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RECONSTRUCTING THE FUNERARY LANDSCAPE: NATURAL ENVIRONMENT AND TOPOGRAPHY OF THE NECROPOLIS

It is well known that the definition of landscape can have multiple declinations depending on the aspects considered by a given discipline. Generally speaking, we could describe the landscape as «the part of the territory that is embraced by the eyes from a given viewpoint» (https://www.treccani.it/vocabolario/paesaggio). Inherent in the definition of landscape is therefore a visual meaning, the view from which we look at and the recognition of certain features that characterize the landscape we are observing. These specific aspects are represented by a series of features, geological, structural, geomorphological, climatic, to which modifications due to human action are necessarily intertwined.

The interaction between natural elements and human settlement structures determines the shape of the landscape that is observed.

If we introduce the chronological aspect and thus shift our point of view, observation will then necessarily have to take into account different sources of information in order to 'look at' that landscape. It is essential to analyze the modifications of the natural and anthropic forms of a given territory, the former being studied by the earth sciences (in particular geomorphology) and the latter by landscape archaeology (Dall'Aglio 2011).

Finally, the reference to a 'historical' or 'ancient' landscape implies the concept of reconstruction, a reconstruction that will obviously be hypothetical and therefore virtual. The potential offered today by Virtual Reality and Augmented Reality makes it possible to visualize this ancient landscape and to recall the visual perception at the basis of the very definition of landscape (Pescarin 2009).

Even for the reconstruction of the landscape of the Picenian necropolis Quagliotti-Davanzali, before defining and detailing techniques and procedures of modelling and three-dimensional reconstruction at site scale (spatial scale) and single burial/object scale (object scale) (see in this volume S. Garagnani) starting from the archival archaeological documentation and recent excavations (see in this volume E. Zampieri), the integration of the information deducible from the archaeological investigations with the geomorphological analysis was evaluated.

It was immediately deemed necessary to extend the topographical analysis to the landscape surrounding the entire necropolis. The first step was the creation of an initial Digital Terrain Model (DTM) starting from the Regional Technical Map at a scale of 1:10000 with a 10 m pitch, through the interpolation of the contour lines and the current hydrography, using the

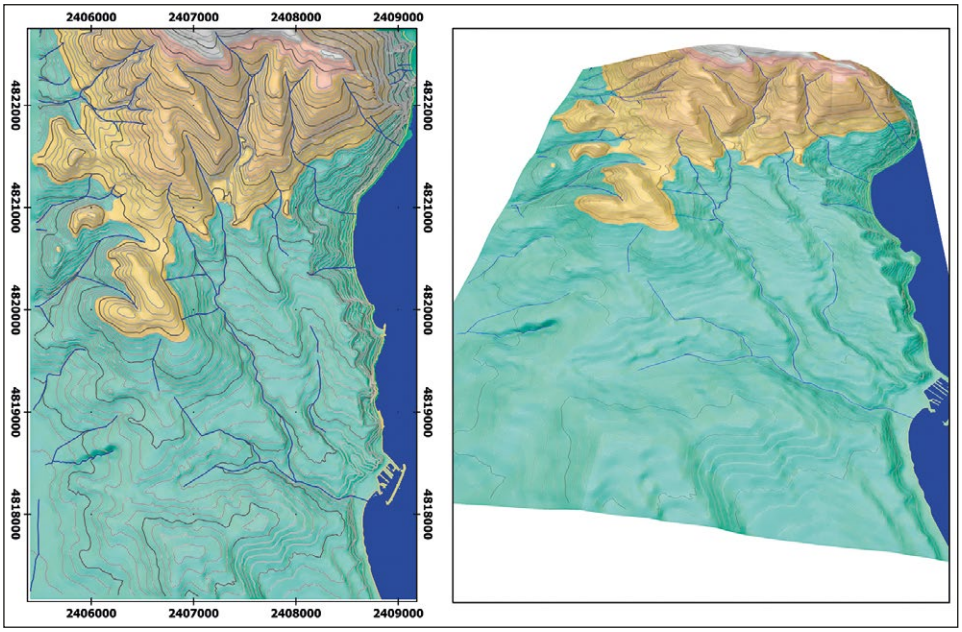

Fig. 1 – DTM of the Numana area extracted from the CTR (Regional Technical Cartography) (elaboration M. Silani).

Topo to raster algorithm (see *Using Topo to Raster in 3D Analyst* in *ArcGIS* online help) (Fig. 1).

In order to obtain a more detailed DTM, a stereoscopic pair of aerial photographs from the 1955 G.A.I. flight (11095-11096, Sheet 118, Stripe 13D, Flight altitude 5000 m, scale 1:33000) was subsequently acquired. These photograms immortalize a territory devoid of the incisive changes due to the mechanization of agricultural practices and the urban densification phenomena of the last sixty years, or in other words, a morphology more similar to the historical landscape. The digital photogrammetric processing (with Agisoft Metashape software) was supported by a measurement campaign of different GCP (Ground Control Points) by differential GPS (see below), visible in the frames and still recognizable on the ground. The classification of the evidence related to the elements on the ground surface (buildings and vegetation) present in the frames finally allowed the extraction of a detailed DTM (0.5 m cell sizes), which describes with good accuracy the morphology of the site (Fig. 2).

At the same time, the collection of geomorphological data of the area currently published began, to which it is hoped to add data from direct surveys.

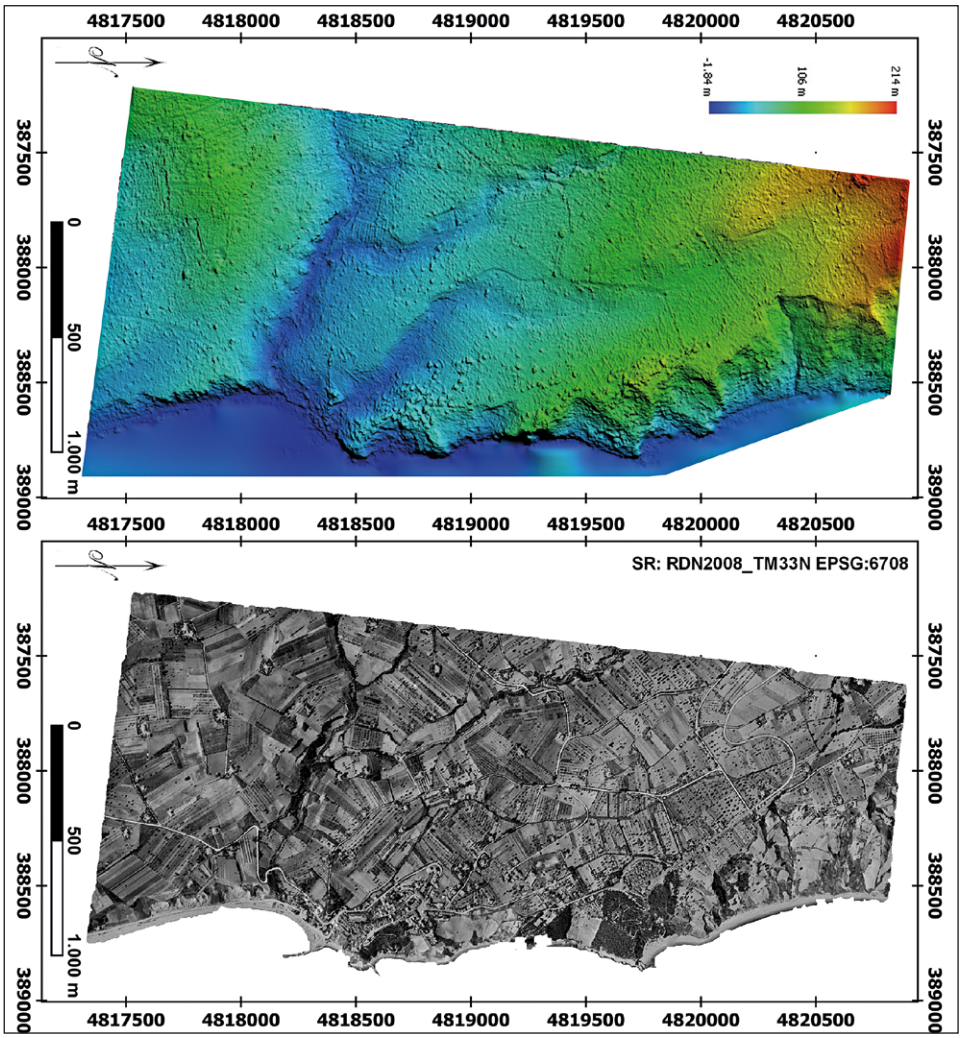

Fig. 2 – Detailed DTM (0.5 cell sizes) and relative orthophoto of the Numana area: photogrammetric elaboration of the 1955 G.A.I. flight (elaboration E. Zampieri, M. Silani).

Although the analysis is still at a preliminary stage, interesting indications and problems for the reconstruction of the ancient landscape have immediately emerged. As it is well known (Finocchi 2018), the town of Numana lies on the top of a coastal cliff subject to strong erosion, characterised by Holocene landslide deposits in evolution belonging to the Musone synthema (Fig. 3). Towards the hinterland, the hilly relief is furrowed by modest valley incisions,

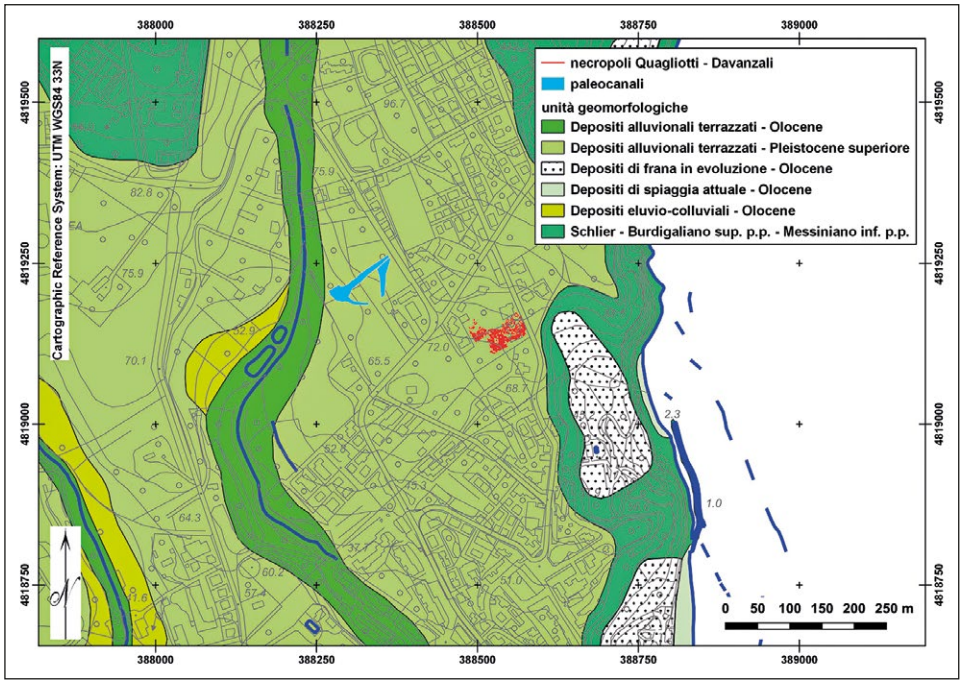

Fig. 3 – Extract of the geomorphological map of the Numana area: in evidence the funerary areas under study (elaboration by M. Silani).

where there are numerous streams, today as in ancient times, which feed the main collector of the Fosso dei Mulini that flows 100 metres south of Numana. With a course parallel to the previous one, but more shifted towards the coast, the Fosso della Fonte, today partly entombed, borders the slope that limits the settlement of Numana to the west and therefore also the necropolis sector. The latter are located in a more stable area than the coastal sector, i.e. on the alluvial terraced deposits of the Matelica synthema, with a predominantly sandy matrix, datable to the Upper Pleistocene. Of particular interest are the data from the recent excavations of the necropolis of Via Peschiera (Baldoni, Paci, Finocchi 2019), about 250 m from the Davanzali necropolis, in a terraced sector sloping down towards the Fosso della Fonte. The area, during the phase of use between the 3rd-2nd century BC, was crossed by wide and deep active paleochannels, with direction NE-SW and EO, converging on the Fosso della Fonte. The fills of the paleochannels, between 7 and 20 m wide and more than 5 m deep, consisted of alternating colluvial deposits with post-antique ceramic materials inside. This information is of particular interest, as it testifies to the geomorphological dynamism of the area, which may

also have conditioned the choice of location of the necropolises and, above all, may have modified the height of the original paleosols in ancient times.

In order to put forward some initial hypotheses for the reconstruction of the different phases of occupation of the necropolis and to identify the relative topographical planes (paleosols), it was necessary to define a sort of 'zero elevation' from which to begin in order to understand the choices implemented by man in the realization of the funerary area.

From a procedural point of view, the definition of a single altimetric reference system for the entire necropolis made it possible to relate the information deduced from previous investigations to the only portion of the excavation area still partially accessible (Baldoni, Paci, Finocchi 2019).

A new topographical documentation activity was therefore set up through the systematic use of geomatic techniques (photogrammetry, photomodelling, laser scanning, DGPS), to document the archaeological evidence and form the starting point for the virtual model.

The starting point was the materialization of a new network of topographical vertices using differential GPS, not only as a support for future archaeological research and geophysical surveys, but also for the georeferencing of the laser scanner and photogrammetric surveys. The acquisition was carried out with NTRIP real-time differential correction on the basis of the Leica Smartnet Italpos network, subsequently re-processed in post-processing on the basis of the IGM grids of the area and related to the national network for the restitution of coordinates in the reference system RDN2008 TM 33N.

The network of strongholds materialized on the ground also constituted the reference base for the acquisition of further notable points by means of Total Station, in particular of some modern structures visible in the historical photos and still visible today among the vegetation, which are fundamental for relating the heights present within the documentation of the previous excavations with the mean sea level and therefore the current topography.

While the new survey campaigns made it possible to determine the absolute heights of the topographical planes reached by the previous excavations, the archaeological evidence still visible was documented by means of a laser scanner survey (with Phase-Shift TLS Faro Focus 3d Cam2, 4 station points, step of 6 mm at 10 m and final resolution of 1-2 mm) integrated with a photogrammetric survey (created using image based technique from 135 shots), in order to obtain the best result in terms of metric reliability and radiometric quality (texture) of the 3D model. This three-dimensional modelling provided a first reference for the reconstructive hypothesis of the topographic plans of the main phases of the necropolis' life (Fig. 4).

In particular, this is the fragment of a gravel ballast, datable within the first decades of the 4th century BC on a stratigraphic basis (Baldoni, Paci, Finocchi 2019), which constitutes a fixed point for the definition of the

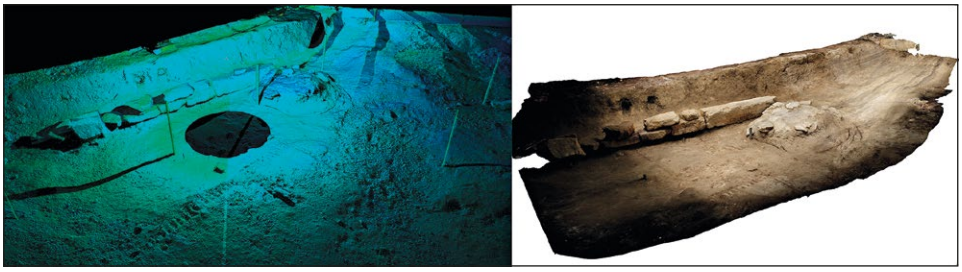

Fig. 4 – Laser scanning and photogrammetric survey of the still visible evidence pertaining to the necropolis (Courtesy of Ministero della Cultura - Sabap Marche, elaboration E. Zampieri, M. Silani).

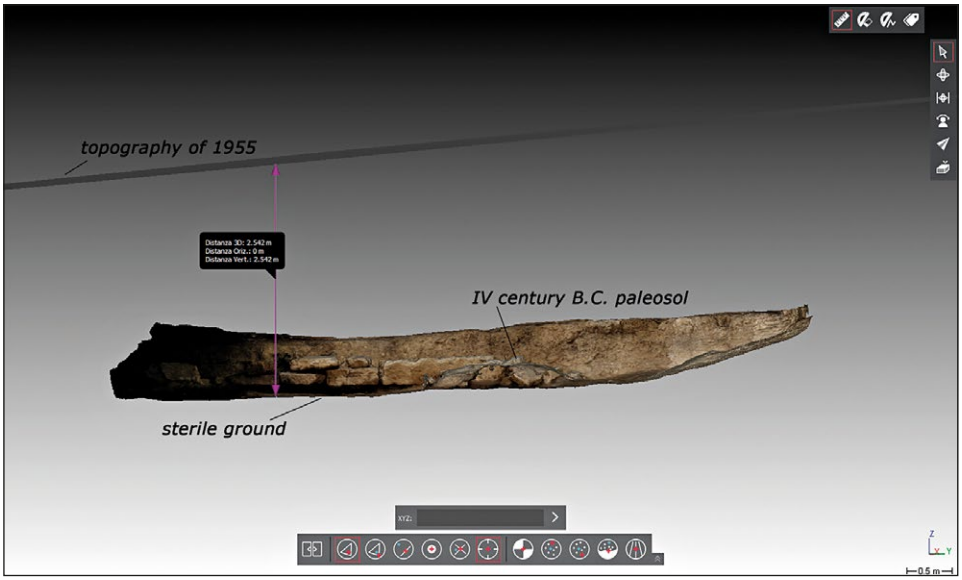

Fig. 5 – Topographic plan of 1955 in relation to the paleosol of the 4th century BC (elaboration M. Silani).

walking surface of the necropolis in this phase of its life. The possibility of relating this paleosol to the DTM of the entire area of the necropolis extracted from the aerial photographs of 1955 represents a significant starting point for the analysis and reconstruction of the modifications of the ancient landscape, including the visual aspect (Fig. 5).

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ABSTRACT

The short note illustrates the activities carried out within the 'Alma Idea' project of the University of Bologna for the reconstruction of the ancient funerary landscape of the Davanzali necropolis in Numana. While waiting for new geological-geomorphological research aimed at the acquisition of data at a territorial scale, the landscape shapes, reconstructed so far on the basis of published data, are recalled for the contextualization of the necropolis sector under study. Attention is focused on geomatic techniques for the documentation of the different ancient topographical plans, the starting point for subsequent topographical reconstructions of the evolution of the landscape of the necropolis over the centuries.