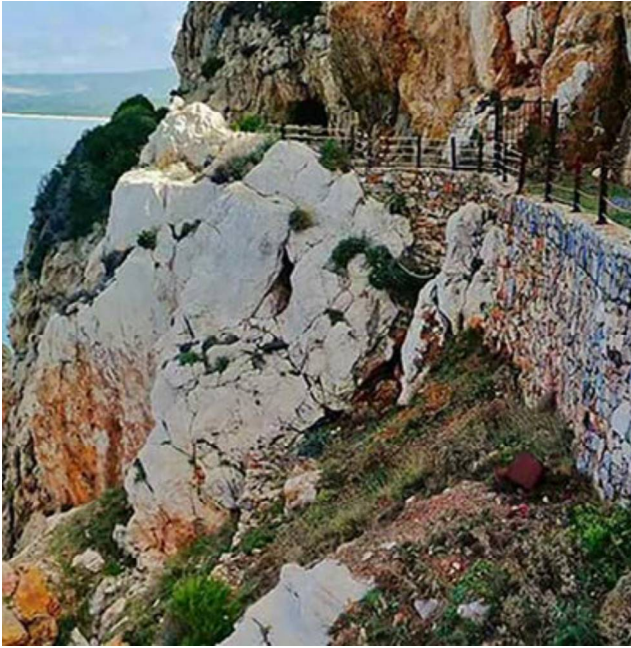
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WALKABILITY AS A TOOL FOR PLACE-BASED REGENERATION: THE CASE STUDY OF IGLESIENTE REGION IN SARDINIA (ITALY)

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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 Iglesiasiente, 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 Iglesiasiente 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 Iglesiasiente 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 Iglesiasiente 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; Iglesiasiente; 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 morphology 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 Iglesias 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 Iglesias 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 Iglesias 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.

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 mining 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.

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.

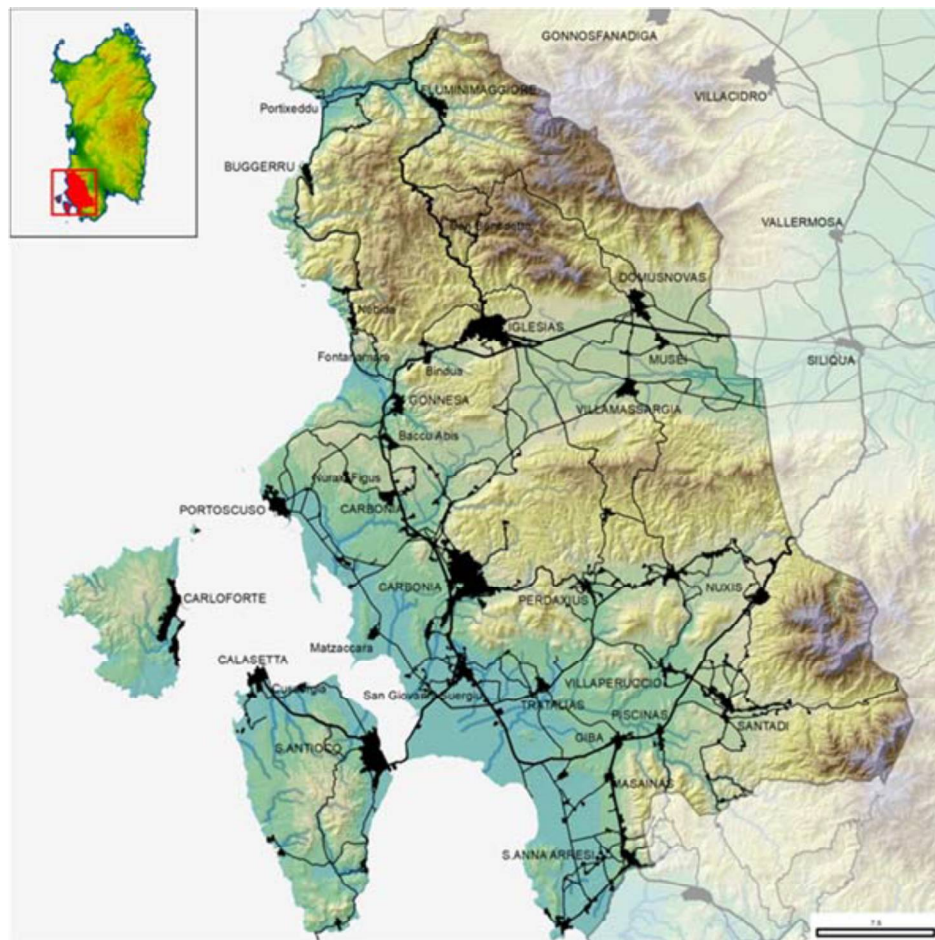


Fig. 1 The Sulcis-Iglesiente area

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'être*.

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);

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 an 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 Iglesiasiente (constituted by the municipalities of Buggerru, Domusnovas, Fluminimaggiore, Gonnese, 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.

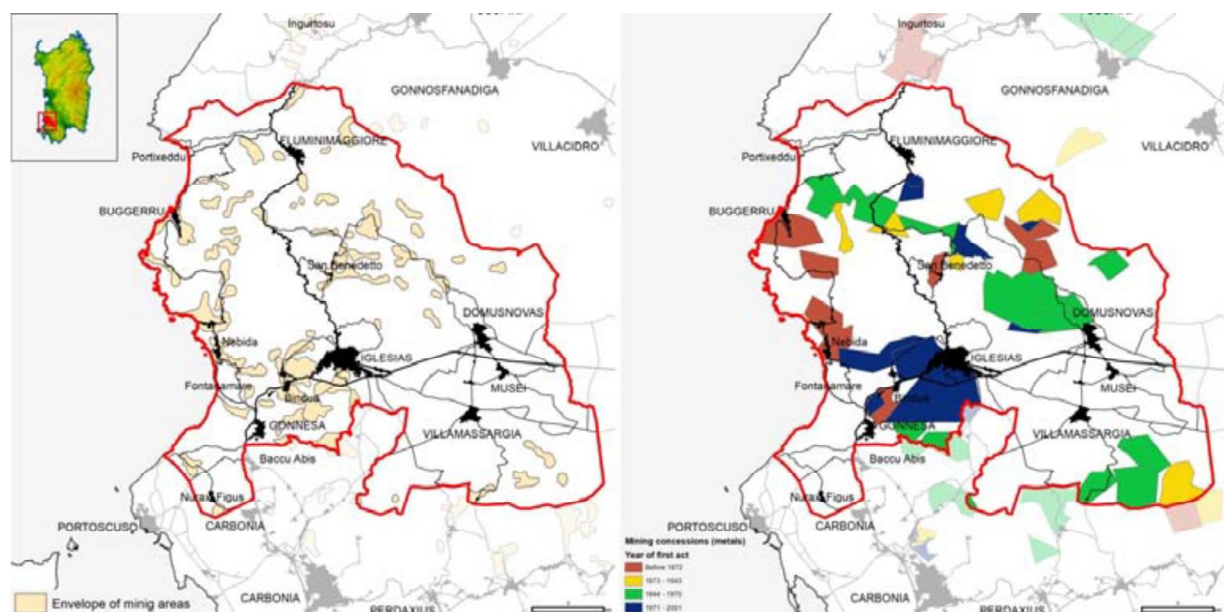


Fig. 2 The red border indicates the Iglesiasiente Region in Sardinia (Italy) with its envelope of mining area and its mining concessions

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 Iglesias 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

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).

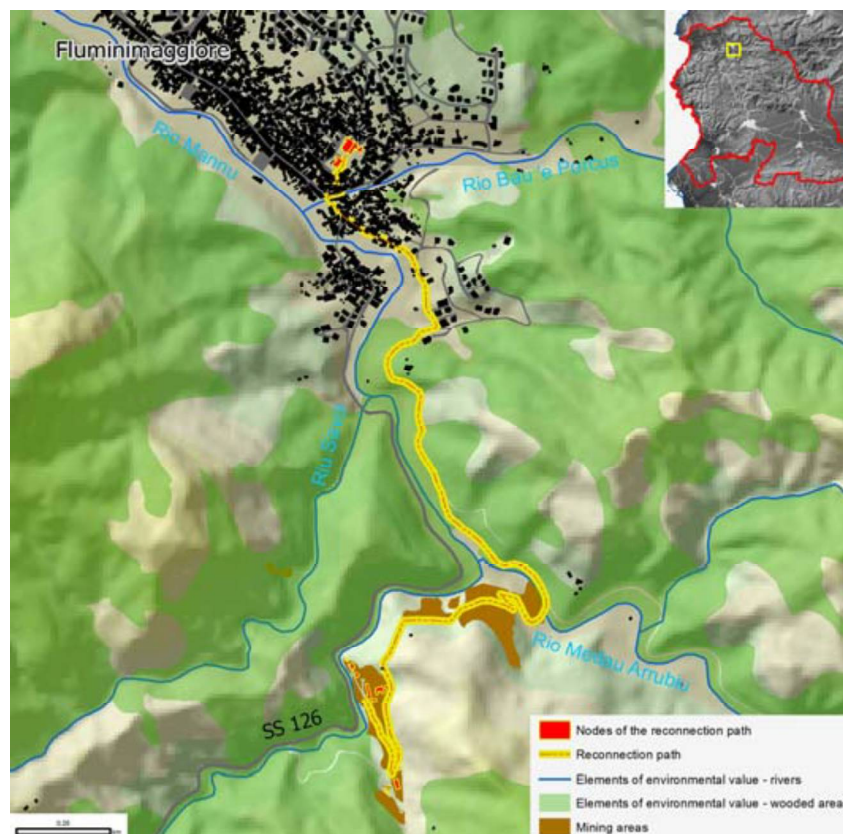


Fig. 3 Walkable reconnection proposal in Fluminimaggiore area

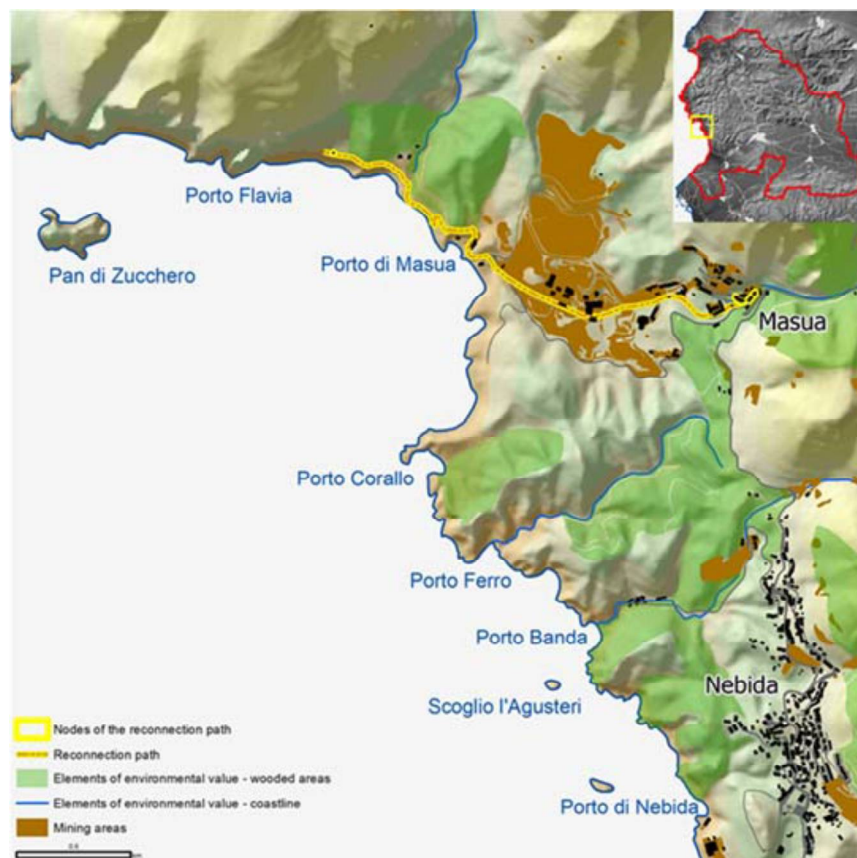


Fig. 4 Walkable reconnection proposal in Nebida - Masua area

The analyzed villages were the most isolated but most populous ones in the Iglesias 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

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 Iglesiasiente 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 Iglesiasiente 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 Iglesiasiente, enhancing the old mining paths, as detail elements of an existing macro-path (the Mining path of Santa Barbara - *Cammino Minerario di Santa Barbara*).

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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REFERENCES

Angelillo A. (2018). *Paesaggi Dismessi. Le implicazioni suburbane di Sebastian Marot*. In Peghin G., a cura di, (2018). *Paesaggi Minerari*, Lettera Ventidue Edizioni, pp. 37-46

Forsyth, A. (2015). What is a walkable place? The walkability debate in urban design. *Urban design international*, 20(4), 274-292. doi: <https://doi.org/10.1057/udi.2015.22>

Giles-Corti, B., Gunn, L., Hooper, P., Boulangé, C., Diomedes, B. Z., Pettit, C., & Foster, S. (2019). Built environment and physical activity. In *Integrating Human Health into Urban and Transport Planning* (pp. 347-381). Springer, Cham. doi: https://doi.org/10.1007/978-3-319-74983-9_18

Hajna, S., Ross, N. A., Joseph, L., Harper, S., & Dasgupta, K. Neighbourhood walkability, daily steps and utilitarian walking in Canadian adults. *BMJ Open*. (2015) 5 (11): pp. 1-10. doi: <http://dx.doi.org/10.1136/bmjopen-2015-008964>

La Riccia, L., Cittadino, A., Fiermonte, F., Garnero, G., Guerreschi, P., & Vico, F. (2019). The Walkability of the Cities: Improving It Through the Reuse of Available Data and Raster Analyses. In *Spatial Planning in the Big Data Revolution* (pp. 113-137). IGI Global. doi: 10.4018/978-1-5225-7927-4.ch005

Lefebvre-Ropars G., Morency C., Singleton P.A., Clifton K. J. (2017). Spatial transferability assessment of a composite walkability index: The Pedestrian Index of the Environment (PIE). *Transportation Research Part D* 57, pagg 378–391. doi: <https://doi.org/10.1016/j.trd.2017.08.018>

Li, S., Zhao, P., Zhang, H., & Quan, J. (2019). Walking behavior in the old downtown Beijing: The impact of perceptions and attitudes and social variations. *Transport policy*, 73, 1-11. doi: <https://doi.org/10.1016/j.tranpol.2018.10.005>

Mistretta, P., & Garau, C. (2013). Città e sfide. Conflitti e Utopie. Strategie di impresa e Politiche del territorio. Successi e criticità dei modelli di governance.

Peghin G., a cura di, (2016). *Paesaggi Minerari*, Lettera Ventidue Edizioni.

Peghin G., a cura di, (2018). *Paesaggi Minerari*, Lettera Ventidue Edizioni.

Rattan, A., Campese, A. and Eden, C. (2012) Modeling walkability. *ArcUser winter*: <http://www.esri.com/news/arcuser/0112/modeling-walkability.html>.

Sanna, F. (2014). *La miniera e il petrolchimico. Una questione storica nella Sardegna e nell'Italia del secondo dopoguerra*. Diacronie. Studi di Storia Contemporanea, (17, 1).

Talia, I. (2007). *Forme, strutture, politiche della città*. Liguori Editore Srl.

Zaninović, T., Palaiologou, G., & Šćitaroci, B. B. O. (2019). Walkspace as Cultural Heritage Within Urban Landscape. In *Cultural Urban Heritage* (pp. 263-288). Springer, Cham. doi: https://doi.org/10.1007/978-3-030-10612-6_19

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