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Geological landscape and stone heritage of the Genoa Walls Urban Park and surrounding area (Italy)

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ABSTRACT

In the last 20 years the conservation and enhancement of cultural and landscape heritage sites have been increasingly promoted by specific national and international laws. Thematic maps from scientific studies facilitate the public promotion and understanding of landscape and cultural heritage. This work introduces a novel geological landscape and stone heritage map of the Genoa Walls Urban Park (1:10.000 scale). The park is located in the immediate surroundings of Genoa city centre and it includes a complex system of historical fortifications. Today the park is frequented by hikers, mountain bikers and tourists.

The map shows three different elements of the park: lithological and geomorphological elements, cultural and landscape heritage sites and the trail network. This map offers new insights into the way in which the park authority can promote the sustainable fruition of a highly valuable area, characterised by landscape and historical interest next to one of the largest historical centres of Europe, part of which is inscribed in the list of Unesco World Heritage Sites.

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1. Introduction

In the last two centuries, and particularly in the post-war period, many Mediterranean cities have dramatically grown, often without specific urban planning (Chaline, 2001). This led to the intense urbanisation of some areas with important landscape changes (Reynard, Pica, & Coratza, 2017).

Genoa is a pre-Roman town in northwestern Mediterranean which became a powerful maritime republic in the early Middle Ages. Since Roman times and up to the C19th defensive walls around the city have been established and progressively expanded. They develop for 20 km and they are the second longest walls in the world after the Great Wall of China (Forti, 1971). Although some areas in Genoa underwent important morphological changes in the last century (Faccini, Paliaga, Piana, Sacchini, & Watkins, 2016), the city still keeps remarkable natural and cultural features, including the Genoa Walls Urban Park, a protected area established in 1995 (Ligurian Regional Decree nr. 1506/2008). This park includes elements of geological, geomorphological and cultural interest. Due to its central location, the park attracts many local and foreign visitors, representing a valuable geotourism attraction.

Geotourism (*sensu* Newsome & Dowling, 2010), i.e. a niche of global tourism industry with a geographical and geological focus (Newsome & Dowling, 2018), enhances the distinctive geographical character of a place, its cultural and environmental features, and the wellbeing of its resident, in a holistic approach to the environment. Studies on geoheritage (*sensu* Osborne, 2000), its identification, assessment and enhancement, even in a geotourism perspective, have traditionally been carried out in rural or natural areas. Only recently, Earth Sciences witnessed the birth of a new research field concerning geoheritage – and geomorphological heritage in particular – and geotourism in urban areas (Faccini, Piccazzo, Robbiano, & Roccati, 2008; Pica et al., 2017). However, geotourism products for the enhancement of urban geological heritage remain extremely limited (Del Monte et al., 2016; Pica, Vergari, Fredi, & Del Monte, 2016).

In this perspective geoheritage maps can be considered as useful tools for the recognition, conservation and fruition of the geodiversity elements of natural and urban landscapes, particularly in protected areas (Brandolini, Canepa, Faccini, Robbiano, & Terranova, 2007; Castaldini, Valdati, Ilies, & Chiriatic, 2005; Regolini-Bissig, 2010; Regolini-Bissig & Reynard, 2010; Serano & Gonzalez Trueba, 2011).

These thematic maps underline: i) the representation of the main geological and geomorphological features of the landscape (Coratza & Regolini-Bissig, 2009; Howie, 2004; Sapp, Miro, & Cesar, 2006); ii) the representation of geoheritage elements; iii) the trail network and basic tourist information (Castaldini, Valdati, & Ilies, 2009; Martin & Reynard, 2009); iv) information about the presence of other features of interest (historical, archaeological, cultural, botanical etc.) (Coratza, Ghinoi, Piacentini, & Valdati, 2008).

This paper introduces the geoheritage map of a typical Mediterranean area in the Ligurian Apennines (Figure 1, Main Map) in a region which is very vulnerable to climate change (Acquaotta, Faccini, Fratianni, Paliaga, & Sacchini, 2018; Acquaotta et al., 2018; Sacchini, Ferraris, Faccini, & Firpo, 2012). Genoa has suffered from an explosive urban sprawl since the end of the C19th, firstly along its small floodplains and successively along the slopes (Faccini, Paliaga, et al., 2016). Climate variations and urban sprawl trigger frequent floods that periodically hit the city, alongside with landslides on the hills (Faccini, Luino, Sacchini, Turconi, & De Graff, 2015).

The map highlights the lithological and geomorphological features of the Urban Protected Area together with trails, geotourism, cultural heritage sites and historical elements of the landscape. This map aims to increase the knowledge on the geological landscape and stone heritage of the area, and to provide new insights into the sustainable management of the protected area by the park authority; with some implementations and simplifications, other geo-thematic maps can be produced from this map, particularly geohiking, geotourism, geologic hazard and geomorphological risk maps.

2. Study area

The park is a 600 ha wide protected area which stretches along the ridge between the Bisagno and Polcevera Valleys, immediately inland the natural ‘amphitheatre’ of Genoa city centre (Figure 1).

The Park lies entirely within the border of Genoa Municipality and it constitutes its largest green lung. It develops between 200 and 600 m asl and it offers several wide panoramic views on the city as far as the Alps and Corsica. The importance of this park is given by the combination of landscape and historical values.

Since the Middle Ages, walls and forts have represented the most important defensive system of the Republic of Genoa. The first walls were built in the C12th and C13th, but they were greatly improved in the C17th, following the attempted invasion of the city by the Duke of Savoy. The defensive system is characterised by a series of gates, towers, tunnels and watchtowers for a total length of c. 20 km.

The climate is of Mediterranean type and sub-coastal Apennine subtype (Sacchini et al., 2012). The average annual rainfall is 1320 mm at Fort Castellaccio, with a maximum of about 200 mm (October) and a minimum between 35 and 45 mm (July). The rainfall is often intense and of short duration, triggering floods and shallow landslides (Faccini, Luino, Paliaga, Sacchini, & Turconi, 2015). Heavy rains, steep gradients and large amount of loose sediment can trigger debris/mud flows, particularly after flood events in late summer and autumn. The average annual air temperature is 12.7 °C at Fort Castellaccio. The climate profile is characterised by temperate summers and mild winters; this allows outdoor activities all year round.

From a geological point of view the rocks of the Genoa Walls Park belong to the Ligurian Units of the Northern Apennine (APAT, 2008), composed of heterogeneous rock masses (Figure 1): in particular, the protected area lies almost entirely on the Antola Tectonic Unit, characterised by: i) marly limestone turbidites (sometimes silty limestone), in limestone layers which reach metric thickness, marls and marly limestone, with hemipelagic shales in centimetric interlayers (Formazione di Mt. Antola *auct*); ii) its base complex, composed of green hemipelagic shales, in layer thickness from centimetre to decimetre (Argilliti di Montoggio *auct*).

Along the south-western edge, lithotypes belonging to the Ronco Unit outcrop, made up of turbidites, siltstones, marly siltstones and shales, in centimetre to decimetre layers (Formazione di Ronco, *auct*). Further west, there are outcrops of formazione di Montanesi *auct* (Figure 1) made up of hemipelagic shales and blackish silty shales, rarely polychrome, with quartz sandstones interlayers, with a thickness ranging from centimetre to multi-decimetre.

The right side of the Polcevera Valley is characterised by the Argillite di Murta *auct* (black slate phyllite schist with siltstone interlayers), belonging to the Monte Figogna Unit (APAT, 2008). The Antola Unit is the top formation of the Apennines and it overthrusts eastward the other formations (Capponi & Crispini, 2008). However, the westernmost sectors of this unit, where the Park lies, have been involved in the alpine orogeny and they overthrust from E to W the other units with alpine direction (APAT, 2008). W of the Park the units of the Sestri-Voltaggio area are well visible (particularly ophiolites and dolomites) as well as the meta-ophiolites of the Voltri massif group. All the geological formations of the area around the Park have a complex tectonic history with several brittle and ductile deformations and a mean dip direction towards SE.

From a geomorphological point of view the park lies on the watershed between the Bisagno (E) and the Polcevera Valleys (W), while its southern edge is included within the historical ‘amphitheatre’ of Genoa city centre, characterised by seven small catchments

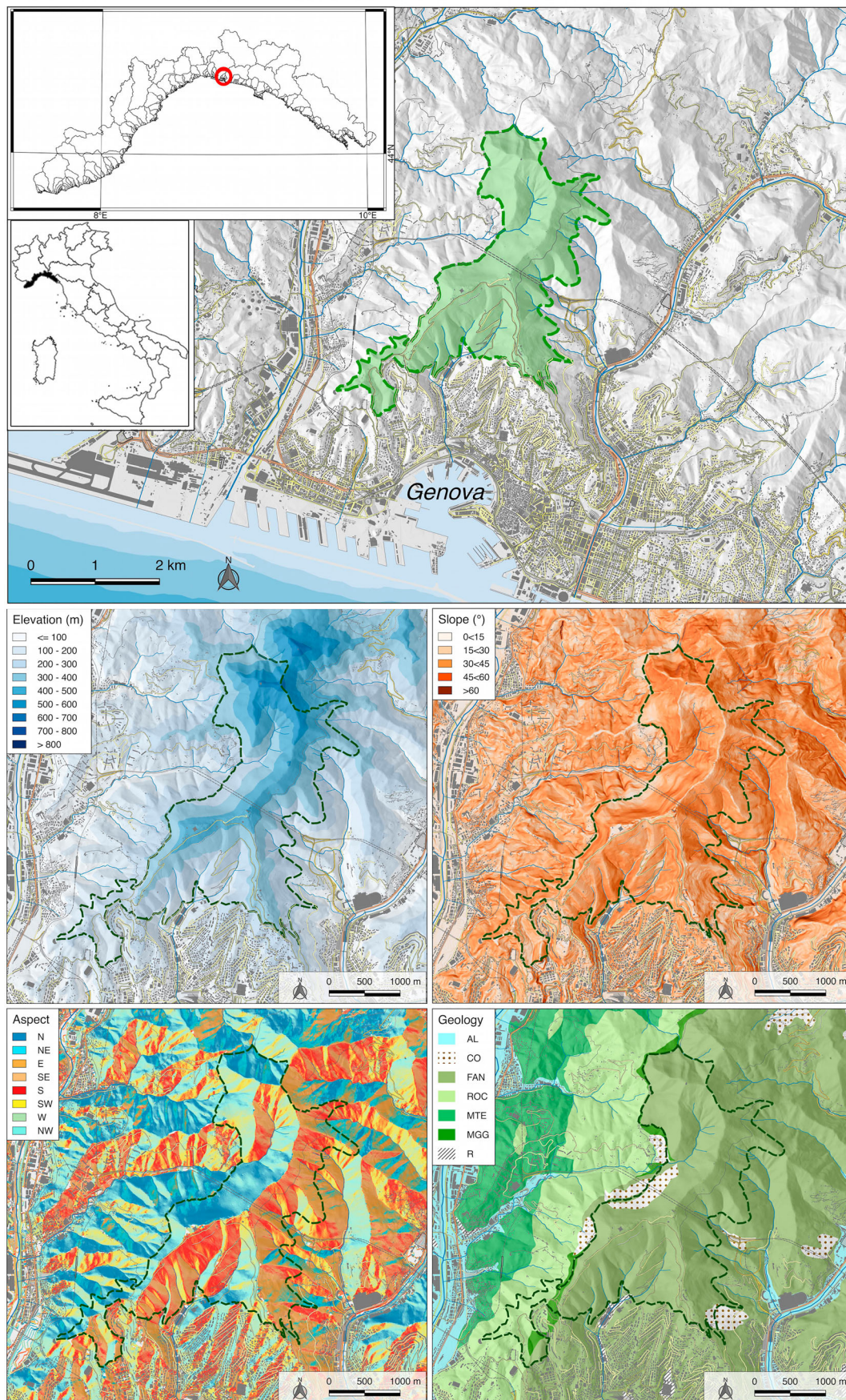


Figure 1. Geographical, elevation, slope, aspect and geological sketch maps of the Genoa Walls Urban Park (green dashed line) on Digital Elevation Model (5 m \times 5 m resolution). Key of the Geology Map: AL. alluvial deposits (Holocene); CO. debris covers (Holocene); FAN. Mt. Antola Formation (Upper Cretaceous); ROC. Ronco Formation (Upper Cretaceous); MTE. Montanesi Formation (Upper Cretaceous); MGG. Montoggio shales (Upper Cretaceous); R. fills (Anthropocene).

(<1 km²) (Bixio et al., 2017). The geomorphology is conditioned by the slopes steepness, which is often >30°: landforms of erosion and deposition due to running water and gravity prevail, while limited karstic features are occasionally observed in the limestone interlayers of the Mt. Antola formation; artificial landforms are very common and they often modify the natural ones. Woodland is characterised by mixed deciduous species where chestnut trees prevail, particularly in the northern part. Small fields and cultivations are found around the villages, while the upper slopes are bare and grassy, with occasional pasture.

3. Material and methods

The methodological approach is summarised as follows. Initial bibliographical and cartographical analysis provided a useful historical and geographical background. The base map consists of several vector layers (buildings, roads, hydrographical network, contour lines), while the sketch maps were obtained from a shaded relief map based on a Digital Terrain Model (DTM) with 5 m resolution. Lithological and geomorphological elements were obtained from: a) existing geological maps (APAT, 2008; Capponi & Crispini, 2008); b) urban planning and basin master plan studies (Autorità di Bacino Regionale, 2017a, 2017b, 2017c; Comune di Genova, 2014; c) specific scientific works (Cortesogno & Haccard, 1984; Limoncelli & Marini, 1969; Marini, 1981; Marini, 1998); d) detailed lithological and geomorphological field surveys at 1:5,000 scale based on Regional Technical Map (2007) and original photo interpretation using the regional flight (2003) ‘Volo 63 – Medio Genova’. This has allowed us to map the rock formations and to identify the main landforms connected to geomorphological processes. In order to provide a valuable tool for the sustainable management of the park, the geological legend was simplified by grouping the lithotypes based on their technical characteristics. Similarly the geomorphological features are classified as gravitational and water-related processes (landslides, alluvial deposits and debris covers), artificial landforms (excavations, embankments, fills) and geomorphic elements (hydrographical network, springs).

Cultural and landscape heritage elements were surveyed and selected in accordance with the European Landscape Convention (Council Of Europe, 2000); in particular, art. 6 of the Convention informs about specific training and education measures on landscape policy, conservation, management and planning.

In Italy the Convention was implemented in 2004 with the Code of Cultural Heritage and Landscape (‘codice Urbani’) which considers the landscape as the product of natural and human influence and their interrelation; according to the convention, the cultural heritage consists of cultural property and landscape assets: cultural property consists of immovable and

movable things which present artistic, historical, archaeological, ethno-anthropological, archival and bibliographical interest as testifying to the values of civilisation. Landscape assets are the buildings and areas which are the expression of historical, cultural, natural, morphological and aesthetic values of the land.

Heritage sites have been divided into two specific themes:

- 1) landscape heritage sites of geological (palaeontology, sedimentology and structural geology) and geomorphological interest (running water, morphotectonics, gravity) and panoramic geo-viewpoint (*sensu* Migoñ & Pijet-Migoñ, 2017). Caves were assigned a specific category as they are protected by the Liguria regional law n° 39/ 2009 ‘Law for the development of geodiversity, geosites and karst areas in Liguria’, which also promoted the Ligurian caves database (Faccini, Benedettini, Firpo, Perasso, & Poggi, 2012). Caves were differentiated from geosites: while the former were already validated by a regional database, an inventory of the latter is still under examination by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale).
- 2) cultural heritage: artificial cavities (data obtained from the database of the Italian Speleological Society), ice houses, historical buildings, forts, towers, ancient aqueducts, ancient walls and terraces with dry-stone walls. These sites show the complex relationship between the natural and cultural heritage of the park.

The trail network was mapped using the database and shape files of the High Route of Ligurian Mountains, the Italian Alpine Club, the Italian Hiking Federation and the Ligurian regional authority; several thematic trails promoted by the urban park were also included. In addition, original field surveys were carried out in order to define the characteristics of the trails.

Two sketch maps indicate the main tourist features and land use categories of the area, while two geographical maps show the position of the park in relation to Liguria, its protected areas and the main forts and garrisons of Genoa Metropolitan Area.

4. Results

The park lies in a central position between other protected areas of regional and national interest. From at

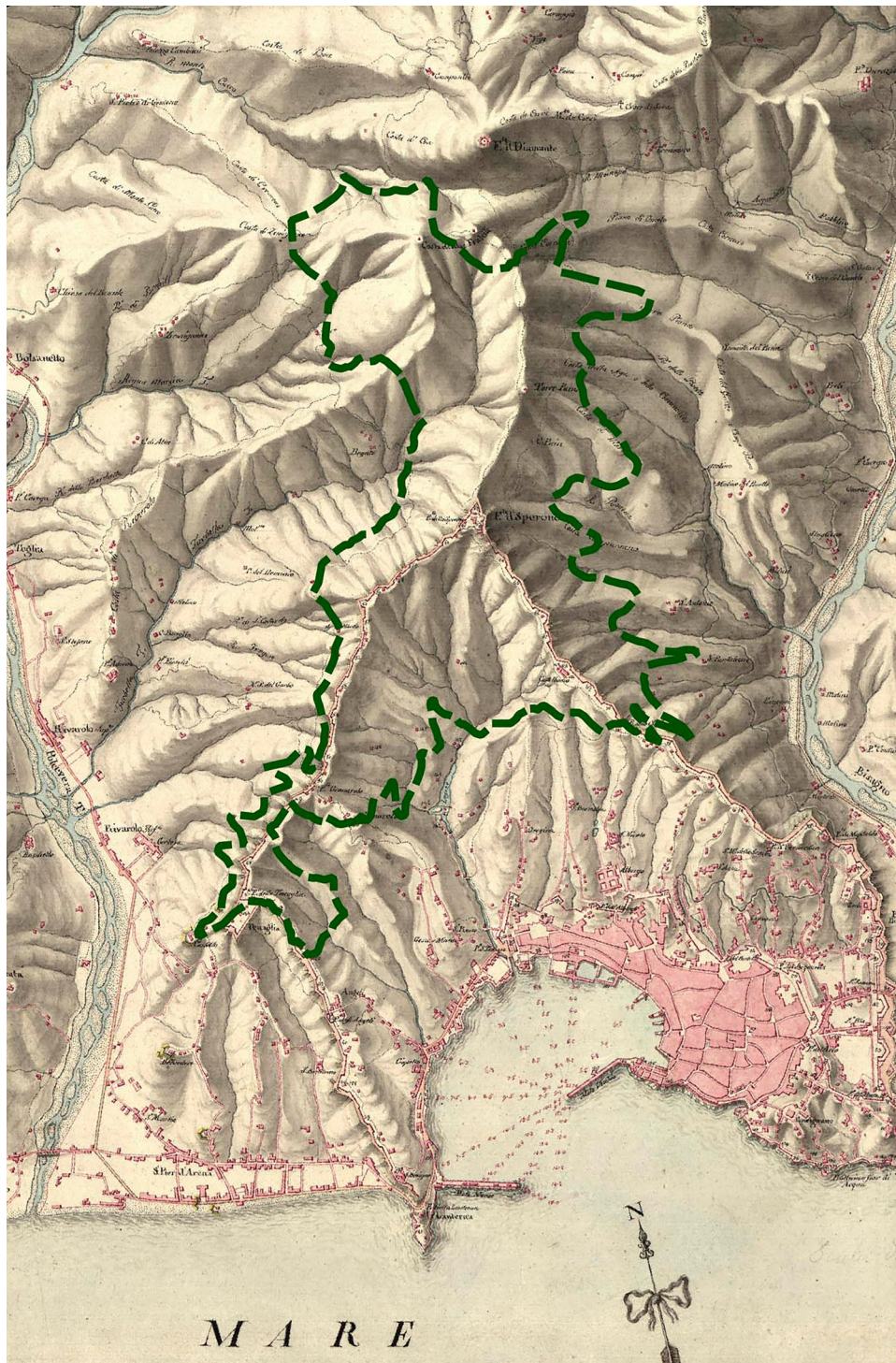


Figure 2. Genoa and the walls (c. 1815-1823) (from Italian Military Geographical Institute archive). The green dashed line indicates the Genoa Walls Urban Park.

least the Middle Ages forts and walls were built to protect Genoa from N (Forti, 1971). Three main walls are still visible (Figure 2): the *Mura del Barbarossa* walls in the historical centre, built against Emperor Fredrick Barbarossa in the C12th, the sixteenth-century walls and the walls built between C17th and C18th, more or less corresponding to the current boundaries of the park (Grossi Bianchi & Poleggi, 1980). Other military garrisons were established in the Genoa metropolitan area by the Italian Kingdom (1861–1943), particularly anti-aircraft artilleries in the Second World War.

4.1. Lithological and geomorphological elements

The lithological characteristics of rock mass formations are emphasised through the use of solid colours which group lithotypes according to their different geomechanical behaviour (Joyce, 1994). In particular: i) the Mt. Antola and Ronco formations were labelled as ‘marly limestones and marly siltstones with shales and calcarenites interlayers’; ii) the Montanesi Formation (stratigraphic base of Ronco Formation) belongs to the



Figure 3. Geological and geomorphological features: 1. Mt. Antola formation outcrop, photo by G. Paliaga; 2. Montoggio shales formation typical outcrop, photo by A. Sacchini; 3. Meandering-like track of the *Helminthoidea labyrinthica* in the marly layers of Mt. Antola formation, photo by G. Paliaga; 4. Waterfall along the Rialasco streambed, photo by A. Sacchini; 5. Morphology of the streambed along the upper Torbella Valley, photo by A. Sacchini; 6. Typical spring along the Rialasco Valley, photo by A. Sacchini.

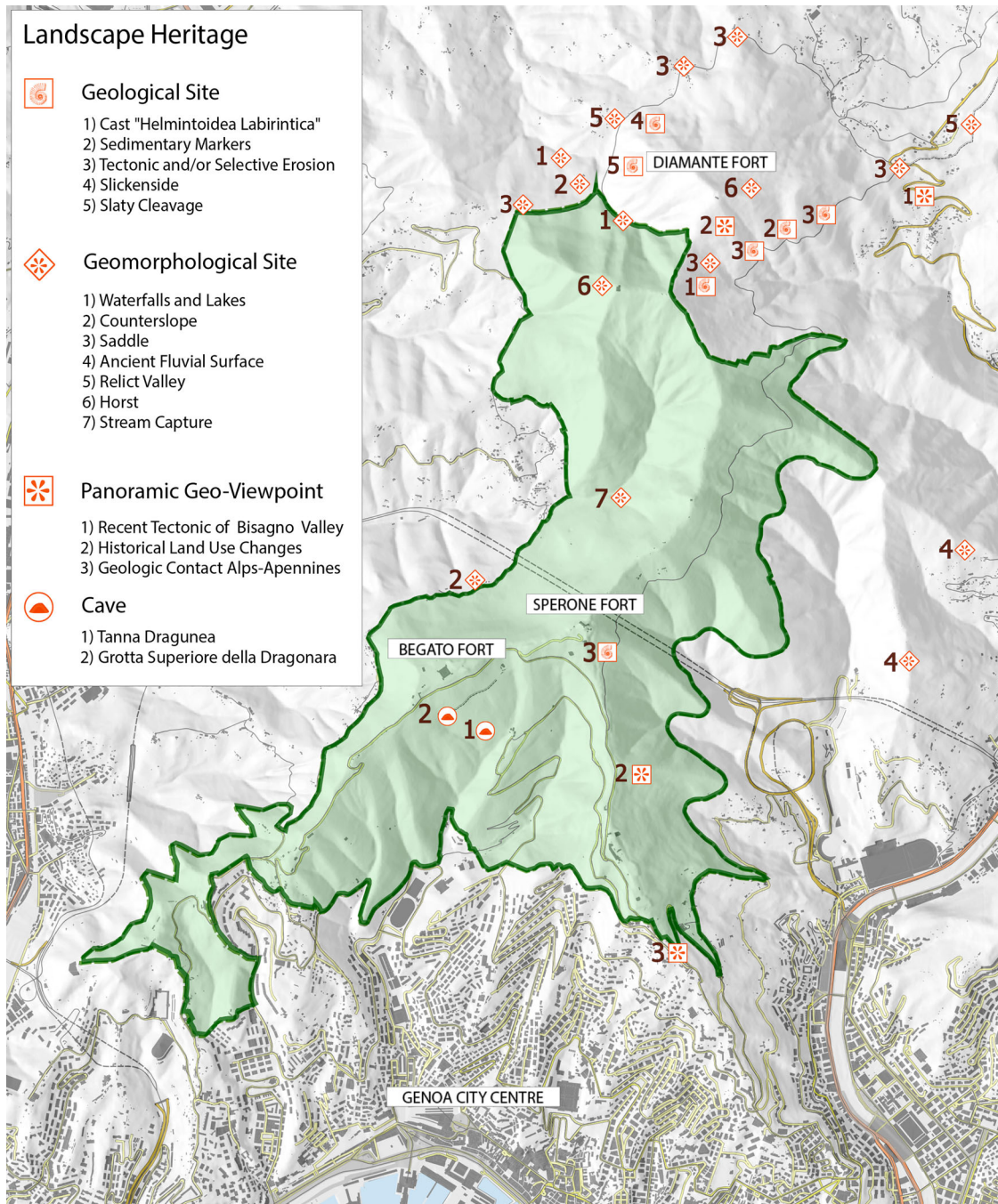


Figure 4. Sketch map of the landscape heritage sites. See Tab. 1 for legend and details.

'shales and silty shales with siltstones interlayers'; iii) the Montoggio Formation (base complex of Antola Formation) was labelled as 'clayey shales'. Although it is often fractured and permeable, the first formation is harder, while the second and third formations are ductile and impermeable.

In particular the area of the park is characterised by the so called 'Flysch with *Helminthoidea labyrinthica*'. Their dip direction was conditioned by the tectonic processes they went through and it is generally towards SE. Occasionally inverted strata are found, indicated by traces of meandering-like tracks of *Helminthoidea labyrinthica*, particularly E of Fort Fratello Maggiore (Figure 3). The most significant outcrops are in the

southern and north-western parts, mainly between Forts Sperone, Begato and Puin.

Clayey shales of the Montoggio Formation are characterised by irregular surfaces and significantly gentler slopes. They are found in the western part of the park, particularly near Begato village (Figure 3).

Due to important gravitational processes, debris covers and landslides characterise the rocky formations, as well as colluvial deposits due to running waters. Slope covers generally consist of limestone breccias with mud and clay matrix, while landslides, with chaotic texture, are mainly ancient and relict mass movements. These covers characterise the boundaries of the park in the Bisagno and Polcevera Valleys, while floodplains,

Table 1. Description of geological sites.

Site	Number	Description
<i>Geological sites</i>		
Cast 'Helmintoidea Labirintica'	1	Ichnofacies outcrop characterising geological Formation and its sedimentary environment
Sedimentary markers	2	Sole marks: flute, load and groove casts in Bouma sequences of turbiditic sedimentary rocks
Tectonic and/or selective erosion	3	Parasitic folds and/or erosion in argillitic levels alternated with sandstone or limestone of turbiditic sequences
Slickenside	4	Fossils fault planes with fault striae
Slaty cleavage	5	Pencil and slaty cleavage for tectonic load during early stages of Alps-Appennines orogenic deformation
<i>Geomorphological sites</i>		
Waterfalls and lakes	1	Waterfalls and lakes of tectonic/erosive origin
Counterslope	2	Counterslopes of tectonic-gravitational origin
Saddle	3	Saddles marking ancient fluvial base levels
Ancient fluvial surface	4	Almost flat areas marking ancient fluvial surfaces
Relict valley	5	Relict valleys marker of ancient hydrographic network
Horst	6	Relief marking neotectonic activity
Stream Capture	7	Recent stream deviation of tectonic/erosive origin
<i>Geoview point</i>		
Recent tectonic activity of Bisagno valley	1	Neotectonic deviation of Bisagno river and base level lowering
Historical land use changes	2	Agricultural terraced areas alternated with factories, recent buildings, roads, highways, railways, airport in Polcevera valley
Geologic contact Alps-Appennines	3	View of the geological thrust of Alpine Units (Voltri and Sestri-Volatggio Units) on Appenninic Units in the right slope of Polcevera Valley

today entirely built up, are represented by alluvial deposits (Faccini, Luino, et al., 2018).

In addition, many excavation surfaces and fills surround forts and walls, characterised by limestone ash-lars, cemented in a gravel and sand matrix. Furthermore some small and unmappable quarries, now abandoned, were historically active in the area. All the quarries in the map are linked to limestone and marl geomaterials of the Mt. Antola Formation.

Water springs were mapped too: they are often found along the contact between different lithotypes and next to landslide bodies. Some of them were used for the old aqueduct of Genoa, particularly the springs near Fort Fratello Minore, while the springs of Rio Rialasco, and Torbella, above Begato, have been used for the local aqueduct (Figure 3).

The hydrographical network, strictly conditioned by the tectonic of maritime Liguria (Fanucci & Nosengo, 1977), is organised using the Strahler classification. This facilitates the immediate understanding of both the stream order between the main river and its tributaries and the physical-geographical characteristics of the catchments.

4.2. Geological Landscape and Stone Heritage

The geological landscape and stone heritage of the Genoa Walls Urban Park and surrounding area includes several features of interest: based on current national and European regulations, they can be divided into cultural and landscape heritage sites, the latter also including the geological elements. This list of features of interest and their spatial distribution within the area can be used by the park authority for several purposes, including training and education activities for local stakeholders and schools and landscape conservation, management and planning policies

Among cultural heritage sites, stone cultural heritage is highlighted (Cimmino, Faccini, & Robbiano, 2004); this category includes snow pits for the accumulation of snow, artificial cavities used as water tanks or underground escape routes and heritage buildings such as ancient military garrisons or monumental stone buildings (Figure 4). The typical Ligurian terraces with dry-stone walls for agriculture are particularly significant (Brancucci & Paliaga, 2006; Paliaga, Giostrella, & Faccini, 2016). In addition the ancient Genoa aqueduct, the forts and towers and three main walls are mapped.

Interesting artificial cavities are found in Fort Sperone, Diamante and Begato, particularly hydraulic works (cisterns and water drainage) and military structures (firing posts and walkways). Interesting examples of snow pits are visible in the upper western side of the Bisagno Valley between Fort Puin and Diamante, often partly hidden behind the vegetation. Heritage sites, some of which being described in section 4.3, relate to important historical buildings and museums (for example the Staglieno cemetery or the Rural Museum of Garbo) or recollect significant events occurred in the park area.

The forts of the park are particularly important not only for their historical-environmental value, but also for their significance as unique examples of stone-built cultural heritage. They are made of blocks of marly limestone from local quarries and from the historical quarries of the Genoa Promontory. The most interesting examples are probably Fort Diamante and Fort Sperone, respectively along the northern and the southern edge of the protected area. Remains of the old aqueduct are found in the park area: this was an old architectural structure in the Val Bisagno which ensured for centuries the water supply of Genoa and its port. In the park area, the seventeenth-century walls, which develop along the ridge between Genoa, the Polcevera and the Bisagno Valley, are still well



Figure 5. Landscape and cultural features of the protected area: 1. Fort Puin from Fort Fratello Minore ruins, photo by L. Fiorentini; 2. South side of Fort Diamante, photo by L. Fiorentini; 3. Fort Puin (a), Fort Sperone (b) and Fort Begato (c) from Fort Fratello Minore viewpoint, photo by L. Fiorentini; 4. Panoramic view of Fort Puin, photo by A. Cavaliere; 5. Panoramic view of Fort Diamante, photo by A. Cavaliere; 6. Old ice-house near Trensasco, photo by P. Piana; 7. Dry-stone walls terraced landscape near Begato village, photo by A. Sacchini.

conserved. Particularly impressive fortifications are visible around Righi and below Fort Sperone. Terraces, traditionally sustained by dry-stone walls, testify to the historical agricultural vocation of the area. Some

well-conserved examples are found around the settlements of Baracche, Begato and Trensasco, where olive trees are grown, together with seasonal vegetables, fruit trees and occasionally vineyards.



Figure 6. Trail network features of the Genoa Walls Urban Park and surrounding area: 1. Dirt road nearby Fort Sperone, photo by A. Sacchini; 2. Granarolo funicular railway, photo by G. Paliaga; 3. Creuza (typical Ligurian footpath) at Begato village, photo by A. Sacchini; 4. Natural soil path for Fort Fratello Minore, photo by G. Paliaga; 5. Dirt road from Fort Puin to Fort Fratello Minore, photo by L. Fiorentini; 6. Asphalt and concrete road on the ancient Via Postumia nearby Begato Village, photo by A. Sacchini.

Among geological landscape heritage sites, geosites *l.s.* and panoramic geo-viewpoints are mapped (Facchini, Galiano, Paliaga, & Roccati, 2016) (Table 1 and Figure 5). In particular geosites are distinguished into sites of geological and geomorphological interest. The first category includes the *Helminthoidea labyrinthica* fossils, as well as sedimentary markers such as Bouma sequences, flute or groove casts, selective erosion (in particular at Fort Puin and between Trensasco and Fort Diamante) or structural geological elements such as faults slickensides, slaty cleavage

or selective tectonics on different lithotypes, particularly around Fort Diamante and Fratello Minore. Among sites of geomorphological interests, landforms related to running waters and karst are particularly significant.

Watercourses are characterised by river bed erosion, especially those in the upper basin of the Lagaccio, Moinasso di Trensasco, Rialasco and Goresina streams, in addition to the tributaries on the hydrographical right of the Bisagno (Autorità di Bacino Regionale, 2017a, 2017b).

Other landscape elements include slope steepness variations, with waterfalls and little lakes along streams (Rialasco and Moinasso Valleys) or counter-slopes linked to large slope gravitational processes. These are particularly significant in the Polcevera Valley above Fort Begato and Fort Fratello Minore (Sacchini, Faccini, & Luino, 2016; Sacchini, Faccini, Ferraris, Firpo, & Angelini, 2016). Saddles, ancient surfaces of fluvial erosion and relict valleys (Rialasco Valley), stream capture branches (Torbella Valley) and structural landforms (Fort Diamante, Fratello Maggiore and Fratello Minore) are mapped as examples of recent intense geological-geomorphological activity (Fanucci & Nosengo, 1977). Finally, karst landforms are mapped, represented by caves in the Mt. Antola Formation (Figure 1); their genesis is linked to physical and chemical dissolution in limestone interlayers along tectonic lineaments. The ‘Tann-a da Dragunea’ (313 m asl), located below Fort Begato, is particularly significant, while the ‘Grotta Superiore della Dragunea’ (396 m asl) is a typical pseudokarst landform linked to tectonic activity (Faccini et al., 2012).

Panoramic geo-viewpoints label special sites where particular neotectonic elements which influenced land use and landscape changes can be observed. Furthermore general tectonic landforms such as the geological structure of the Northern Apennines or the geological contact between the Alps and the Apennines chains can be identified.

4.3. Trail network and tourist features

The trail network was mapped highlighting the path surface (concrete or asphalt, cobbled, natural soil or rocky, staircase) (Figure 6). Trails starting from the city centre are usually on concrete surface or staircases which join the ancient *creuze*; these are mule-tracks once used to transport goods from the port of Genoa to mountain passes of the Apennines and the Po Valley. Out of the city, the paths are characterised by natural surfaces, either loose soil or rock, particularly along the ridges. There are also trails of historical and naturalistic interest: the *Sentiero delle Farfalle* (butterfly path), so called because of the presence of the *Vanessa atalanta* butterfly, especially in spring; the *Via del Sale* (salt route) an ancient route used to transport salt from the port of Genoa to the Po Valley and the *Via Postumia* path, the ancient Roman road from Genoa to Aquileia (on the Adriatic Sea). Furthermore jogging tracks, horse riding trails and mountain bike routes are highlighted.

The park has several tourist facilities (car parks, picnic areas, campsites, bus stops) and other attractions such as an aerial adventure park, an astronomical observatory, the ancient funicular and the Genova-Casella railway. Historical and heritage sites are ancient mills, an artificial lake historically connected to a mill

and today used for trout fishing, ancient rural villas once belonging to local aristocratic families (Quaini, 1979) and many typical rural settlements. In addition, cemeteries, religious sanctuaries and churches are found in the area, as well as a museum of rural life. Finally, several locations recollect historical events that took place in the area, including a partisan house used during the Italian Resistance and the place where the famous Italian poet Ugo Foscolo was wounded in battle in 1800.

5. Final remarks

The park authority has been instituted to promote the fruition and protection of the environment: today, these purposes are only partly reached and the consequences of the abandonment of the countryside, abusive dams and shallow landslides are still well visible in the landscape. Specific policies aimed to promote agriculture and tourism and to increase the population in the area would reduce the impact that the abandonment of the countryside has on the landscape. Participatory land management, where the population is actively involved in the decision making process, appears of essential importance to reduce environmental degradation. This is possible by making the public aware of the importance of the geological and cultural landscape of the area, stressing their potential in terms of economic development (O’Halloran, Green, Harley, Stanley, & Knill, 1994; Sharples, 2002).

The map brings together elements of the geological, geomorphological and cultural landscape, offering a key to read and interpret a complex and rapidly changing landscape. It is a useful tool for the management and enhancement of what can constitute a strategic area for the tourist development of Genoa. In Liguria, increasing attention to outdoor activities resulted in the growth of green tourism, particularly in some parts of the Riviera (Faccini, Gabellieri, et al., 2018). This map offers new insights into the way in which the park authority can promote the sustainable fruition of a highly valuable area, less than 20 minutes from one of the largest historical centres of Europe, part of which was recently declared a UNESCO heritage site.

Along the itineraries it is possible to observe interesting geological structures, the geomorphological evolution of the slopes and related environmental-geological issues. Over the centuries, people took advantage of the morphology of the area to build a complex system of defensive walls and forts and shaped steep slopes to build terraces. The combination of geological and artificial elements as it is shown in the map, makes this area an almost unique case in the Mediterranean. For what concerns the maintenance of the territory, management carried out by the park authority only partly contributes to reduce soil erosion and slope instability. A more stable and active protection of the territory, connected with the

management of terraces for agriculture and water drainage appears of essential importance; it would effectively contribute to decrease solid transport and runoff, reducing flood risk for the city of Genoa.

Today the park management is carried out by an office of the Genoa City Council in charge of all historical urban parks. This reduces the autonomy and budget of the park authority which has limited power in terms of conservation, development and promotion of the protected area. In addition, based on a regional law, the protected area should have its own autonomy and identity. One solution could be the establishment of a regional park; this would allow the park authority to act as intermediary between the surrounding protected areas and to fulfil its function as institution devoted to the conservation and promotion of the environment.

Software used and map design

Quantum GIS, Adobe Illustrator and Photoshop were used for the maps. The vector shape files were either created by the authors or downloaded from the institutional website of Liguria region authority (<https://geoportal.regione.liguria.it/>).

The map was designed in order to meet the format ISO standard requested by the journal and to provide a suitable scale at the same time.

Based on these conditions, a base map with scale of 1:10.000 was chosen as it allows a good detail of the representation and the use of the paper size A1 (594 × 841 mm) was considered the most suitable.

Once the map was embedded into the A1 size map frame, the legend (geological and geomorphological, cultural and landscape heritage, trail network elements), the geographical setting references and the authors' names and details were inserted.

The symbologies of the heritage elements are those normally in use and they effectively highlight the features of interest.

In order to have a vector-based map we:

- (1) produced the vector files
- (2) built single layer files composing the map
- (3) uploaded each file to the graphic software to obtain the final framework
- (4) improved the graphic rendering of the final product

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