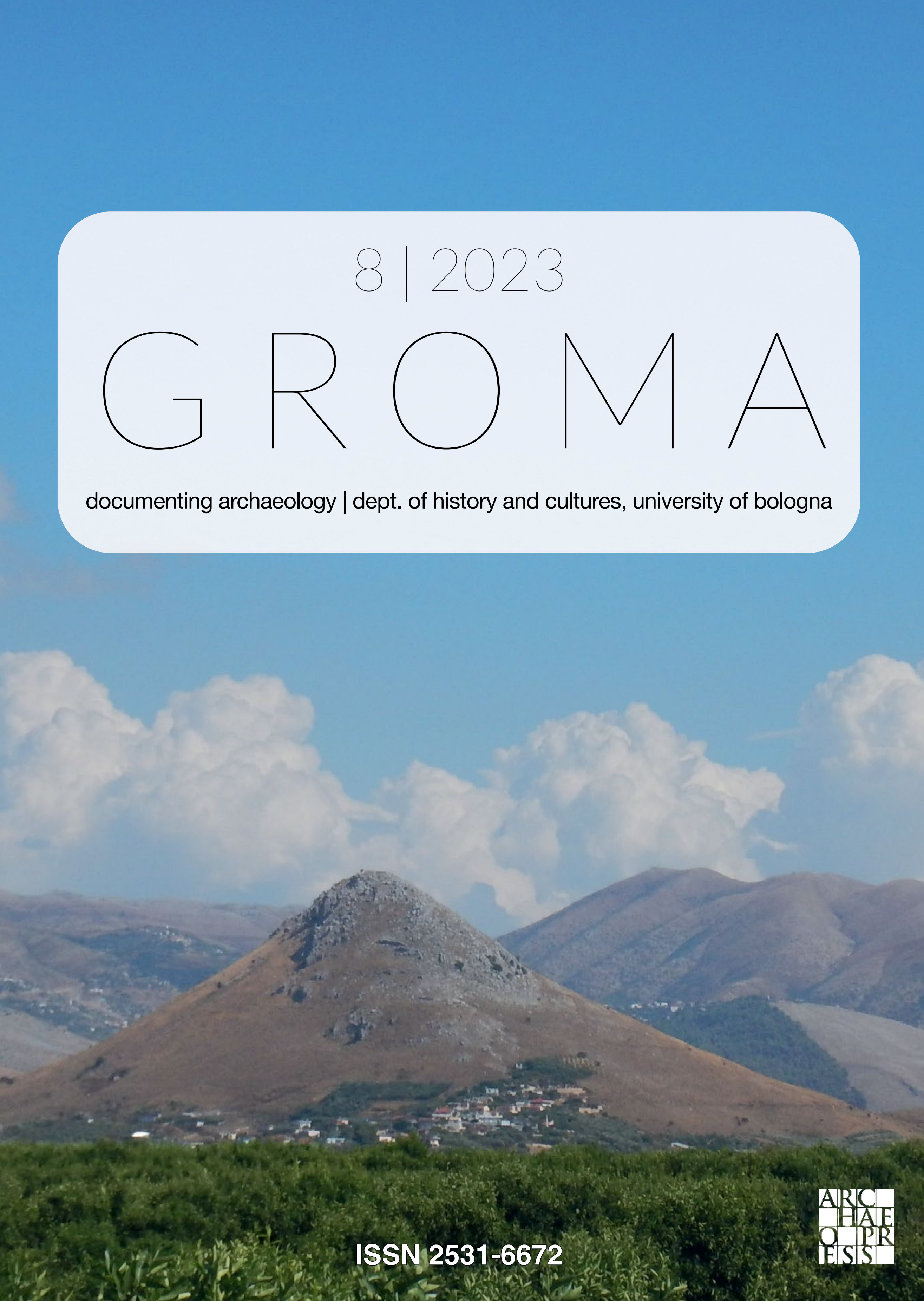

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# Articles

# Non-invasive investigations of Roman villa sites in the Potenza-valley (Marche, IT)

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**Abstract**

Long standing archaeological investigations in a valley of central Adriatic Italy allowed a team of Ghent University, during the past two decades, to apply systematic prospections and monitoring of more than a hundred Roman rural sites. The research presented here concerns a series of rural sites where the integration of data from surface artefact scatters, with results from geophysical prospections and remote sensing, contributes to the understanding of architectural aspects and the typology of Roman villas in this part of ancient *Picenum*.

**Keywords**

Roman period, villas, aerial photography, geophysical prospection, typology

## Introduction

During the past 25 years the full potential of aerial photography for archaeological explorations has been reached in Italian archaeology, and during this period research with this methodology was particularly successful in central Adriatic Italy. In effect, the intensive applications of active aerial prospection using low flying airplanes on a regular basis, especially by university teams from Ghent (e.g., Vermeulen 2011; Verhoeven et al. 2017) and Bologna (e.g. Boschi 2016; Boschi and Silani 2013), have allowed some major contributions to the archaeology of the region. This active aerial photography prospection and monitoring has been a fundamental tool in particular for studying the Roman urban and rural landscape of the fertile valleys between the Apennines and the Adriatic Sea, where such sites are abundantly present in the still mainly agricultural environments. In these past decades, more and more archaeological features have been successfully mapped in all landscape types, also facilitated by technological innovations such as satellite imagery and, more recently, drone applications. Especially the number and quality of freely available aerial and satellite images, at always higher ground resolution has increased exponentially over the years, and this now allows to take a further step in the discovery and exploration of often remote rural sites, especially if these belong to the archaeologically more visible Roman period. These non-destructive sources allow to discover new structures, to enhance the mapping of rural sites in the region, and to shed new light on specific architectural and typological aspects of the phenomenon of farm and villa occupation in this period. Especially the typological details of villas need much more study as only very few of these higher level rural sites have been excavated in this central Adriatic part of Italy.

Another revolution in the landscape archaeological approach to sites in the central Adriatic region is the more systematic and intensive use of geophysical investigations on archaeological sites, again in particular of the Roman period. Geophysical methods, based on physical properties of the Earth and their local variations, are widely applied in archaeology for the detection of buried features, and increasingly so on a large scale (Kvamme 2003; Campana and Piro 2009). Their advantage over excavation is that they are fast and non-destructive, yet their success rate depends on local circumstances and the right choice of method. The increasing incorporation of different geophysical technologies into survey programs allows more and more to produce multiple spatial data layers of subsurface features that can be integrated with the results from more traditional approaches, such as artefact surveys, and the above mentioned oblique aerial photography for archaeological purposes. As such, a more detailed and accurate mapping – and thus a more reliable interpretation – of these contexts comes within reach, without the absolute need for invasive and thus partially destructive field operations such as excavation. In particular for research on Roman rural sites of the more tangible 'villa-type' there is a great potential in the application and spatial integration of these non-invasive approaches, which are more and more part of the basic toolkit of field archaeologists. Especially in regions of Italy where excavations of Roman rural and villa sites remain rare, the wider implementation of these non-invasive methods will allow to catch up somewhat with the general study of this important facet of settlement dynamics and the rural economy in Roman times. Our examples here from research in one of the central Adriatic valleys can be illustrations of this potential for further research.

### Investigating Roman villas in a valley of northern *Picenum*

During the Potenza Valley Survey (PVS) project by Ghent University, which started in 2000 and achieved its final field operations in 2021 (Vermeulen et al. 2017), a multidisciplinary team has looked intensively at a specific valley in the ancient region of *Picenum*, with a focus on settlement typology and dynamics in the protohistoric and Roman periods. The multi-method and predominantly non-invasive approach in this project, merging advanced geoarchaeological and more traditional studies of sites and landscape forms, enabled the Belgian team to study diachronic patterns of rural habitation and land use with much greater precision than before. For the more or less isolated rural sites of the Roman period, represented at present by over a hundred farms and villas in the hinterlands of the evenly spread Roman cities of this valley (Fig. 1), this approach without excavation not only procured a quite detailed view of their general dispersion, density and chronology, but also a first analysis of site typology and main architectural characteristics. As such it became possible, even without any excavation activity, to identify and characterize a series of rural sites that belong to the well-known category of *villa rustica* sites: essentially defined as more or less isolated rural settlements of the elite or upper segments of society, combining residential and productive functions, with a particular mode of systematic exploitation of the land, and in early phases sometimes clear indicators of 'Romanization' and/or 'Hellenisation' of former non-Roman territories in this part of Italy (Verdonck and Vermeulen 2004).

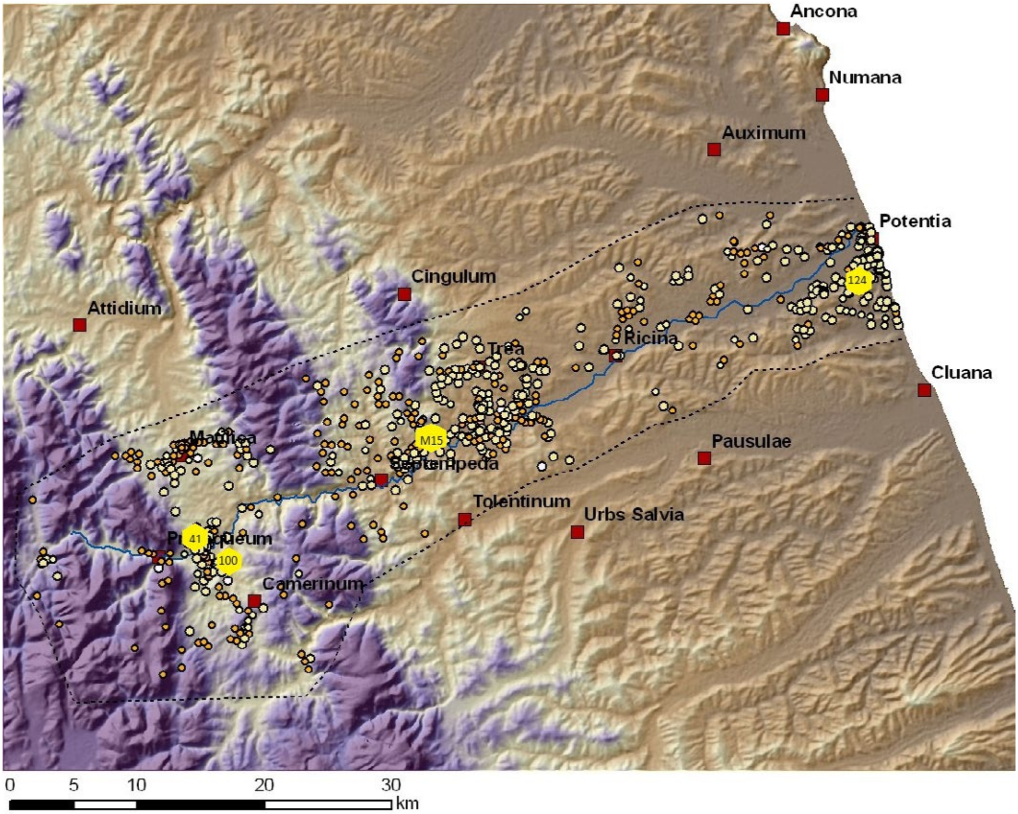


*Figure 1 - Roman sites and findspots in the valley of the River Potenza (Marche, IT) with location of the known Roman cities in and near the valley corridor and of the four villa sites discussed in this paper (image D. Mlekuz and F. Vermeulen).*

Although at any given period between their appearance in later Republican times and disappearance in Late Antiquity these sites probably never represented more than 15 to 20 % of all rural sites identified and dated so far with certainty in the valley, their typical material features allow us in a number of cases to distinguish them from the larger group of simpler farms. Based on the evidence from surface archaeology on arable land they are often (but not always) easily identified thanks to somewhat larger surface concentrations of Roman pottery and building materials (often between 2,500 and 6,000 m$^2$). Typically, the surface scatters show the presence of several functional units and/or buildings, signs of luxury in architectural decoration (*crustae* and *tesserae* of fine flooring, fragments of columns, *tubuli* for heating systems...), a greater variety of pottery (including a significant number of fine and/or imported products), and not seldom a dominant or special position in the landscape, such as on a hillcrest or hillslope near the river or with attractive views on the valley landscape. There is of course an evolution in the size and architecture of these higher ranked rural sites throughout the period of Roman dominance in the area. More modest sizes and architectural features of such sites occur during the first phase leading up to the reign of Augustus (essentially the first century BCE), and presumably less continuity of villa-type characteristics of some of these settlements in late Antiquity, as has been well observed elsewhere in central Italy (Marzano 2007).

Repeated aerial photography flights by the PVS team over all Roman rural sites in the valley between 2000 and 2012, during different seasons, resulted on most locations in the observation of discolorations in the ploughed soil. These probably stem from a combination of ploughed up occupation layers, zones with locally more organic substance in the upper layers and humidity traces caused by differential drying of the soil in certain archaeological zones. In only a few cases however, on less than 10% of all rural sites, our aerial photography spotted clear crop marks indicating the presence of subsoil remains of building structures, such as houses, and of secondary structures, such as pits, ditches and terracing walls.

Such traces indicating architectural and other relevant anomalies in the soil were for instance observed on site PVS 100, probably a large Roman farm or simple villa, located in the territory of ancient *Camerinum* (Fig. 2). The rural site, with a well-chosen location on a natural gravel terrace at a few meters south of the river Potenza, reveals the presence of a rectangular building (circa 20x10m), divided in several spaces, and close to other architectural structures with probably underground rooms, cellars or cisterns. Close examination in the field on two occasions (in 2003 and 2015) showed the presence in the area of the observed crop marks of dense concentrations of Roman pottery fragments (e.g., table ware, dolia, amphorae,...) and building material (bricks, floor slabs, lumps of concrete,...) in a total area of circa 0.8


*Figure 2 - Crop marks of site PVS 100, probably a Roman farm or small villa, photographed during prospection flights over Camerino in 2002. The presence of a rectangular building (circa 20x10m), divided in several spaces (nr. 1) and other architectural structures with underground rooms, cellars or cisterns nearby (nr. 2) can be well distinguished (photo F. Vermeulen).*

hectare. The archaeological surface materials suggest that the settlement area was divided in a residential and a productive zone, and the finds suggest occupation of the site at least during the first and second centuries CE (Vermeulen et al. 2017, 229).

On a few occasions we had the opportunity to supplement the convincing evidence of a villa occupation from our artefact surveys and from some architectural traces seen from the air, with results from geophysical prospection of the site (Fig. 3). This was the case at San Girio in Potenza Picena, where the villa owners chose a fine mid-slope location in the lower Potenza valley, south of the river and some 40 meters above sea level, with a view on the coast (site PVS 124). The magnetometer survey undertaken here in 2013 revealed the quite detailed plan of a Roman *villa rustica*, which according to the datable surface artefacts had a long-term occupation from the second century BCE to the fifth century CE (Vermeulen et al. 2017, 240). Important elements that came to light were walls of the main and very large rectangular

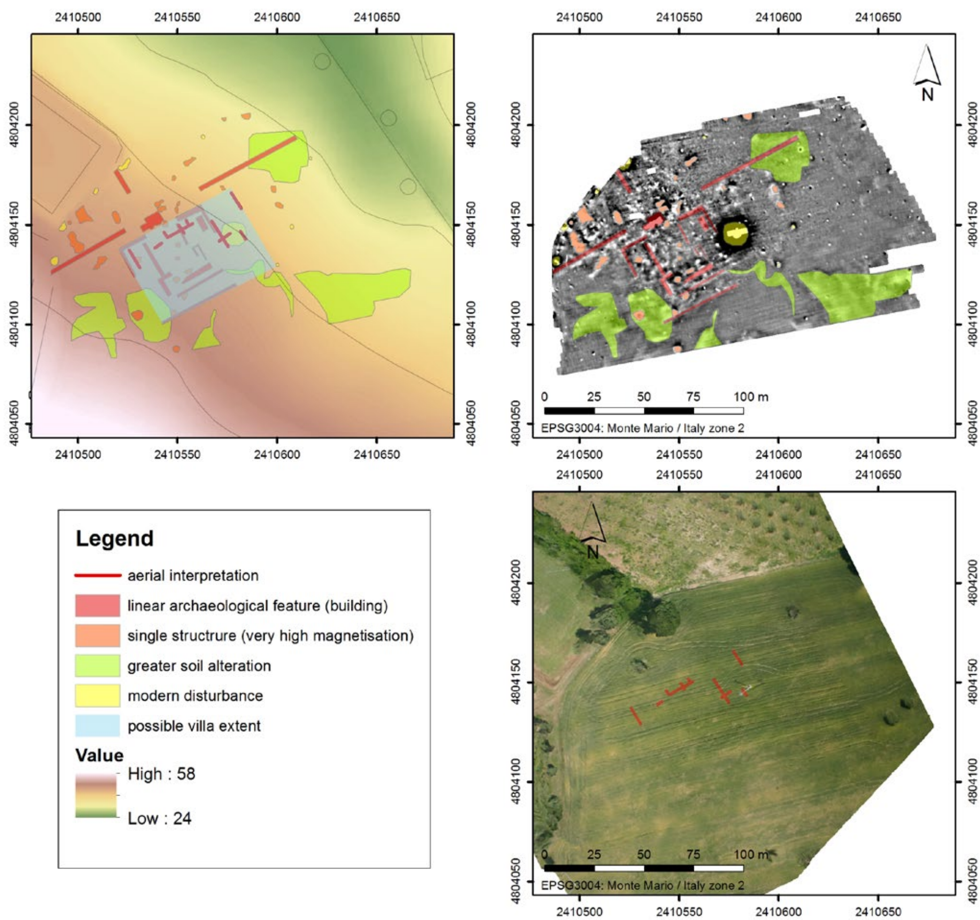


*Figure 3 - The villa site at Potenza Picena (PVS 124) with structural traces of walls, floors and other anomalies, as revealed by magnetic survey (upper R), oblique aerial photography (lower R), and their integrated interpretation (upper L) (image D. Taelman).*

building (min. 65x45m), a separate bathing facility provisioned by a local water source, and an artificial min. 125m long terrace wall, supporting the main building but possibly also a colonnade or ambulatory. Many fragments of *tesserae*, *crustae*, and painted stucco attest to rich architectural finishing at this property.

Continued monitoring of the many Roman rural sites identified in the Potenza valley over time, discovered by way of earlier research and chance finds, as well as within the systematic prospections of the PVS project, has allowed in recent years to reveal some more elements that contribute to typological studies of *villae*. As mentioned above, especially the use of always higher resolution aerial and satellite imagery, made available on commercial sites such as Google Earth and Bing, behold a great potential for enhancing knowledge. Such is the case for a clear villa site whose location in frazione Rocchetta of San Severino Marche was first noted by Umberto Moscatelli within the framework of his *Forma Italiae* prospections during the 1980's (Moscatelli 1988, site nr. M15). The site near the northern bank of the river Potenza and probably at only 250m north of the Roman valley floor road between the cities of *Septempeda* and *Ricina* was until recently only known for a surface concentration of mostly Roman Imperial pottery and building materials. On recent satellite images, uploaded on Google Earth between 2017 and 2021, the very distinct cropmarks of a villa appeared (Fig. 4).[1] The rectangular building with a NW-SE orientation and an entrance directed towards the mentioned river and road has an estimated size of 39x33m. Its perfectly symmetrical plan with presumably two axially oriented *peristilia* surrounded by regular symmetrical rooms and leading to a main apsidal reception or dining room shows that this villa structure had mostly a residential and possibly even a semi-public function. Roman pottery finds on the fields west of this site, found during our artefact prospections in 2019, seem to confirm the essentially Imperial date and might indicate that other buildings or activity zones (for production?) are located nearby the main building. As with the example of a site in Castelraimondo, whose investigation we would like to discuss and illustrate more in detail, this site shows well that continued monitoring of rural Roman farms and villas remains a crucial task for archaeologists in this and other regions of Italy. A site once known only summarily by way of a surface scatter of Roman artefacts, has now provided us with an amazingly complete plan, without invasive field operations.

## Survey and monitoring of a small riverside villa in Castelraimondo

In September 2000, during the initial year of systematic artefact surveys in the PVS project, our team discovered a small but dense surface concentration of Roman pottery and building materials on a field in Castelraimondo, located on a flat river terrace bordering the northern banks of the river Potenza (site 41, Vermeulen et al. 2017, 212). In an area of some 50 by 35m we found large fragments of roof tiles and limestone building blocks, as well as some datable pottery (terra sigillata, Augustan/Tiberian cooking ware, Dressel 2-4 and 6A/6B amphorae, and early Imperial *dolia*). The materials suggested the presence of a rural settlement of Early to Mid-Imperial date, with well-attested occupation in the first half of the first century CE. We can assume that this settlement was located in the ancient territory of the Roman town of *Matilica*.

[1] We are grateful to Dott. Tommaso Casci Ceccacci for signaling us this imagery.

*Figure 4 - Satellite image from 31.8.2017 on Google Earth showing the full plan of the* pars urbana *of a villa in San Severino Marche (fraz. Rocchetta; site M15), situated four km NE from the Roman town of* Septempeda.

Our aerial photography monitoring of all known sites in this upper part of the Potenza valley revealed in 2003 distinct linear crop marks of a rectangular building of circa 25x20m at exactly the same spot where the artefact concentration had indicated the presence of the Roman rural settlement (Fig. 5 and 6). It showed a rectangular building with NE/SW orientation, more or less parallel with the river Potenza, containing a central courtyard surrounded by regularly spaced rooms. The crop marks were less clear towards the east and south and, therefore, a full plan of the building could not be proposed yet.

Further monitoring of the site on commercially available satellite imagery was again productive here, as a very clear and high-resolution image showing crop marks, taken in April 2022 and uploaded on Google Earth, added further details to our understanding of the building (Fig. 7 and 8). The full rectangular building plan of what is clearly a small villa was available, as the negative crop marks of walls showed a very symmetrical structure with a central courtyard, surrounded by probably five rooms on each long side and one or two rooms on each short side. The building seems prolonged towards the SE where possibly a porch provided nice views over the river and its surrounding valley landscape. If this interpretation is correct, the villa

*Figure 5 - Crop marks of site PVS 41 photographed during prospection flights over Castelraimondo in 2003 (photo F. Vermeulen).*

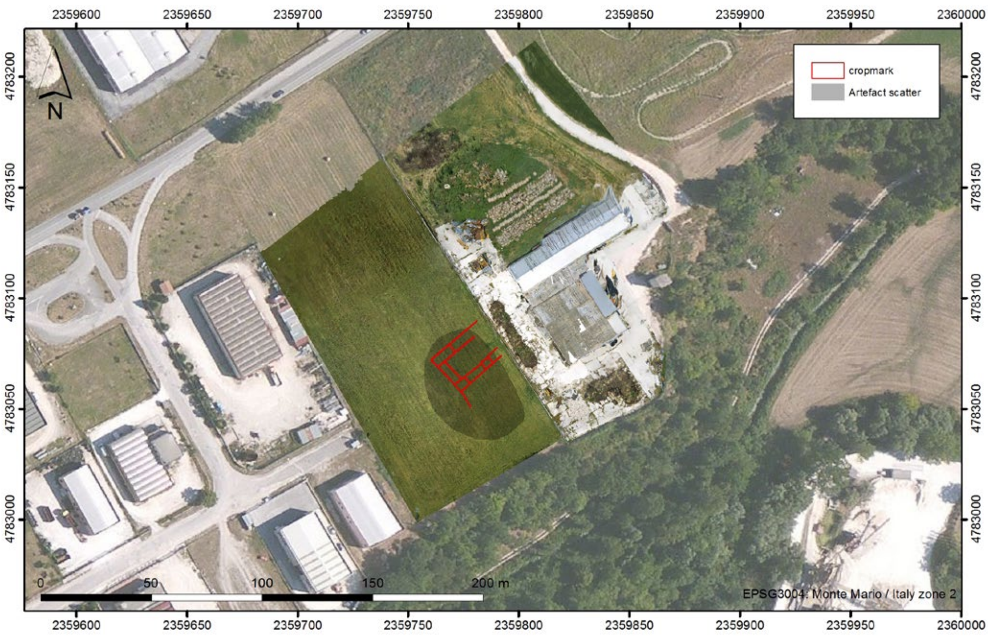


*Figure 6 - Location of the artefact scatter and first interpretation of the crop marks shown in Figure 5 on a vertical image of the site (image W. de Neef).*


*Figure 7 - Satellite image from April 2022 on Google Earth showing the full plan of the small villa at Castelraimondo.*


*Figure 8 - Interpretation of the crop marks in Figure 7.*

had a more or less quadrangular plan of circa 25m side. The central room on the NW long side can be interpreted as the *vestibulum* or entrance room allowing access to the building from the Roman road, a *diverticulum* from the Via Flaminia linking Nocera Umbra to Ancona through the Potenza valley. According to our earlier aerial photography observations the Roman road deck lies only some 120m north of the discovered rural building. A series of broad elongated positive and negative crop marks visible on the satellite image south and west of the rectangular building indicated possible features connected with this Roman occupation. To obtain more information about the site we decided to add a layer of geophysical data to our already quite good information.

For the non-invasive geophysical work at this site PVS 41 we conducted a magnetometer survey applying gradiometry. We chose this method as we expected it to be successful in detecting a broad range of archaeological features, primarily the (lime-)stone walls, which showed up so well in the satellite imagery, but also pits, ditches, kilns and other traces relevant for a Roman villa site. Elsewhere in the Potenza Valley, such as during the intensive geophysical surveys of the above-mentioned villa of San Girio (Fig. 3, top right) and the four abandoned Roman town sites of *Potentia*, *Ricina*, *Trea* and *Septempeda*, Roman walls were successfully detected due to their generally weakly magnetic to diamagnetic properties, causing a contrast with the surroundings soils (Vermeulen et al. 2017). Moreover, we decided against a ground penetrating radar survey, potentially a suitable technique to map buried stone structures. Repeated attempts with this method at various locations in the valley had proven unsuccessful, due to the strong attenuation of electromagnetic energy in the clay-rich soils of this part of Marche. We expected this to be the case too at Castelraimondo.

Magnetic gradiometry is suitable for mapping near-surface features with a contrast in the magnetic properties and visualizing them in a 2D map. Features are typically detected up to depths of 1-2 meters, depending on local soils and geology, the dimension and depth of buried objects, and the contrasts between the surrounding natural soils and magnetic objects. For the magnetometry surveys at site PVS 41 we used a mobile cart array with four Sensys FM650 fluxgate gradiometer probes mounted on a light and flexible fiberglass frame (LEA MINI system, Eastern Atlas). Each probe holds two sensors, one at each end of the probe: one close to the ground surface, and the other further away. Each sensor measures the vertical component of the Earth magnetic field with a sensitivity of 0.1nT (nanoTesla). With a datalogger the difference between the two sensors in each probe is measured and the data subsequently used to map local variations. This difference thus records the vertical difference in the vertical component of Earth's magnetic field, often simply called the 'gradient', and is insensitive to the background fluctuations in the Earth magnetic field.

The probes are mounted on the cart at 0.5 m distance and data is collected at 0.05 m point distance. The data is positioned using a Leica GS15 GNSS antenna mounted on the cart, receiving RTK corrections via the Italpos network resulting in a positioning accuracy of ca. 2 cm. Data processing consisted of normalization, drift- and offset correction per profile, and gridding using a kriging routine with a search radius of 0.5 m. The data were plotted at a resolution of 0.10 m.

At site PVS 41 we covered a small area of ca. 65 x 60 m, targeting the features visible in the aerial photos and the satellite imagery (Fig. 9 and 10). The field conditions were favourable,


*Figure 9 - Image from the magnetometry at Castelraimondo, positioned on the satellite view of the site.*


*Figure 10 - Superposition of the interpretation of the crop marks on the magnetometry data in Figure 9.*

with dry, warm weather and fallow terrain with low vegetation. Still, there were considerable disturbances from fences and buildings on either side of the field, as well as scrap metal on the field, resulting in strong measurement effects. This may have obscured archaeological traces at the borders of the survey area, most notably in the east.

The results of the survey indicate a progressive degradation of the site, resulting in the ploughing out and mixing of materials near the surface. Strikingly, the rectangular lay-out of the cropmark traces are poorly recognizable in the magnetometer data. This appears to be an effect of the presence of near-surface features with strong magnetic amplitudes, which we tentatively ascribe to strongly burnt or ferromagnetic materials. These are situated inside the central courtyard of the villa, but also in the southern and southwestern rooms, one of which lying centrally in the southern aisle of the building might have given access to the porch. These locations suggest that these materials are archaeologically relevant, but it is difficult to say what they are and how they relate to the use, abandonment or reuse of the building.

A remarkable magnetic feature is the large semi-circular anomaly in the southern end of the field. It is also visible as a large positive cropmark feature in the satellite imagery. It consists of a cluster of oval features with diameters up to 4 m and positive magnetic amplitudes up to 25nT above the general background, and is demarcated in the north and south by curvilinear features with negative magnetic amplitudes. Its association with the nearby Roman site is still unclear.

**Discussion**

As one of us stated in a paper two decades ago (Verdonck and Vermeulen 2004), the systematic archaeological study of *villae rusticae* and other upscale types of Roman farms in Marche is still at its beginning. Fully informative and well-published excavations on villa sites in the region before 2000 are limited to a handful of villas, such as at Osimo-Monte Torto (Pignocchi 2001), Moscosi di Cingoli (Percossi Serenelli 1998), Santa Lucia di Pollenza (Percossi Serenelli 2005) and Colombarone (Dall'Aglio *et al.* 1997). Also, since the beginning of the current century stratigraphical excavation of complete villa sites was limited to only very few locations, such as at Villa Magna in Urbisaglia (Paci and Perna 2016). As other recent invasive interventions most often only revealed small parts of such villa complexes, the state of research prevented thus far a comprehensive typological investigation into villa architecture in the region. It is not the place here to discuss in detail our own results in the Potenza valley when it comes to the general reconstruction of rural (and urban) settlement dynamics during the Roman era, but we can summarize some of the main evolutions that allow us to at least contextualize somewhat the few finds of *villae rusticae* presented above.

Data from several surveys and investigations on rural sites seem to indicate that the final Roman takeover of this central Adriatic area between the Apennines and the sea in 268 BC does not bring a strong break with the general rural settlement pattern of pre-Roman times (e.g., Verdonck and Vermeulen 2004, table 1; Perna and Capponi 2012; Ciuccarelli 2012; De Neef 2020). It is probable that a number of new rural establishments came into being after the founding of a series of coastal and near-coastal Roman and Latin colonies, and especially from the later third century BCE onwards, when individual Roman citizens were granted land in the best parts of the newly conquered landscape, as a result of the *Lex Flaminia de agro gallico et* *piceno viritim dividundo* (232 BCE). It is however unlikely that these new farms could already be called villas, as this wave of colonisation was probably not yet supported by serious financial and market-oriented investments. Only after the mid-second century BCE, when a general economic expansion in this part of Adriatic Italy followed the trends in the Tyrrhenian part of the peninsula, a fertile base was laid here for real villa development. In the Potenza valley it is likely that the above discussed site of San Girio (Potenza Picena), falls into that trend. Its perfect hillslope location in the hinterland of the coastal colony of Potentia and with regards to the well exploitable valley landscape laid the base for an initially wine producing domain with a long survival rate into Late Antiquity. The supposed typology of an imposing terrace villa with great valley and sea views, and possibly later attached bath complex, probably indicates a site with a still humble late Republican and a more sumptuous Imperial history.

Data from several valleys in Marche indicate that smaller villas tend to be built in the inland areas from the later second century BCE onwards. These are first often located at good positions on the slopes and were probably more connected with extensive agriculture. On the hill terraces of second and third order appear mostly smaller farms, in places already occupied before the Romans (for instance at Monte Franco near Passo di Treia; De Neef 2020). The valley floors are seldom used before the first century BCE, as they stayed probably longer occupied by woodland, marshes and common land for grazing (*saltus*), until more measures are taken for drainage and land division. The latter is surely the case during the Triumviral and Augustan periods, which brings centuriation in the valley floors and the assignation of land to veterans of the armies of Caesar, Marc Anthony, and later Augustus. Especially also the processes of municipalisation affecting many village-like settlements and helping them to become fully monumentalized towns, together with a better structuring of the road system and the involvement of financing external and internal elites, must have had a serious impact on villa development along the valley corridors. It is likely that all three other sites discussed here (at Camerino, Castelraimondo and San Severino Marche) belong to this wave of villa building, which gains momentum during the final decades of the Republic and the first decades of the Empire. The more modest looking site at Camerino could well have grown out of an existing farm, while the two villas at Castelraimondo and San Severino Marche, with their strict symmetrical planning copying examples from Tyrrhenian Italy, were most likely built by newcomers or at least influenced by them. Especially the latter villa, with its more intricate plan with two peristyles and an apsidal room for receptions, might well be the seat of a local elite family with some public role in the nearby town of *Septempeda*.

The results of the non-invasive prospections and the monitoring of a handful of villas in the Potenza valley is only a small contribution to the debate about further villa evolution during the Mid- and Late Imperial periods. As we know from many examples elsewhere these phases show a significant decline during the third and fourth centuries CE, but also an increasing concentration of land in the hands of fewer owners, and thus the relative growth of certain villa domains (Launaro 2011, 171). This evolution must be read as the gradual reorganization of the rural landscape under different socio-economic conditions (Banaji 2002, 16) with a particular impact on villa estates. Even if it is unlikely that the central Adriatic area ever saw the rise of proper *latifundia* such as in southern Italy (Vera 2001, 627; Verreyke and Vermeulen 2009, 114), we can only hope that the non-invasive discovery of the architecture and typology of many more villa sites in the region incites researchers to focus future excavation work on a good selection of diagnostic sites.

## Bibliography

Banaji, J. 2002. *Agrarian change in late antiquity: gold, labour and aristocratic dominance*, Oxford: Oxford Classical Monographs.

Boschi, F. 2016. "Reading ancient cities. The contribution of the non-invasive techniques". In *Looking to the future, caring for the past. Preventive archaeology in theory and practice*, edited by F. Boschi, 85–100. Bologna: Bologna University Press.

Boschi, F. and M. Silani. 2013. "Aerofotografia e geofisica nella Valle del Misa (Ancona): nuovi dati per la topografia urbana di Ostra", *Rivista di topografia antica* XXII: 69 – 82.

Campana, S. and S. Piro (eds.) 2008. *Seeing the unseen. Geophysics and landscape archaeology*. Boca Raton: CRC Press.

Ciuccarelli, M.C. 2012. *Inter duos fluvios. Il popolamento del Piceno tra Tenna e Tronto dal V al I sec.a.C.* BAR International Series 2435. Oxford.

Dall'Aglio, P.L., G. Trovabene, M. Destro and M. Vergari. 1997. "Colombarone (PS)". In *Scavi e ricerche del dipartimento di archeologia: mostra fotografica: Complesso monumentale di San Giovanni in Monte, ottobre-novembre 1997*, edited by M.T. Guaitoli, 79-88. Bologna: Bologna University Press.

De Neef, W. 2020. "A crossroads in the central Potenza Valley: non-invasive research of settlement (dis-) continuity at Monte Franco (Pollenza, Marche, Italy)". In *Picenum and the Ager Gallicus at the Dawn of the Roman Conquest: Topography and Material Culture*, edited by F. Boschi, E. Giorgi and F. Vermeulen, 133-141. Oxford: Archaeopress.

Kvamme, K. L. 2003. "Geophysical surveys as landscape archaeology", *American Antiquity* 68(3): 435-457.

Launaro, A. 2011. *Peasants and Slaves. The Rural Population of Roman Italy (200 BC – AD 100)*, Cambridge: Cambridge University Press.

Marzano, A., 2007. *Roman Villas in Central Italy. A Social and Economic History*. Leiden and Boston: Brill.

Moscatelli, U. 1988. *Trea*, (Forma Italiae). Firenze: Leo S. Olschki Editore.

Paci, G. and R. Perna. 2016. "Una villa romana nel territorio di Pollentia-Urbs Salvia: note preliminari sulle indagini archeologiche condotte presso Villamagna (Urbisaglia – MC)", *FOLD&R. FastiOnLine documents & research* 371: 1-14.

Percossi Serenelli, E. (ed.) 1998. *Guida del Museo Archeologico Statale di Cingoli,* Ancona.

Percossi Serenelli, E. 2005. "La villa romana di Santa Lucia di Pollenza". In *Archeologia nel Maceratese. Nuovi Acquisizioni*, edited by G. de Marinis, G. Paci, E. Percossi Serenelli and M. Silvestrini, 210-221. Macerata: Fondazione Cassa di Risparmio della Provincia di Macerata.

Perna, R., C. Capponi. 2012. "Città e campagna nella valle del Chienti in età repubblicana ed imperiale. La carta archeologica della provincia di Macerata". In *I Processi formativi ed evolutivi della città in area adriatica*, edited by G. de Marinis, G.M. Fabrini, G. Paci, R. Perna and M. Silvestrini, 149-164. Oxford: Archaeopress.

Pignocchi, G. 2001. *Monte Torto di Osimo: l'impianto produttivo,* Ancona: Servizio editoria della Soprintendenza archeologica per le Marche.

Vera, D. 2001, "Sulla (ri)organizzazione agraria dell'Italia meridionale in età imperiale: origini, forme e funzioni della massa fundorum". In *Modalità insediative e strutture agrarie nell'Italia meridionale in età romana*, edited by E. Lo Cascio and A. Storchi Marino, 613-633. Bari: Edipuglia.

Verdonck, L. and F. Vermeulen. 2004. "A contribution to the study of Roman rural settlement in Marche", *Picus* XXIV: 161-229.

Verhoeven, G., F. Vermeulen, D. Taelman and L. Verdonck. 2017, "Taking vegetation marks into the next dimension(s) – Mapping the hilltop settlement of Montarice (central Adriatic Italy) by a multi-dimensional analysis of aerial imagery", *Archeologia Aerea* 11: 79-84.

Vermeulen, F. 2011. "Reviewing 10 years of aerial photography in the valley of the River Potenza (Le Marche)", *Archeologia aerea* 4-5: 257-266.

Vermeulen, F. 2017. *From the Mountains to the Sea. The Roman Colonisation and Urbanisation of Central Adriatic Italy*, Babesch Supplement 30, Leuven – Paris – Bristol: Peeters Publishers.

Vermeulen, F., D. Van Limbergen, P. Monsieur and D. Taelman. 2017. *The Potenza Valley Survey (Marche, Italy). Settlement dynamics and changing material culture in an Adriatic valley between Iron Age and Late Antiquity,* Roma: Academia Belgica. Studia Archaeologica 1.

Verreyke, H. and F. Vermeulen. 2009. "Tracing Late Roman Rural Occupation in Adriatic Central Italy", *American Journal of Archaeology* 113: 103-120.

# Documenting a hilltop settlement: methodologies and preliminary results of the joint Albano-Italian project at Çuka e Ajtoit (Albania).

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## Introduction

The archaeological site of Çuka e Ajtoit (lit. "mount of the eagle") is located at the southern fringe of the Albanian territory, a few kilometres from the Greek border, on the top of a conical hill with very steep slopes (Fig. 1). Its sharp profile dominates the lowland area extending from Butrint in the north, a World Heritage site by UNESCO, to the valley of Kalamas, ancient *Thyamis* in the south (Fig. 2). The area, known as Cestrine or Cammania during Antiquity (Bogdani 2022) was located in a highly significant geographical position, along the channel of Corfu, opposite to the city of Corcyra, along the maritime route connecting Balkan Greece to

*Figure 1 - View of the hill of Çuka e Ajtoit (ÇAj Project)*

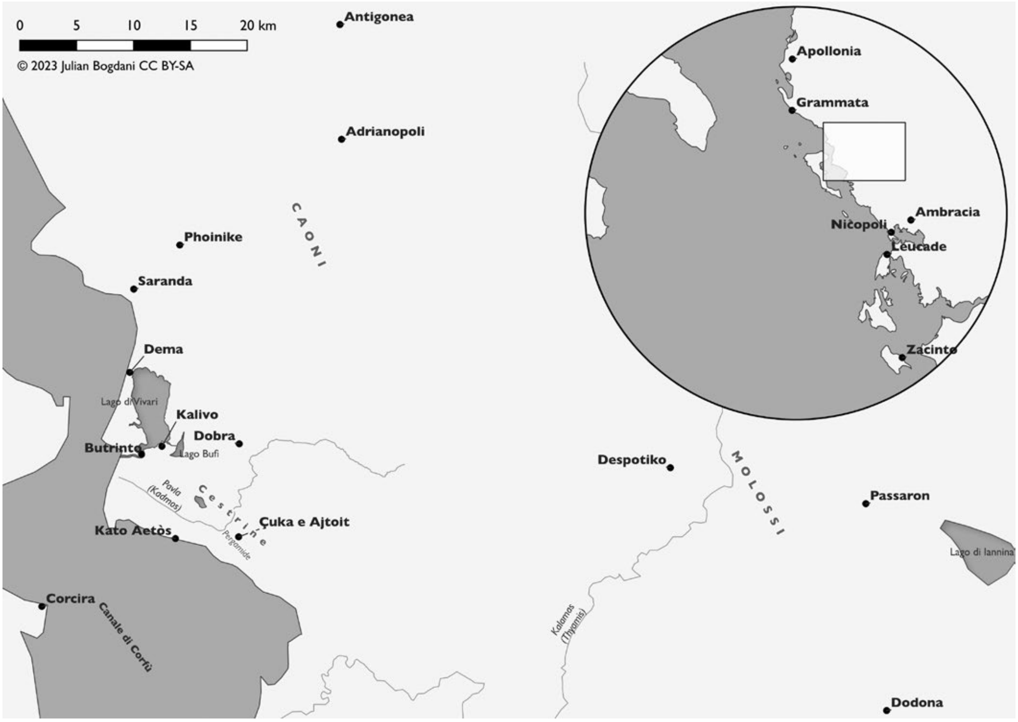


*Figure 2 - Map of the ancient region of Cestrine (ÇAj Project)*

Sicily and *Magna Graecia*. This geographical position determined an early interest of the Greek poleis of Corinth first, and Corcyra after, in this area, materialised in the presence of the site of Butrint since the Archaic period (Hernandez 2017; Aleotti et al. 2023) and the definition of a *peraea* of Corcyra on the opposite side of the channel (Carusi 2011). Since 2021 a new joint Albano-Italian project by the Albanian Institute of Archaeology and Sapienza University of Rome has been active on the site, renovating the field research and the study of the site in a diachronic view (Bogdani and Meta 2022; Bogdani and Aleotti 2024; Bogdani 2023).

The first archaeological investigations in the site of Çuka e Ajtoit were launched by the Italian Archaeological Mission of Luigi Maria Ugolini working in Butrint (Fig. 03). In 1929, a few members of the mission, including Alfredo Nuccitelli (photographer), Dario Roversi Monaco (topographer), and certainly Ugolini himself moved to the village of Çiflik at the feet of Çuka e Ajtoit and dedicated a few months of fieldwork to the site. The Italian team investigated the Hellenistic and Medieval fortifications, some residential units, the area of the so-called 'Palace' located on the western slopes, outside the fortifications and the necropolis of the site. These activities were never published by the researchers: the findings have disappeared and manuscript and notes, including the 1:500 detail map of the site by Roversi Monaco (Fig. 4) were forgotten at the archives of the Mission at Museo della Civiltà Romana in Rome where they were discovered and published by the Butrint Foundation team (Hansen, Gilkes, and Crowson 2005; Hernandez and Hodges 2020).

*Figure 3 - Luigi Maria Ugolini at Çuka e Ajtoit*
*(Archive of the Albanian Institute of Archaeology in Tirana)*

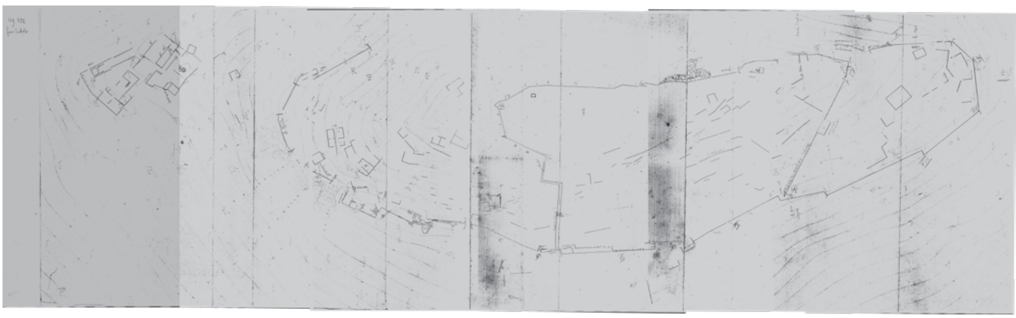

*Figure 4 - 1:500 map of Çuka e Ajtoit by Dario Roversi Monaco,*
*Archive of Museo della Civiltà Romana, Rome*

After the Second World War, the reprisal of the archaeological activities in Albania was coordinated by the Soviet Archaeological Mission directed by Vladimir Blavatsky and involved also the site of Çuka e Ajtoit (1958-1959) where a joint expedition followed the steps of the Italian mission and investigated the 'Palace' and the fortification, also producing the first map of the site ever published (Budina 1971, 318 fig. 31). The rupture of the international relations between the Soviet Union and Albania determined the interruption of the scientific collaboration between the two countries and the loss of the documentation of the field research in Çuka e Ajtoit and other archaeological sites (Gilkes 2020). Once more, the archaeological knowledge of the site was still at the starting point. Other field campaigns were organised by the Albanian Institute of Archaeology under the direction of Selim Islami in 1973 and 1979 and produced only a few articles about specific topics, such as the Mediaeval fortifications (Lako 1982), few considerations on residential architecture (Baçe and Bushati 1989) and minor considerations on the Hellenistic fortifications (Ceka 1976). The excavations of the 'Palace' (a residential area located outside the fortified area and extending more than 2,500 square meters) and those of other residential units in 1979 were partially published posthumously (Islami 2008 in Albanian; 2020 in English). In the early 1980s a questionable effort was put in place, disassembling from the site the lithic staircase and gate, featuring a corbel arc, and re-assembling it in the newly opened Historical Museum in Tirana, where it is still visible (Fig. 5).

Few other studies have been published after the archives of Ugolini were made available and based on limited field verification (Bogdani 2006; 2009).

**The new project**

Considering the complicated history of field research and publications, where successive researchers had a very faint idea (if any) of previous operations, resulting in each step being the first and at the same time progressively destroying the archaeological deposit of the site with no benefit to the scientific community, it was clear that general assessment of our knowledge of the site was fundamental. The re-publication of the manuscripts of L.M. Ugolini

*Figure 5 - Polygonal staircase and corbel-arch entrance of the so-called 'Palace' of Çuka e Ajtoit in the courtyard of the Historical National Museum of Tirana (ÇAj Project)*

and S. Islami by R. Hodges and D. Hernadez (2020) with several contributions assessing the history of the studies and contextualising the few surviving photographs of the finds must be considered a fundamental step in this direction. Yet this volume was mostly based on the surviving archive data, often hopelessly decontextualised. This is the context that saw the birth of the joint project of the Albanian Institute of Archaeology and the Sapienza University of Rome started its activities. Since its inception, the main focus of the new field research was, on one hand, to try to provide an archaeological context of the surviving archive material, and on the other to contribute with a new thorough and updated documentation of the site, based on the application of modern technologies. This documentation is aimed at providing new ground for further advancement in the archaeological knowledge of the site and to try to enlarge the chronological focus of the research, almost totally flattened to the Hellenistic period. The first effort has already provided new data to the discussion (Bogdani and Aleotti 2024) and hopefully, it will take us further ahead in the future, and due to space limits will be excluded from this contribution. We will rather focus here on the new documentation of the site, discussing methodological and technological aspects, and research aims and only briefly adding some preliminary results.

**From the map to the information system: the topographical survey of Çuka e Ajtoit**

The most important contribution of the new field research is by far the creation of a new archaeological map of the site, which is not only a flat even though complete, representation of the archaeological evidence, but the tip of the iceberg of a rather complex information

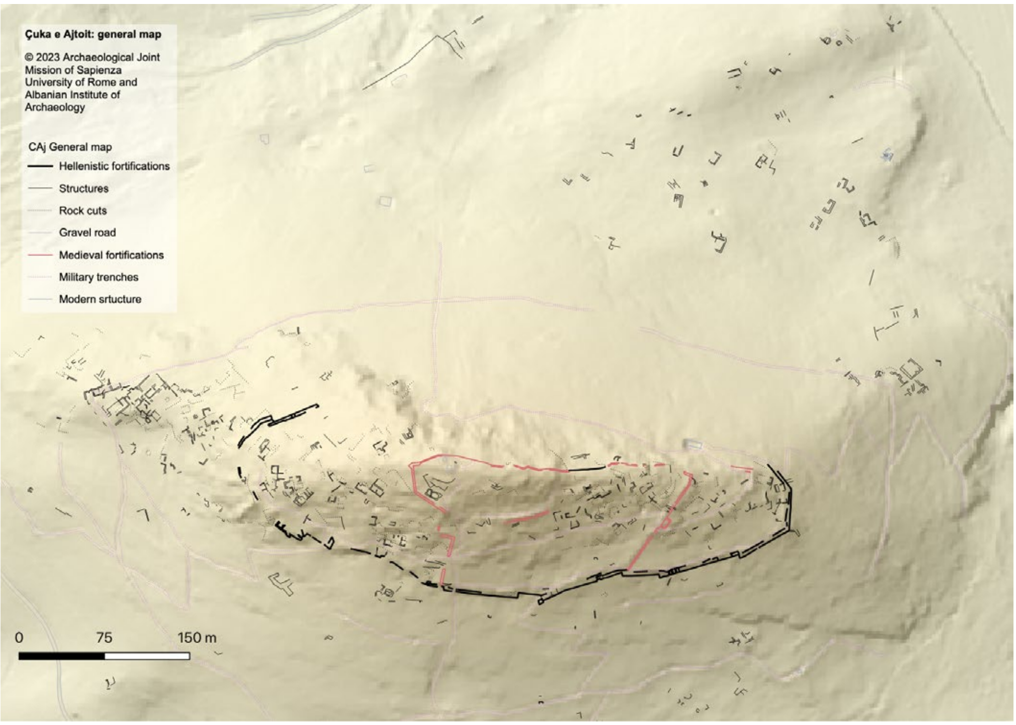


*Figure 6 - archaeological map of Çuka e Ajtoit (ÇAj Project 2023)*

system, including several databases at various scales dealing with the different aspects of the represented context. (Fig. 6).

**Methodology of the topographical survey and further implementations**

> *Dalla bassa pianura della Kestrine, ove le acque indugiano a lungo, sorge isolate Monte Aetòs* (i.e. Çuka e Ajtoit)*, che di lontano appare nella lontana forma di un cono, mentre da vicino, per i suoi ripidissimi fianchi tormentati e coperti da scoscesi roccioni calcarei, e per la sua cima ridotta ad una strettissima e digradante cresta disseminata di roccie e massi, cambia profondamente aspetto; tanto da rivelarsi come un immenso cumulo di sassi, povero d'erbe, spoglio di alberi. Tale sua natura rende particolarmente pesante il lavoro del rilevatore* (Gilkes 2020 quoting Dario Roversi Monaco; see also Roversi Monaco 1934).

As the above-quoted words of Dario Roversi Monaco stress, the terrain of the hill of Çuka e Ajtoit is very difficult, characterised by very steep slopes with significant erosion that has determined the almost total loss of the archaeological deposits, the collapse of the built structures and the exposure of the natural bedrock. The rubble produced by the disintegration of the bedrock and the debris resulting from the collapses covers almost entirely the surface of the hill. There are few trees, yet the vegetation is quite intense, consisting mainly of the typical Jerusalem sage (*Phlomis fruticose*), an evergreen shrub very difficult to eradicate and highly irritating to the upper respiratory tract. This landscape makes it very difficult to properly document archaeological features: the visibility is limited by the slope that does not offer optimal observation points; the rubble and the vegetation, on the other hand, are a serious obstacle to the reading of the planimetry of the complexes. Finally, traditional topographic instruments, such as Total Stations are complicated to use in this difficult terrain, since numerous setups are required to cover rather small areas. The same is true for the laser scanner methodology, which requires rather bulky instruments that are very difficult to handle on rough terrains. Just as in Total Stations, a great number of setups are needed to cover relatively small areas with very low visibility.

On the other hand, the photogrammetric methodology proved to be a very flexible surveying technique, especially if applied to drone-captured images, even if it is not unproblematic (Campana 2017; Fiz et al. 2022).

In these three years of topographical surveying (2021-2023), the general workflow has been more or less the same, but our research questions have changed over time, also producing significant novelties in the field methodologies.

The canonical workflow is rather straightforward: (1) images are acquired using drones making sure to guarantee a good overlap (>60%, actually ~80%) between single images in both directions (sides and front/back). (2) Images are processed using commercial Structure from Motion (SfM) software (Agisoft Metashape) to create 3D models to use as the basis for more "traditional" outputs such as orthophoto mosaics and digital elevation models (DEM). (3) These data are further analysed in a GIS environment, where certain and presumed archaeological features are vectorised and annotated together with paramount natural features. (4) All annotated features are part of the preliminary map of the site and are made objects of ground truthing and on-field detailed documentation. This is a fundamental passage that often determines substantial corrections to the remotely surveyed map, in terms of new features visible in the field and for many reasons not distinguishable in the 3D model, and the other way round, on features seemingly anthropic on the 3D model that are recognised as natural after an autoptic exam.

As anticipated, this rather standard workflow is often susceptible to changes. Step (1) regarding image collection might be enhanced with the inclusion of the photographs of ground control points (GCP), whose exact coordinates are measured using GNSS instruments with centimetric precision. This enhancement greatly helps the alignment process of the images, producing a more accurate 3D model and also provides a higher metric accuracy of the overall georeferencing of the model. While this was not fundamental to the aims of the brief campaign of 2021, which mainly focused on acquiring a general knowledge of the site, it was an important prerequisite for the successive, high-resolution acquisitions. During 2022 and 2023 GCPs were used in each image acquisition and their coordinates were captured with GNSS instruments paired with RTK error correction, a service offered by the Albanian Authority for Geospatial Information (ASIG).

A second major issue regards the final ground resolution of the model and, as a consequence, the resolution of the resulting orthophoto mosaic. The resolution depends on the sensor of the camera, but also — and most importantly to our work —on the distance of the camera from the terrain surface being photographed: the greater the distance, the lower the final resolution. This is not a big issue for flat areas being surveyed, but becomes highly relevant for steep slopes, where near if not consecutive photographs might present quite different resolutions. Slopes also drastically reduce the overlapping areas between the images, given the same flight parameters in comparison to flat areas (Fig. 7). These considerations have deeply conditioned the data collection process at Çuka e Ajtoit, where high-resolution models

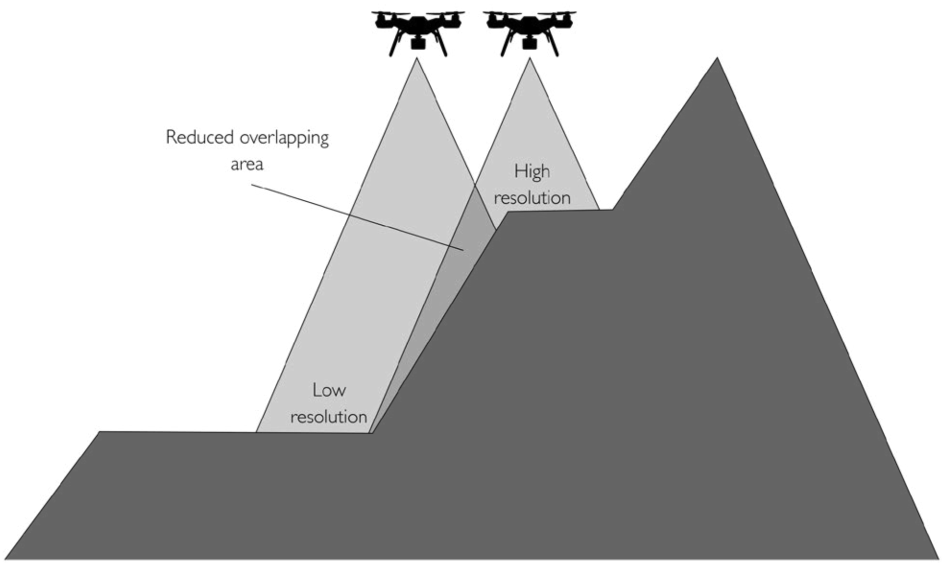


*Figure 7 - Visual example of the variable ground resolution and reduced overlapping area issues during the same flight*

(~1 cm) can be obtained only for limited areas, while site-scale models are at present available with a medium (~3-5cm) resolution.

Another issue regards the desired output: if a plane projection (map) is required, then nadir images with a good overlap (~80%) are sufficient, but if also the documentation of vertical planes is needed (prospects and front-views) then these images are quite unsatisfactory for a proper 3D model. Oblique and frontal images of each vertical surface are needed having the same overlap policy, and this drastically lengthens the data acquisition process.

Both these issues prevent the use of built-in functionalities in modern drone applications to plan and automatize the acquisition process and require fully manual management of this phase.

At Çuka e Ajtoit the need to document the vertical surfaces of the ancient structures was paramount in the 2023 campaign where the topographical survey of the defensive system was the main focus. Both Hellenistic and Medieval fortifications are sometimes preserved for a height of several meters, bearing useful information on the building techniques that needed to be documented and studied. In this case, a much more detailed survey was undertaken, multiplying by many factors the number of images required for a "normal" planar representation (Fig. 8).

In conclusion, photogrammetry is quite a flexible, expeditious and inexpensive methodology able to provide high-resolution and highly precise three-dimensional data for archaeological

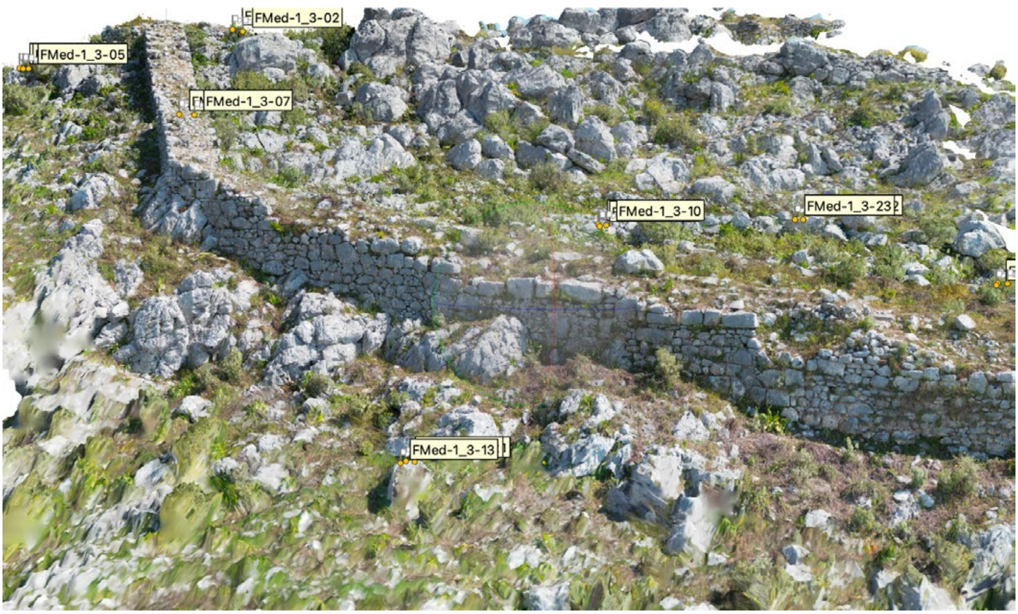


*Figure 8 - A bird's eye view of a section of the Mediaeval fortifications from the digital 3D model, making use of oblique photographs*

documentation. Yet, it is not a one-shot solution for the topographical documentation, but rather an aim-oriented methodology, requiring a good knowledge of the tool, the terrain and the aims of the research to provide reliable results.

### The topographical naming system and the database of the archaeological complexes

As already anticipated, the ground truthing of the remote survey is a fundamental step, capable of overturning our understanding of the survey. It is also the very basis of the archaeological description of the structures and their understanding. The field verification depended on the definition of an identification and naming system for the archaeological features that need to be intuitive, flexible, extensible and easy to use in the field.

To this end, the surface of the hill and its immediate surroundings were divided into seven regions named after the cardinal points (N, NE, NW, E, S, W), except for the summit area, enclosed by the Hellenistic fortifications named F (= fortified area). Easily distinguishable features, such as the fortification circuit, military trenches or roads act as inner borders between these areas. Smaller units identified by a progressive number (starting from 1 in each major area) were defined within those areas, using similar features (mainly military trenches) as borders (Fig. 9). Each of these smaller areas serves as a 'container' of one or more *complexes*, ie. a topographical unit of archaeological interest, perceived as unitary. Complexes are therefore not strictly defined, and both a small domestic unit and 'the Palace' are considered complexes, since, during our fieldwork, these were perceived as autonomous functional units. It is clear that contexts


*Figure 9 - General view of areas and subareas*

are strictly connected to the archaeological understanding of the area and are susceptible to future change when deeper knowledge is available. What initially was believed to be a single context may be split into two or more, if the archaeological investigation brings more data into the discourse. On the other hand, what was interpreted as not connected structures might be revealed to belong to a unitary building, and so originally different contexts might be merged. Inside each small area, the count of the complexes starts from 1. Following this, the typical name of a complex is F1-05, where F identifies the area defended by walls; 1 identifies its most western part (between the Hellenistic and the Mediaeval fortifications); 05 is the fifth identified complex of the area. The last number is typically assigned in the field and does not follow any specific logic except the order of the identification.

Special complexes also exist, mainly connected to the fortification system: G01 - G06 identify the gates or posterns in the city walls (both Hellenistic and Mediaeval), while FHell-01 - FHell12 and FMed-01 - FMed-10 identify the different stretches of respectively the Hellenistic and Mediaeval fortifications. Few more particular contexts regard areas that do not preserve structural remains, but that have yielded ceramic fragments that have been collected, such as NW-01.

As already mentioned, this identification and naming system is fully extensible with the future identification of new complexes and must not be considered immune to change (by merging or splitting) following a deeper study or the availability of new data.

## The surface pottery collection: morphological and fabric study

This naming system is also the fundamental base for another important field activity, which is the collection of ceramic fragments available on the surface of the hill. The collection of the pottery was performed contextually with the ground-truthing activities, during which complexes were identified, named and documented. We have already underlined the strong erosion that the site has undergone and is still experiencing. To this, the disturbing activity of the previous undocumented archaeological research should be added. Finally, the deep impact of the military activities during the last phase of life on the site, the Socialist period, when it was converted into a military base and observation point, has also impacted the surface distribution of the pottery. The excavation of the many trenches, the implantation of bunkers and the construction of pillboxes and artillery positions are the most relevant legacy of this period. All these factors make it very clear that any attempt to date a single context based on the surface pottery collected on it lacks any scientific soundness. Yet, a statistical use of the pottery-related data on a site level is most likely to bring new information. While later events, both natural and anthropic might have changed the topographical position of the ceramic fragments, there is no doubt that all collected fragments were used and broken on the hill, in a position most likely not too distant from where these were found. In other words, it is impossible to infer new information on a context-level detail, but on a small-, and better on a large-area-level surface pottery analysis might be significant.

Finally, since surface pottery is usually very fragmentary and worn out, the morphological, stylistic and technological analysis can be performed only on a small percentage of the collected samples. To overcome this an archaeometric study of the ceramic fabrics of all samples is put forward. As a first step, all samples have undergone an autoptic macroscopic analysis aimed at defining clusters of ceramic fabrics presenting the same (or very similar) features. Selected samples of each group have been selected and are being analysed from the petrographic and chemical points of view, an activity carried out in collaboration with the GeomLab: Laboratory for the Archaeological Characterisation of Geomaterials of the Sapienza University of Rome. This approach seems very promising and, despite the work being still ongoing, has already yielded some significant results.

## Some preliminary results

The new field activities in Çuka e Ajtoit are still in an early stage, with only two effective campaigns of the duration of one month, nevertheless, some important results are readily apparent. Even if these need some more fine-tuning to be fully comprehensible, their brief presentation might be of interest to the general understanding of the site.

One of the most important contributions of the new general map of the site, although its drafting is still ongoing and probably new features will be added in future campaigns, is the certainty that the site has been intensively occupied by what seem to be residential units of different sizes and planimetries. Albeit previous research on domestic architecture had already included some limited examples from Çuka e Ajtoit (Baçe and Bushati 1989), with a particular focus on planimetric typology and limited interest in urban layout, the picture that the latest research is providing is much more articulated. In particular, the area of the so-called Palace, a huge residential complex extending on more

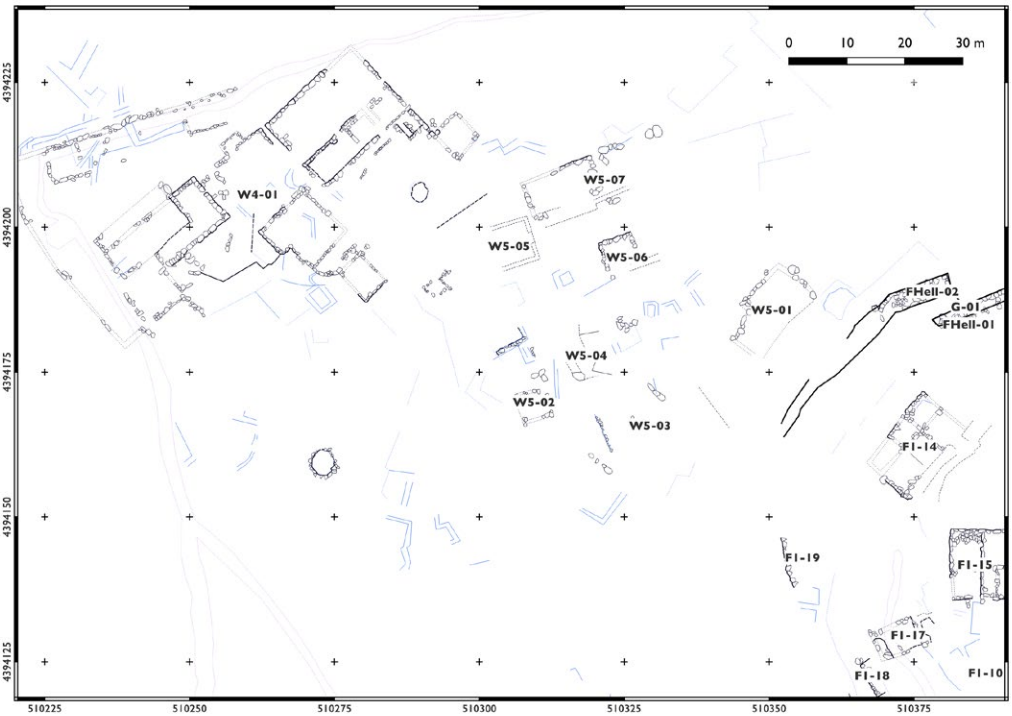


*Figure 10 - detailed view of the W5 area*

than 2,500 square meters and located on the western slopes of the hill on a rather plain ridge halfway to the hilltop appears in the light of recent research far away from being disconnected from the fortified 'upper town'. In the W5 area, located between the Palace (W4-01) area and the western section of the Hellenistic fortifications, where Gate 1 (G-01) is found (Fig. 10), seven complexes have been identified (W5-01 — W5-07) presenting very different preservation states. The better legible (W5-07, W5-06 and W5-01) define rather big terraces, with the upland (SE) part excavated in the bedrock and the lowland (NW) part built in polygonal masonry. It is therefore clear that the residential occupation of the site was not limited to the fortified area, and the 'Palace' was far from being isolated from the 'main' site.

The greater relevance of the residential function of the site, as compared to previous studies can be observed in the fortified area, as well. In particular, in the western area between the Hellenistic fortifications and the Mediaeval ones (F1), the four or five residential units excavated by Selim Islami in 1979 are part of a much more intensively occupied layout, although the poor state of preservation of many units has determined the almost destruction of the built structures and the conservation of the cut/carved parts (Fig. 11).

We can be sure, moreover, that even the updated map is a very partial view of the ancient situation since other residential units might have entirely disappeared resulting in rather flat, completely eroded areas, which are not uncommon in this area.

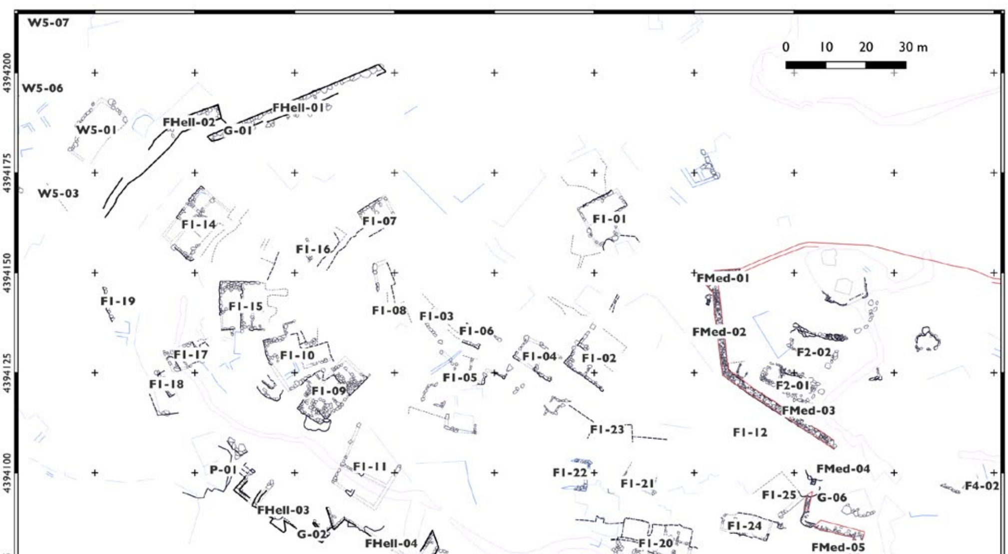


*Figure 11 - Detailed view of the F1 area*

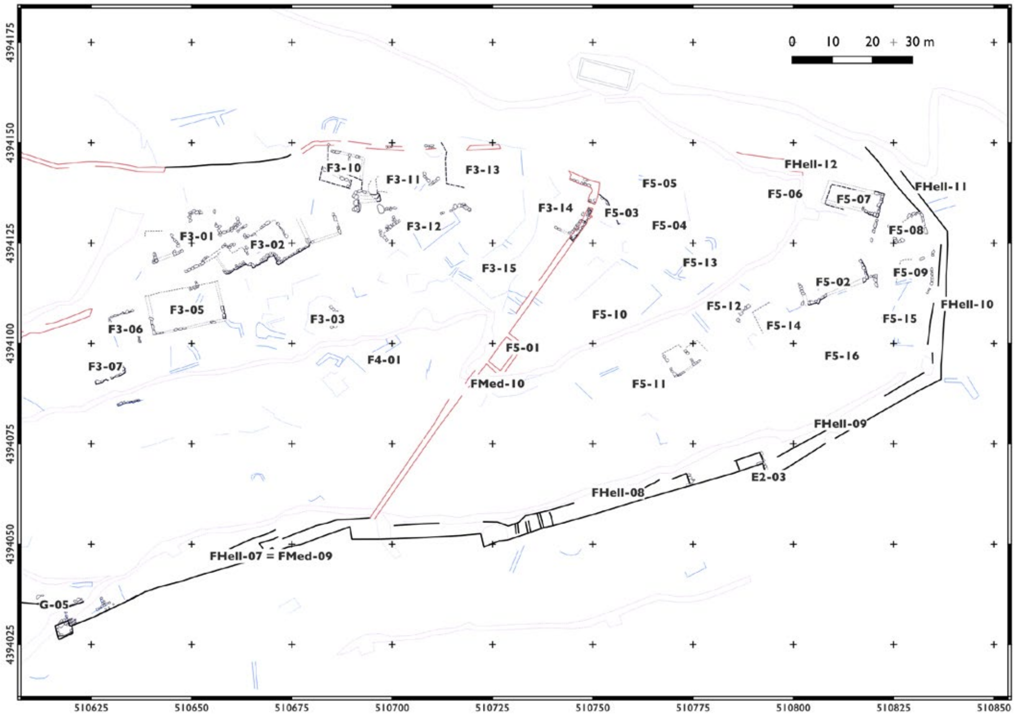


*Figure 12 - Detailed view of the F3 and F5 areas*

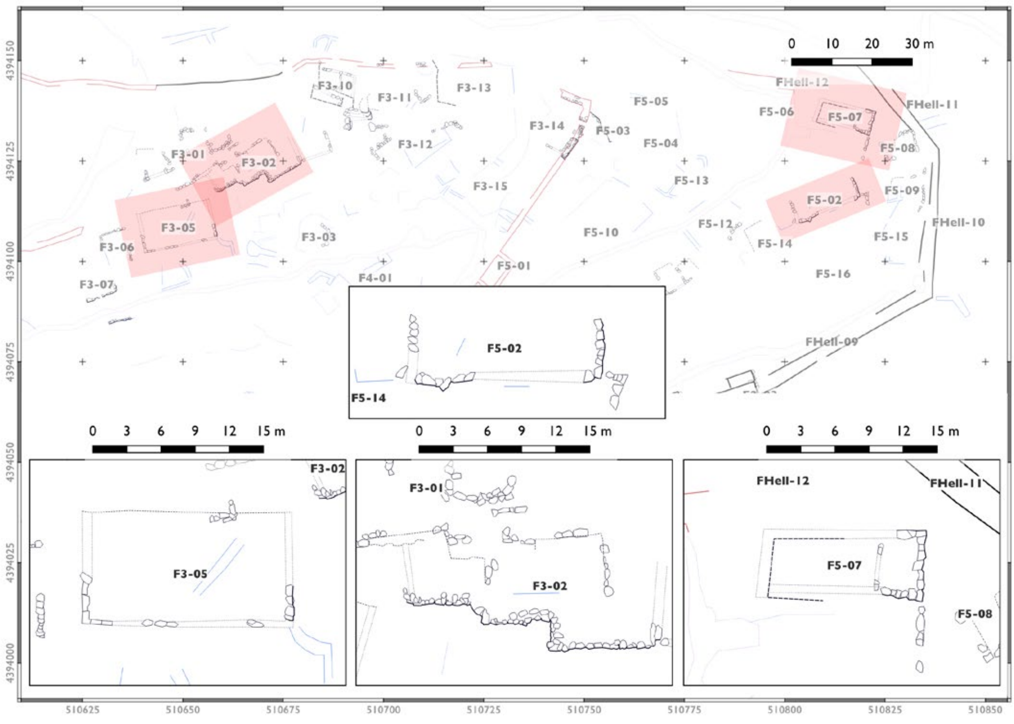


*Figure 13 - Detail of complexes F3-02, F3-05, F5-02, and F5-07*

The same considerations are valid for other parts of the fortified area, particularly the F3 and F5 areas, in the eastern part of the site (Fig. 12), the visibility being here further limited by the gentler slopes of the hill that have determined a limited use of the rock-cut for the construction of the buildings and a more important recourse to built-up structures, whose destruction has determined the current 'lunar' landscape. This different state of preservation, mostly determined by the different geomorphology of the hill, is therefore the main reason for our poor knowledge of the western part of the site. A second important reason is the physical difficulty of accessing this area from the east, which is today the preferred access to the site: the few brave visitors who climb up the site today will never go (down) east of F2.

The gentler slope of the western part is not only a negative factor for the state of preservation of the archaeological structures, but it also offers easier and wider ground for construction, which has determined the building of some rather big complexes, such as F3-02, F3-05, F5-02, F5-07, etc. (Fig. 13). Their poor condition of preservation strongly prevents us from determining their precise extension and detailed planimetry, yet the layout resulting from the preliminary analysis of their fragmented maps differentiates these structures from the rather typical residential units of the eastern area (F1).

To complete this very rough overview of the topography of the site, it is important to stress that the narrow and elongated hilltop does not seem to have ever been occupied and built. The highly irregular rocky shape of this sector surprisingly has not been cut and shaped to host buildings, nor it has been used as a quarry site for the lower construction, which is a rather common feature in hill sites of various dimensions (Grillini, Minguzzi, and Gurini 2007). The reason for this we do not comprehend for the time being, and the inability of local masons to technically handle this task seems not valid justification.

If we turn our attention from topographical considerations to the analysis of the archaeological finds, some important, although preliminary, results can be briefly presented. Firstly, some fragments of ceramic shards have been collected presenting coarse fabric and polished surfaces that might be compared to late Bronze Age pottery found in nearby sites (mainly Butrint, Cape Stillo and Mursi) in recent years (Lima 2016; 2020). At Çuka e Ajtoit these finds are not concentrated at a single spot but have been evenly documented on the entire surface of the site (Fig. 14). The theoretical premises on which the analysis of the spatial distribution of the pottery fragments has already been discussed, and the dispersal of these few recognised fragments reports for a distributed presence of this ceramic typology, rather than a unitary single deposit. If the still ongoing study of the pottery fragments will confirm their dating to the late Bronze Age, this could be the first evidence of a pre-Hellenistic settlement at Çuka e Ajtoit.

The analysis of the pottery has also confirmed the presence of a statistically significant number of amphorae fragments dating from the Classic period. These are mainly Corinthian A, A1 and B types dated between the 5th and the 4th centuries BCE. Once more, these fragments have an even distribution covering the entire surface of the site, including the western slopes (the 'Palace' area). Amphorae are a rather heavy, utilitarian type of pottery and their presence on the hilltop of Çuka e Ajtoit should be related to the presence there of a settlement that was importing and consuming the wine and oil contained in the amphorae. Weather and to what

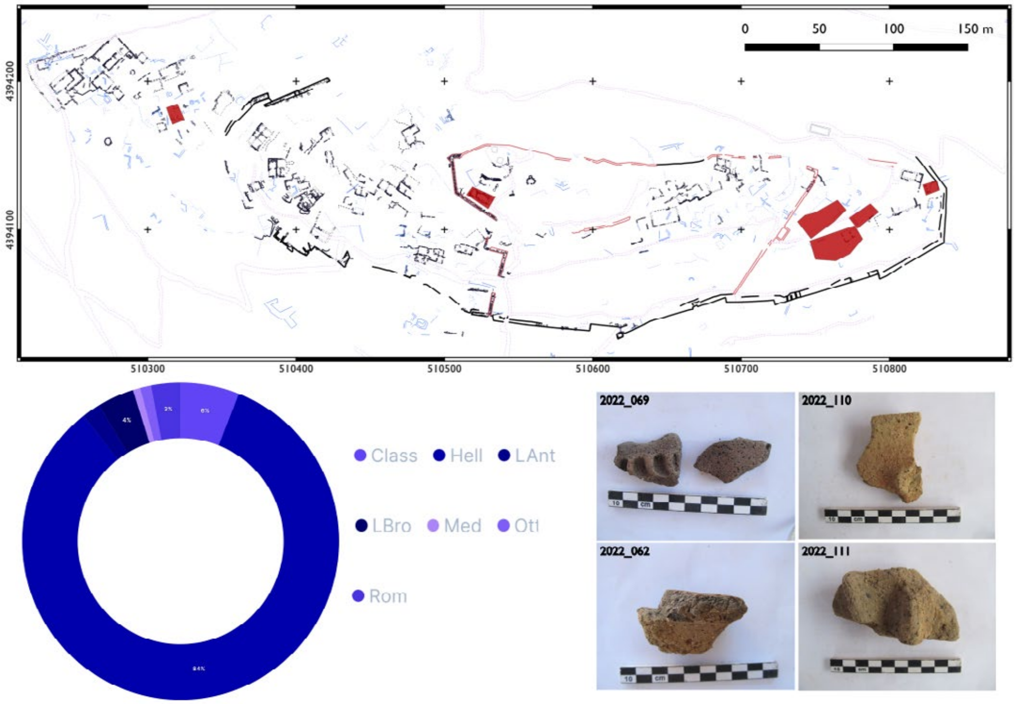


*Figure 14 - Photographs, positioning and statistical contextualisation of some Late Bronze ceramic fragments*

extent this settlement should be connected to the actual presence of Corcyra on the opposite shore of the channel of Corfu (Carusi 2011) the archaeological data cannot resolve. The nature and topography of the settlement itself remain unclear since most of the ceramic fragments are not connected to any archaeological stratigraphy or actual structures. Nevertheless, we should not forget that up to the present, no structure of the site of Çuka e Ajtoit has been dated on stratigraphical ground. The dating to the Hellenistic period of the major part of the archaeology of the site is statistically supported by the finds, and yet it leaves the ground for further discussion.

An emblematic example of this general model is represented by the first results of two trenches of limited dimensions excavated in 2022 and 2023 in complex W4-01, the so-called Palace (Fig. 15. Location of the excavation trenches in W4-01). The trenches investigated the structure of two different terraces featuring different masonry styles and were located in two rare areas untouched by previous excavations on the site. The excavations revealed important technical details about the building of polygonal terracing walls and indicated the mid-third century BCE as the most probable date for their construction. Furthermore, the presence of residual Corinthian A and A1 amphorae fragments further confirms the new chronological model of the site. The discovery of ritually disposed terracotta figurines finally documents the presence of probably domestic cults within the ‘Palace’ area.

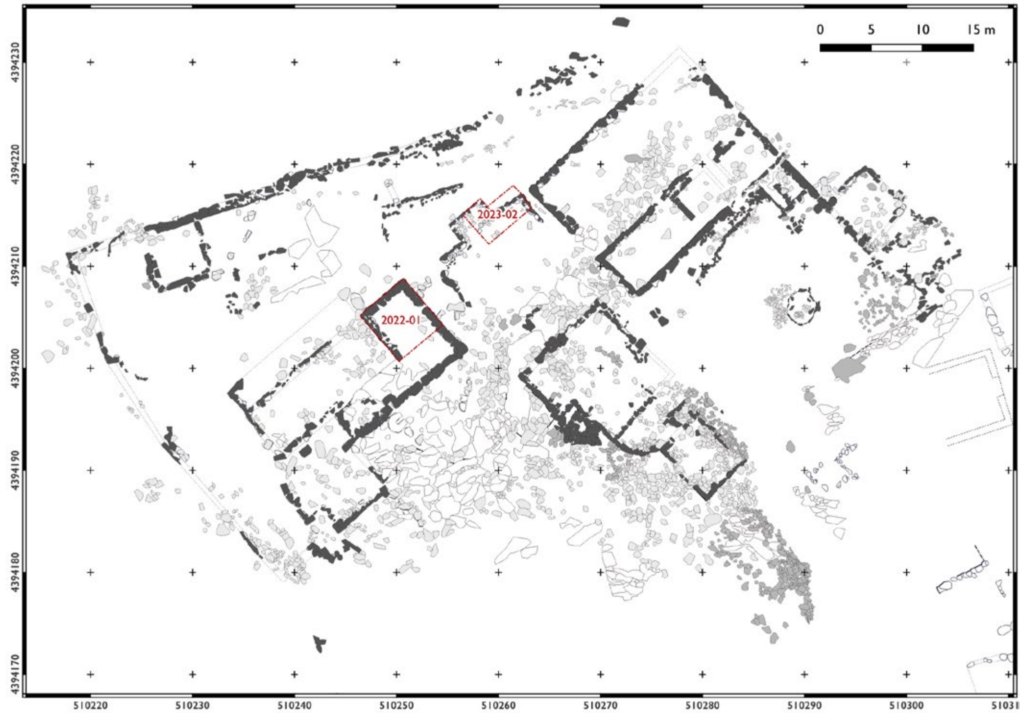


*Figure 15 - Location of the excavation trenches in W4-01*

A final original contribution to the chronological model of Çuka e Ajtoit regards the later phases of the 16th century and onwards. There is no clear evidence of the occupation of the hill in this period, but on the northeast feet of the hill, where a low and rather flat plateau extends towards the lowland many traces of houses built in stone blocks and slabs, sometimes with clear evidence of use of mortar are reported. The houses seem to be very similar to each other, with a simple rectangular planimetry (ca. 10x5m) with a middle division wall on the long side, often separating two different levels. About 20 similar units can be observed, with variable visibility, debris, collapsed material, and vegetation being the main disturbance. Local people connect the ruins of this village to the migrations of the Chams, Albanian-speaking Muslim people who were forced to leave their homes in nowadays Greece after the definition of the Albano-Greek border in 1912 and 1919 and after the First World War, mainly in 1945 (Péchoux and Sivignon 1989; Dépret 2009, 129 ff.). While it is possible that some of these ruins were reoccupied by those people it is highly dubious that in such tough times, the refugees had the time to build stone wall constructions.

Moreover, these structures are visible as ruins in the 1937 aerial imagery of the area by the Italian Geographical Military Institute (Traversi 1965). As a trench of limited extension made clear these houses were in use in the 16-19th centuries. If the results of the limited trench can be extended to the other structures, then this is probably the most recent occupation of the site of Çuka e Ajtoit dating to the Venetian and Ottoman periods (Fig. 16). As the toponym

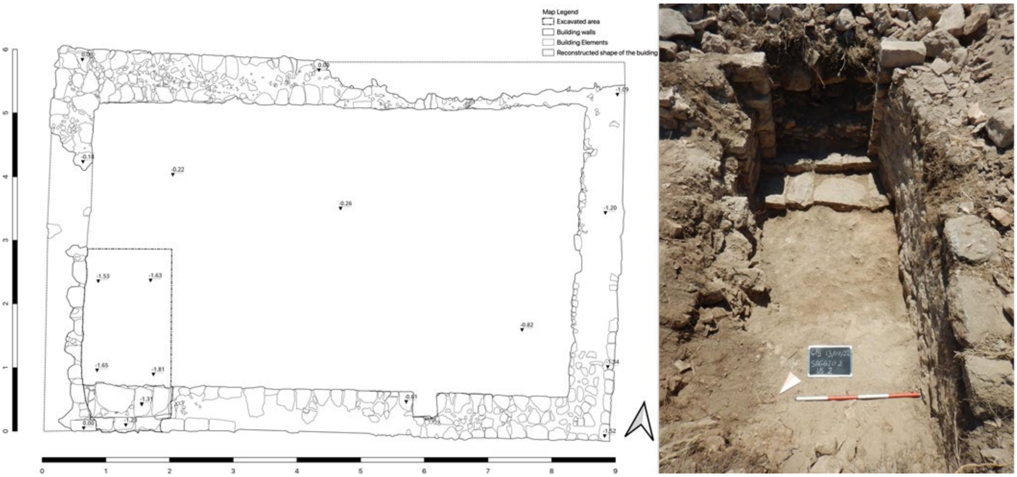


*Figure 16 - Planimetry and image of complex NE-12*

clearly shows, the modern village of Çiflik originates from a chiftlik (Ottoman Turkish *çiftlik*) commonly a farmhouse and the basis of the land management system during the late Ottoman Empire.

**Conclusions**

The approach used until present in Çuka e Ajtoit is strongly determined by the highly irregular and steep terrain, the strong erosion of the site, and the general state of preservation of the structures. Indisputable logistic difficulties and the substantial lack of archaeological stratigraphy, with the natural bedrock exposed, make the most of the hill quite unfitting for extensive excavations. What is left is a 'light' archaeological approach, making extensive use of modern technologies for the detailed documentation of the remains. Paired with ground-truthing campaigns and 'traditional' field documentation it makes a very powerful tool. The collection and analysis of surface pottery adds a new link to the chain of knowledge production. Ceramic-related data have a resolution constraint: they are not very useful and can be deceiving on a small scale, but can provide important information on the big one.

For this reason, we are not analysing pottery data for the context scale, yet they throw an important light on the macro-area and the site scale. The chemical and petrographic analysis of the fabrics, moreover, can overcome identification issues due to the small dimensions of the fragments, that prevent the morphological analysis. These can be very informative on the identification of different imports and possibly the identification of local productions.

Inevitably, this is an approach that works through attempts and successive approximations and requires fine-tuning of the field methodologies as research questions change. Yet it proved to be quite effective on our end and most importantly quite stimulating from the scientific point of view. The continuation of the field and laboratory work is expected to further articulate and enrich the current picture.

## Reference list


Aleotti, Nadia, Federica Carbotti, D'Ambola, and Taip Kaca. 2023. 'La ripresa degli scavi sull'acropoli di Butrinto. Considerazioni preliminari sullo scavo delle mura arcaiche'. *Cronache di archeologia* 41: 117-42.

Baçe, Apollon, and Vladimir Bushati. 1989. 'Vështrim Mbi Banesën Prehistorike Dhe Qytetare Në Iliri Dhe Epir'. *Monumentet* 37: 5-48.

Bogdani, Julian. 2006. 'Le Fortificazioni Di Età Ellenistica Di Çuka e Aitoit (Epiro)'. *Ocnus* 14: 43-60.

Bogdani, Julian. 2009. 'Çuka e Aitoit: Një Kontribut i Ri'. *Iliria* 33: 233-58.

Bogdani, Julian. 2022. 'ΚΕΣΤΡΙΑ ΤΗΣ ΧΑΟΝΙΑΣ: appunti sulla geografia e storia di una regione di frontiera'. *Hesperìa. Studi sulla grecità d'occidente* 4: 87-103.

Bogdani, Julian. 2023 'Documentare l'invisibile. Il Progetto Çuka e Ajtoit: Rilievo e Documentazione Di Un Sito d'altura'. In *"Le Città Invisibili". Remote e Proximal Sensing in Archeologia: Metodologie non Invasive per lo studio della città antica. Atti del terzo convegno internazionale di archeologia aerea 19-21 Maggio 2022.* Archeologia Aerea. Studi Di Aerotopografia Archeologica. XVI (2022): 89-101.

Bogdani, Julian, and Nadia Aleotti. 2024 'Le necropoli di Çuka e Ajtoit. Vecchi e nuove ricerche a aonfronto'. *Atlante Tematico Di Topografia Antica*, 34: 139-160. https://dx.doi.org/10.48255/2283-6357.ATTA.34.2024.7

Bogdani, Julian, and Albana Meta. 2022. 'Kërkime Të Reja Shqiptaro-Italiane Në Çukën e Ajtoit / New Archaeological Research at Çuka e Ajtoit'. *Candavia* 9: 141-158.

Budina, Dhimosten. 1971. 'Harta arkeologjike e Bregdetit Jon dhe e pellgut të Delvinës / La carte archéologique de la côte ionienne et du Bassin de Delvine'. *Iliria* 1 (1): 275-342.

Campana, Stefano. 2017. 'Drones in Archaeology. State-of-the-Art and Future Perspectives'. *Archaeological Prospection* 9999. https://doi.org/10.1002/arp.1569.

Carusi, Cristina. 2011. 'La Grecia Nord-Occidentale e Il Problema Storico Del Rapporto Fra Isole e Peree'. In *Ethne, Identità e Tradizioni: La "Terza" Grecia e l'occidente*, edited by Luisa Breglia, Alda Moleti, and Maria Luisa Napolitano, 89-112. Pisa: Edizioni ETS.

Ceka, Neritan. 1976. 'Fortifikimi Antik i Butrinit Dhe i Territorit Të Presaibëve'. *Monumentet* 12: 27-44.

Dépret, Isabelle. 2009. 'La construction nationale en Épire, 1912-1939 : le rôle du facteur confessionnel et du haut clergé orthodoxe'. *Revue dhistoire moderne contemporaine* 563 (3): 123-49.

Fiz, José Ignacio, Pere Manel Martín, Rosa Cuesta, Eva Subías, Dolors Codina, and Antoni Cartes. 2022. 'Examples and Results of Aerial Photogrammetry in Archeology with UAV: Geometric Documentation, High Resolution Multispectral Analysis, Models and 3D Printing'. *Drones* 6 (3): 59. https://doi.org/10.3390/drones6030059.

Gilkes, Oliver J. 2020. 'The History of Archaeological Investigations in Kalivo and Çuka e Aitoit (Monte Aetòs)'. In *Butrint 7 beyond Butrint : Kalivo, Çuka e Aitoit, Diaporit and the Vrina Plain: Surveys and Excavations in the Pavllas River Valley, Albania, 1928-2015*, edited by Richard Hodges and David R. Hernandez, 10-21. Oxford-Philadelphia: Oxbow Books.

Grillini, Gian Carlo, Vanna Minguzzi, and Enrico Gurini. 2007. 'Caratterizzazione Minero-Petrografica Del Materiale Lapideo Utilizzato Nelle Costruzioni Di Età Ellenistica e Romana a Phoinike (Albania Meridionale)'. In *Phoinike IV. Rapporto Preliminare Sulle Campagne Di Scavi e Ricerche 2004-2006*, edited by Sandro De Maria and Shpresa Gjongecaj, 213-222. Bologna: Ante Quem.

Hansen, Inge Lyse, Oliver J. Gilkes, and Andrew Crowson, eds. 2005. *Kalivo and Çuka e Aitoit, Albania. Interim Report on Survey and Excavations 1928-2004.* Butrint Foundation. http://www.butrintfound.co.uk.

Hernandez, David R. 2017. 'Bouthrotos (Butrint) in the Archaic and Classical Periods: The Acropolis and Temple of Athena Polias'. *Hesperia* 86 (2): 205-271. https://doi.org/10.2972/hesperia.86.2.0205.pdf.

Hernandez, David R., and Richard Hodges, eds. 2020. *Butrint 7 Beyond Butrint : Kalivo, Çuka e Aitoit, Diaporit and the Vrina Plain: Surveys and Excavations in the Pavllas River Valley, Albania, 1928-2015*. Butrint Archaeological Monograph Series 7. Oxford-Philadelphia: Oxbow Books.

Islami, Selim. 2008. 'Çuka e Aetojt'. In *Historia e Ilirëve. Përmbledhje Punimesh*, edited by Selim Islami, 263-336. Albanian Heritage.

Islami, Selim. 2020. 'Çuka e Aitoit: The 1979 Survey and Excavations'. In *Butrint 7 beyond Butrint: Kalivo, Çuka e Aitoit, Diaporit and the Vrina Plain: Surveys and Excavations in the Pavllas River Valley, Albania, 1928-2015*, edited by Richard Hodges and David R. Hernandez, 76-109. Oxford-Philadelphia: Oxbow Books.

Lako, Kosta. 1982. 'Kështjella e Antikitetit Të Vonë Ne Çukën e Aitoit'. *Iliria* 12 (2): 207-219.

Lima, Sarah. 2016. 'Butrint and the Pavllas River Valley in the Late Bronze Age and Early Iron Age'. In *Butrint 4. The Archaeology and Histories of a Ionian Town*, 31-46. Butrint Archaeological Monographs 4. Oxford: Oxbow Books.

Lima, Sarah. 2020. 'The Late Bronze Age Pottery from Mursi, Albania'. In *Butrint 7 Beyond Butrint: Kalivo, Çuka e Aitoit, Diaporit and the Vrina Plain: Surveys and Excavations in the Pavllas River Valley, Albania, 1928-2015*, edited by David R. Hernandez and Richard Hodges, 245-265. Butrint Archaeological Monograph Series 7. Oxford-Philadelphia: Oxbow Books.

Péchoux, Pierre-Yves, and Michel Sivignon. 1989. 'L'éviction Des Tchamidès d'Épire Occidentale En 1944'. *L'Ethnographie* 85 (2): 113-119.

Roversi Monaco, Dario. 1934. 'Rilievi e Scavi Archeologici Italiani in Albania'. *Bollettino Del Sindicato Provinciale Fascista Ingeneri Di Bologna*, 3-12.

Traversi, Carlo. 1965. *Storia della Cartografia Italiana delle Isole Egee e dell'Albania*. Firenze: Istituto Geografico Militare.

# Landscapes of mobility: the results of the Roca Archaeological Survey (Part 1)

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**Abstract**

The Roca Archaeological Survey, the archaeological survey centred on the landscape around the important settlement of Roca Vecchia (sometime spelled also Rocavecchia) in Southeastern Italy, has produced a wealth of new data on the landscape frequentation of one of the most important hubs in the central Mediterranean from later prehistory until medieval times.

In this paper we present some of the results that can be drawn from the data analysed so far for each of the macro-periods of frequentation identified, trying to highlight how the specific features of a mobility hub like Roca Vecchia influenced occupation trends through time.

**Keywords**

Central mediterranean, survey, Palaeolithic, Bronze Age, Iron Age, mobility

## Roca and its Landscape

The settlement of Roca Vecchia is located on a low promontory protruding in the Adriatic Sea, which is currently roughly 3ha in extension but has been estimated at least 5ha during late prehistory. The promontory area (area *Castello Carrare*) is closed toward the land by a large fortification wall whose earliest phase is to be dated to the Middle Bronze Age. Similarly to other coastal sites emerging in Apulia during the Bronze Age, Roca Vecchia is surrounded by a large lagoon (*Bacino dei Tamari*), which is a depression that was at least seasonally filled by water and that must have represented an important attraction area for early occupation (Iacono 2019: 75-76). From a general topographic standpoint, the landscape surrounding the site is completely flat. For this reason and before discussing the fieldwalking survey, the data recovered and their relevance to the study of long-term mobility trends, it is crucial to briefly introduce the area investigated also from a geological and geomorphological perspective as this represents a decisive step in order to understand potential biases in the surface record. The peninsular sector of southern Apulia (Salento) where Roca Vecchia is located, is a low plain whose continuity is interrupted by modest reliefs (locally called *Serre*) not exceeding 200 m above sea level. Overall, this landscape morphology is a result of the combination of the intense Mesozoic tectonic activity (giving the typical Horst-Graben structure) and the Cenozoic transgressive/regressive cycles (producing the marine infillings of basins, see Cotecchia, 2014 and references therein). The horsts (oriented NW-SE/NNW-SSE, according to the Salento main axis) are well-isolated from the grabens with elevation gradients in the order of tens of meters, and more pronounced on the eastern side than on the western one (Cotecchia, 2014; Largaiolli et al., 1969; Martinis, 1970; Martinis and Robba, 1971; Rossi, 1969a, 1969b; Tozzi, 1993). The geomorphological studies suggest the tectonic stability of this area since the Upper Pleistocene. The uplift rate, indeed, tends to be null or very low (between 0.15-0.3 mm/y), as shown by evidence of the Tyrrhenian Sea (MIS 5e, about 123ky BP, see Cotecchia, 2014; Ferranti et al., 2006). Karst processes are particularly important in this area, with a variety of evidence (e.g., dolines, poljes, other karst depressions, caves). They played an important role in shaping the cultural landscape, in different phases of human history (in particular for prehistoric times). Some of the caves from Salento, indeed, are key-sites for the definition of most of the Italian palaeolithic technocomplexes (Palma Di Cesnola, 1993, 2001).

The hydrographic network is almost totally endoreic, with poorly hierarchical incisions of modest depth and occasional torrential nature. Both deep and shallow aquifers are the main freshwater reserves of Salento. Some of these give rise to springs along the coasts or at coastal watersheds. Both along the Ionian and Adriatic sides, there are numerous wetlands or marshes, drained in recent times (Cotecchia, 2014; Largaiolli et al., 1969; Martinis, 1970; Martinis and Robba, 1971; Rossi, 1969a, 1969b). This kind of evidence is well-attested in the territory of Roca Vecchia. Some authors link the name of Grotta Poesia to a local Greek dialect root ("*posìa*" means "to drink water"), referring to the possible presence of a freshwater spring (quoted in: Delle Rose and Parise, 2005). As mentioned, an important hydrological basin is present a few hundred meters beyond the wall of the protohistoric settlement (the Tamari Basin, see Auriemma 2004). The stretch of the coastline along the investigated area evolves as a cliff sloping towards the NW. The Pliocene fine calcarenites of the bedrock are particularly friable. This produces rhythmic and massive collapses of the cliff with a consequential erosion of the coastline, including the promontory where the site of Roca Vecchia lies. The magnitude of these collapses can be measured in a historical time scale (as testified by the remains of the ancient/Hellenistic settlement surviving on what are now isolated rocks in the sea).

A large strip of plain land extends behind the Tamari Basin, bordered by a morphological terrace parallel to the coastline (distant from it about 15 km). The edge of this terrace is set at an elevation of about 30 m and results in a morphological break. It is more pronounced along the SE edge of the area (with an elevation difference of about 15 m) and more nuanced along the NW edge (with an elevation difference of about 5 m). Further toward the hinterland, a vast plain extends at the height of about 50-60 m above sea level.

**Roca Vecchia: a Mediterranean hub before history**

The landscape around the site of Roca Vecchia represents a privileged vantage point for the analysis of widespread phenomena of mobility in the Mediterranean through time, a theme that in recent times has been at the centre of much debate in archaeology (Aldred 2020; Daniels 2022; Heitz and Stapfer 2017; Kristiansen 2014, Kristiansen et al. 2017; Scharl and Gehlen 2017, see also Tab.1). The excavations carried out at Roca in the last thirty years by a research team from the University of Salento have contributed to reconstructing the history of the site (Table 1) starting from the oldest occupation in the area datable to the Middle Bronze Age (Proto-Apennine, around the seventeenth century. B.C, see Iacono 2019; Scarano 2012).

Starting from the MBA, the emergence of fortified sites is attested in the whole of southeastern Italy. The monumentality of these fortifications marks the landscape, making these structures not only functional to defensive needs, but also probably deeply imbued with a complex symbolic meaning. Another important characteristic of fortified sites is the resilience of

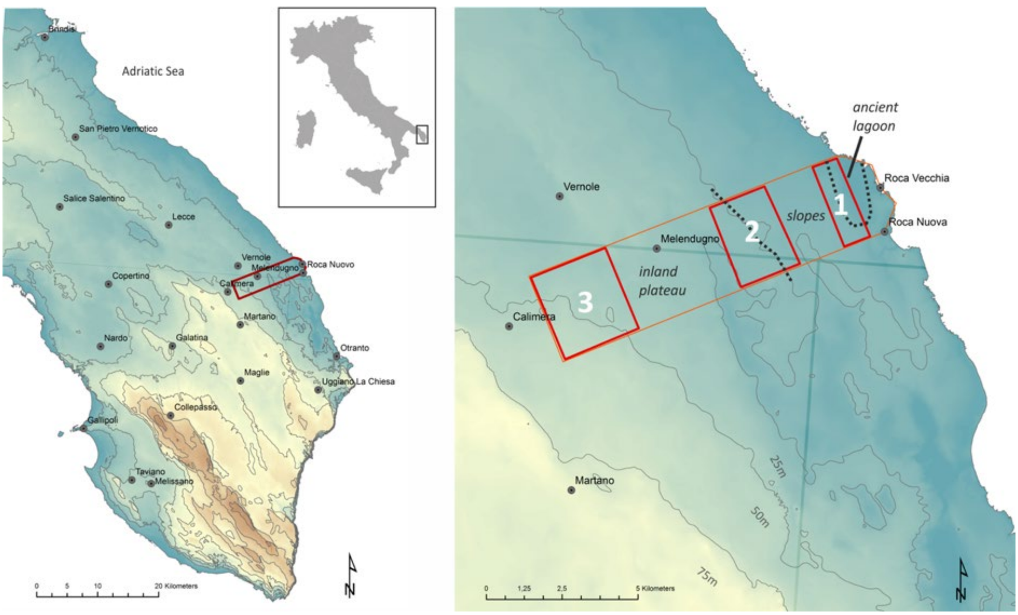


*Figure 1 - Main area of the Roca Archaeological Survey (after Iacono et al. 2020).*

their communities over the long-term, as these have shown the ability to recover even in the aftermath of violent destructions. Roca Vecchia perfectly epitomizes both features. Here fortifications are extremely monumental, reaching a width of some 25 m at the main gate (Scarano 2012). Also, through the second millennium BC it is possible to distinguish at least two massive destruction episodes at the site: the first at the end of the MBA, i.e. 1450 B.C.; the latter, around 1000 B.C (Pagliara 2005; Scarano 2012, 381).

From the MBA onward, Roca Vecchia has shown considerable evidence not only for short scale movement but also for long-range connections. The arrival of small groups of individuals coming from the Aegean – Mycenaean world is essentially witnessed by the arrival of imported ceramics, some of which of the Middle Helladic tradition, datable as early as to the LH I period (see Guglielmino 2006; Guglielmino et al. 2010). A moment of intense contact is recorded in the second half of the second millennium BC, in particular in the Subapennine period. Aegean ceramics, both imported and (especially in this phase) of local production (Jung et al., 2021), increase considerably in number and their use seem to have been connected to banquet practices like those recognised at other sites of the Italian Bronze Age, although probably on a larger scale (Iacono 2015; 2019). In the Iron Age, the site shows notable relations with the Corinthian commercial circuit (Corretti et al. 2017; Merico et al. 2010).

As it can be seen, much was known of the site through time, relatively little about the landscape that had to be crossed to move from / to it. The Roca Archaeological Survey began in 2019 by a team from the University of Bologna in order to address this issue.

*Table 1 - Diachronic developments at Roca Vecchia (dates BC in the table are only approximate and do not take into account main debates on the beginning of the Iron Age (on which see Bartoloni & Delpino 2005 or Plicht & Nijoboer 2018)*

| **Period** | **Roca** | **Approx years** |
|---|---|---|
| Middle Bronze Age (Protoapennine and Apennine) | Earliest occupation at the site.<br>Construction of the fortifications (through various phases, also inclusive of a moat).<br>Violent destruction of the settlement with unburied human remains in the destruction levels of the walls | 1700-1400 BC |
| Recent Bronze Age (Subapennine) | New phase of the fortifications, built with stone blocks.<br>Large scale feasting episodes<br>Peak of Aegean type ceramics on the site. | 1400-1120 BC |
| Final Bronze Age (Protovilanovan) | Large timber buildings and new phase of the fortifications (also made of wood).<br>Metal hoards also containing abundant gold objects.<br>Peak in the attestation of large ceramic containers (*dolii*) and decrease of Aegean type ceramics.<br>Deposits sealed by an extensive fire destruction. | 1120-980 BC |
| Iron Age | Cultic/Ritual context that includes numerous Corinthian ceramics (up to 20% in some contexts) | 980-600 BC |

## The Roca Archaeological Survey

### *The fieldwalking survey*[1]

In agreement with best practices (Attema et al. 2020), the general area to be explored (Fig. 1) has been sampled in advance on the basis of three macro topographical recognisable zones: the coastal one inclusive of the former lagoon of the Tamari Basin (see below and Fig. 1.1), the slopes (Fig. 1.2) and the inner plateau (Fig. 1.3). There is a variation in current land use and occupation density among these areas and one of our initial research questions was how the current situation influences the surface record. At the start our goal was to obtain a general view of the characteristics, conservation and surface visibility of the artefacts in the three above-mentioned areas of the landscape. A detailed study of the coastal area, where Roca Vecchia is situated, was initially not our main focus.

In general terms, the human impact in this area produced both urbanisation (in particular along the coast and nearby the municipality of Melendugno) and intensive agricultural exploitation. Cultivation includes mainly arable/arboreal crops and olive groves. The latter, in particular, and despite have been decimated by a disease, represents the almost totality of local agricultural production, and seems to be concentrated on landscapes with an outcropping rock substrate and/or very limited soil depth. These areas have been subjected to (recent)

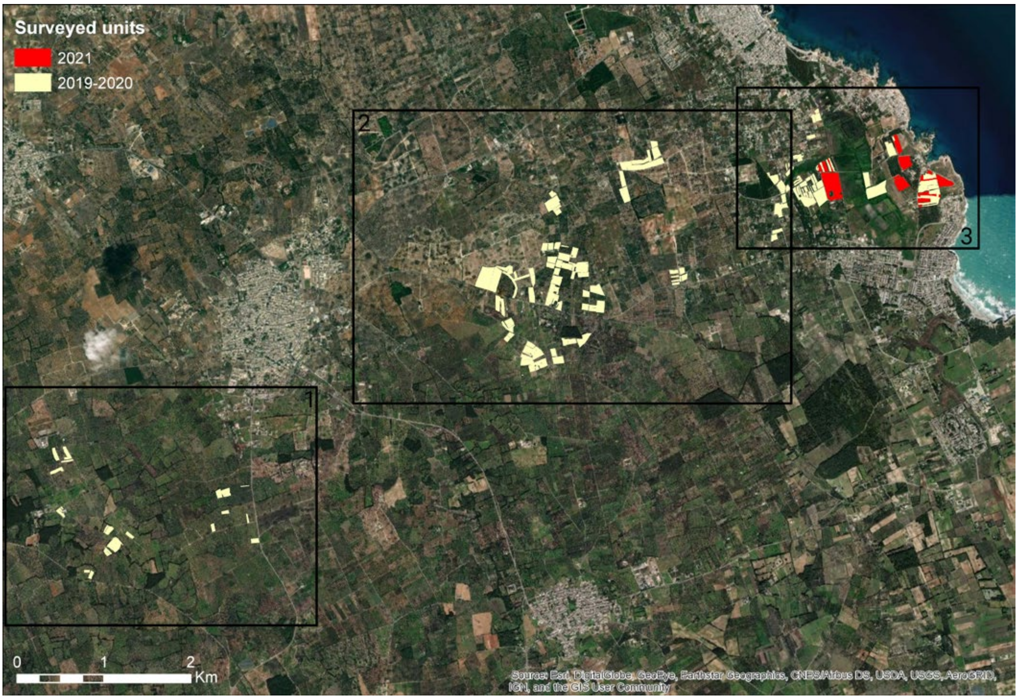


*Figure 2 - Units surveyed of the Roca Archaeological Survey.*

[1] The Roca Archaeological Survey has been conducted thanks to the permit granted by the Superintendence SABAP of the provinces of Brindisi and Lecce. This research has been funded by the project "Landscape of Mobility and Memory" (Progetto Montalcini 1910) and AlmaScavi - University of Bologna.

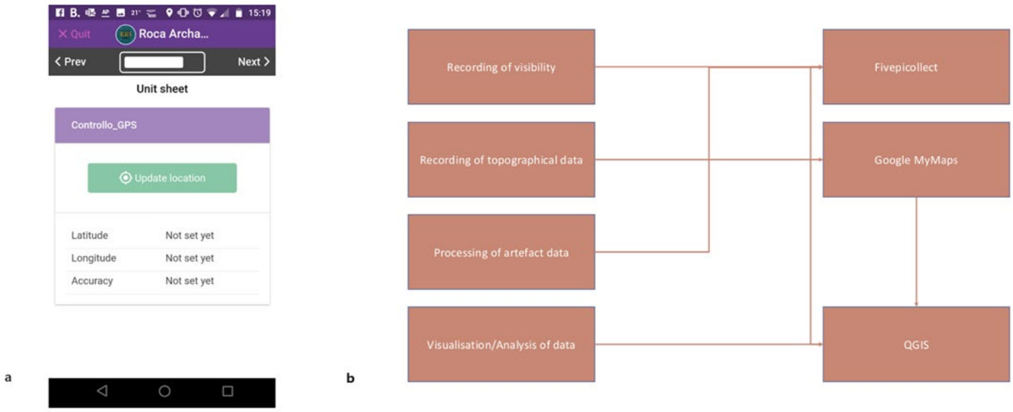


*Figure 3 - a) Screenshot of the visibility database on fiveepicollect.org.*
*b) Workflow of the Roca Archaeological Survey and software adopted.*

heavy agricultural activities, with massive earthworks, rock crushing and ploughing assisted by heavy mechanical equipment.

Initially, areas to be explored within the macro areas identified (see above) have been randomly selected (outlined in Fig. 2) except for the most internal area (Fig. 2.1) located in proximity of the two known dolmens (*Gurgulante* and *Placa* potentially datable to the BA; Iacono 2019). Although the project has paid attention to all the periods from Prehistory untill today, at the same time it has represented a chance to explore the “hidden landscapes” (Bintliff et al. 1999) of Bronze Age southern Italy. Indeed, based on our knowledge of the geographical area, the remains pertinent to this period are normally characterised by a low concentration of finds. However, as the exploration made progresses, we recognised that the landscape close to the coast and the main settlement showed a clear difference from the hinterland area, as it exhibited a considerable find density for every period. This can be clearly glanced comparing the raw count of artefacts from the 2019 season, which was centred in the interior areas and yielded only some 2500 objects, with those of the year 2020 and 2021. These latter focused on the coastal area and on the surrounding of the former Tamari lagoon and yielded more than 10000 and 60000 finds, respectively.

Such a stark difference demonstrates that the landscape around Roca Vecchia shows two different contemporary patterns: a low density and sparsely occupied hinterland along with a coastal stripe that was bulging with evidence of past occupation from late prehistory to post-medieval times.

### *Field methods and data analysis*

In our data-recording workflow, our goal was to document the survey without the aid of paper documentation, using only free (and preferably open-source) software (Fig. 3b).

Two team leaders were responsible for the recording of the limits of the survey units. The points at the corner of each survey unit were recorded using Google’s My Maps application.

Influencing factors that affect visibility (weather, vegetation, shadow, ploughing, modern material, rocks) have been recorded on an application purposefully created on five.epicollect.net (a cloud-synced DBMS developed by the Imperial College, see Fig. 3a). The recording was carried out by participants directly through their smartphones but regularly checked by the director and/or team leaders for consistency.

The accessible fields within the selected areas have been divided in 20x20m units directly on the field. Such units have been explored following the topographic features of the land (e.g. following the rows of olive trees) recording visibility conditions and collecting archaeological finds separately for each unit. Such division in small units has been facilitated by the general organisation of the property, particularly in the areas explored during the first campaign, normally small properties partially fenced by dry-stone walls, often accompanied by traditional dry-stone constructions (locally known as *pagghiare*). Our fieldwork has allowed the creation of high-resolution distribution maps of the materials, as well as a considerably detailed evaluation of visibility. At the same time, the intense agricultural use of these plots has affected the level of preservation of the surface record.

Usually, the distance between walkers was 5m (a typical distance between rows of olive trees) but a smaller coverage has also been selected (10m of interval/gap) depending on surface conditions and the quantity of finds counted over a strip of 3 units.[2] The interval of 5m was always applied to the areas with presumably good conditions of preservation or where pre-modern material was already evident on the boundaries of the field. Assuming that each walker is able to cover a width of about 2m in front of them (1m to the left and 1m to the right), the coverage then varied between 20 and 40% (being aware of the debate on visual coverage this percentage is thus considered only an approximation, see Banning 2002). The former (20%) sampling is already representative, however given the abundance of the archaeological record of the landscape under study we decided to adopt a 40% sampling strategy in order to have a richer basis for our analysis. In the density maps units with 20% coverage are a minority and the number of potsherds from these has therefore been doubled to make the data comparable with the 40% coverage units. In the maps, interval classes were established separately for each phase using the Jenks natural breaks classification method which seeks to reduce the variance within classes and maximize the variance between classes (Jenks 1967).

All the finds have been collected by unit, including post-medieval material. Samples of special materials (*special bags*) have been collected separately from the materials of the regular coverage, but only in the limited number of cases where these attested the presence of periods otherwise not present in the regular coverage of the unit.

As a general rule, it has been decided not to use any discard threshold (based on sherd size) for collecting material. This decision is based on the consideration that in situation of over-abundance of finds, minute prehistoric sherd material tend to be more easily overlooked and left aside.

Primary pottery processing has normally been conducted in Bologna also by the means of another five.epicollect.net database purposefully created. Besides the identification of

[2] The distance between walkers was shifted from 5 to 10m in the event of a number of artefacts fewer or equal to 3.

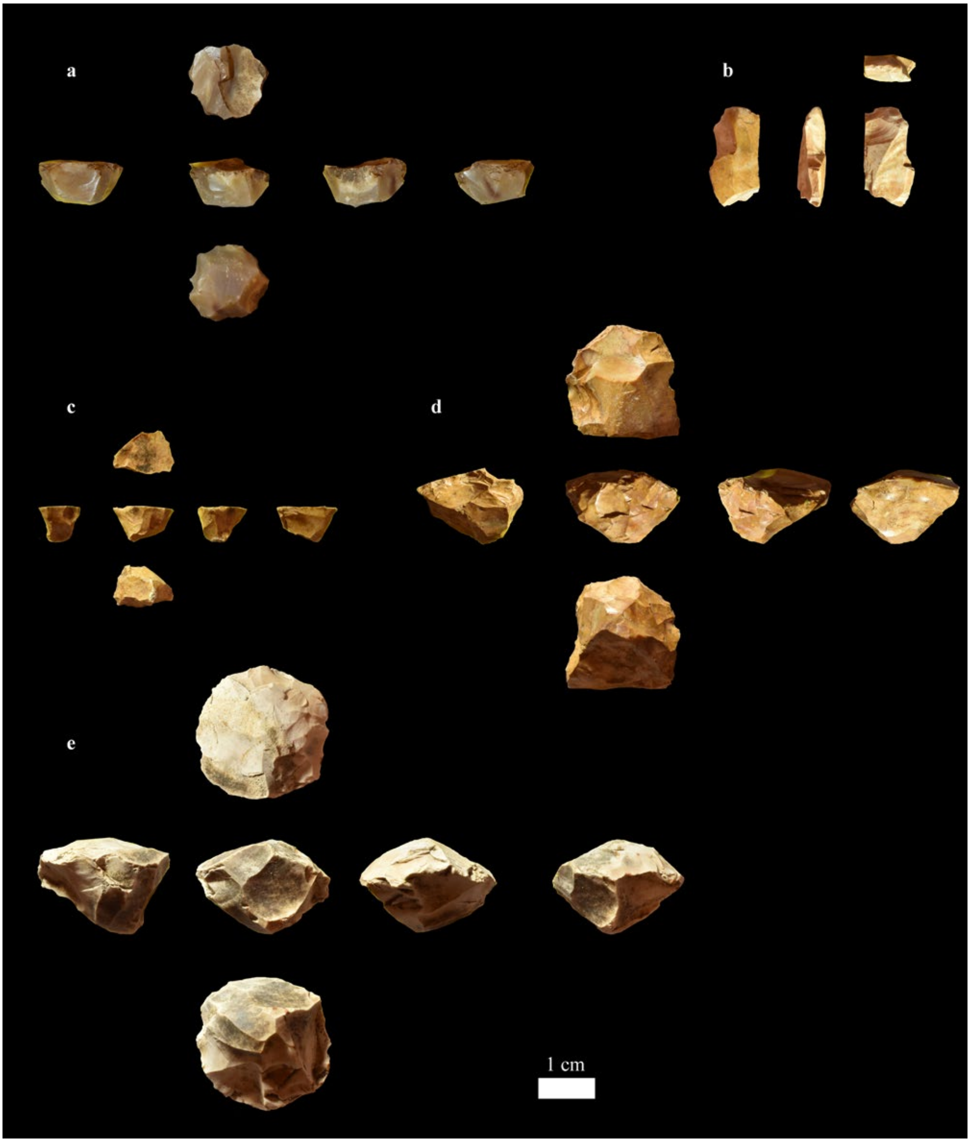


*Figure 4 - Lithic artefacts discussed in the text.*

macroscopically recognisable classes of material, the analysis has tried also to assign non-diagnostic undecorated sherd to broad chronological brackets by the means of an assessment of fabric hardness, starting from the basic assumption that older sherds tend to be softer than recent ones. This characteristic is associated with the degree of vitrification of the clays, which is in turn connected to the firing temperature (Whitbread 2017, 204, Lankford 1983). Consequently, it is possible to suggest that older fabrics are normally (although not always) fired at lower temperatures due to the general improvement of the firing process (Ricci 2016, 35-38), and hence, overall, tend to be softer than those of subsequent periods. This consideration is not universally valid, and the attribution of undiagnostic, undecorated sherds is not always easy to implement, particularly for minute material. Despite such limitations, this method represents a useful starting point and can complement traditional criteria based on identification of classes of materials and on shape morphology.

Within each category of finds, basic measures (linear length and weight) were collected for the larger artefact in each category, as to allow a quick quantitative comparison.

**The Landscape of Roca Vecchia through time**

A first report has been published in 2020 but it was uniquely based on preliminary pottery processing and not on specialised analysis of materials (Iacono et al. 2020). The following discussion will present only data related to the periods from early and later prehistory.

***Early Prehistory***

The earliest phase documented in the territory around Roca Vecchia is represented by evidence of lithic industry, dated to a final moment of Upper Palaeolithic or to the Mesolithic, mainly clustered on the boundary of the Tamari basin (Fig. 4). The absolute paucity of findings (mostly non-diagnostic) might be due to their average small size which hinders accurate chrono-cultural framing. Limited to the 2019 field season, the sample comprehends only 35 pieces. The fine chert is the most represented raw material (with very rare siliceous limestone, radiolarite and quartzarenite). A large part of the lithic implements (91%) is patinated, as result of a long exposure of these materials to weathering. Evidence of dark coating on one third of findings is also relatable to post-depositional alteration, nevertheless, this kind of alteration is usually due to Fe/Mn precipitation, with presence of water, but in anoxic environment (e.g., Goossens et al., 2015). No other chemical alteration is detectable. The physical alterations comprehend mainly post-depositional fracturing (15 pieces), fire alteration (1 piece), and smoothing of edges (1 piece). This suggests that the modern mechanical stress (e.g., agricultural activities) constitutes the main destructive process affecting the original site, while water-flow processes (with long-distance transport of material from primary position) should be negligible. The clustering of main lithic finds around a relatively small area, near the Tamari basin, appears also consistent with this reading. From a technological point of view, most of the pieces are represented by management flakes and indeterminate fragments. Possible target flakes, retouched tools (8 pieces) and cores (2 pieces) are less represented. In particular, the presence of "short endscrapers" (2 elements), blades (2 elements), and bladelet cores (3 elements, Fig. 4) point to a final Upper Palaeolithic or Mesolithic period.

The location of these lithic findings in the nearby Tamari basin seems to reflect a precise settling choice, selecting peri-coastal marsh environments. Other similar Upper Paleolithic and Romanellian/Epiromanellian contexts, indeed, are recognizable along the Eastern side of the Apulian peninsula, such as the sites near Brindisi of Torre Bianca, Torre Canne, Porto Fetente, Gallico I-II and Torre Testa (Punzi, 1968), as well as in a closer range San Foca (just north of Roca, see Ingravallo, 1980), Malapezza (Dell'Anna, 2010), and some others around the Alimini lakes (near Otranto some 10 Km to the south, see Milliken and Skeates, 1989; Piccinno and Piccinno, 1978). This settlement pattern could be the result of economic and behavioral practices shared by a common cultural background. The marsh environment may have acted


*Figure 5 - Distribution of prehistoric material in the areas 1-2 of Figure 2.*

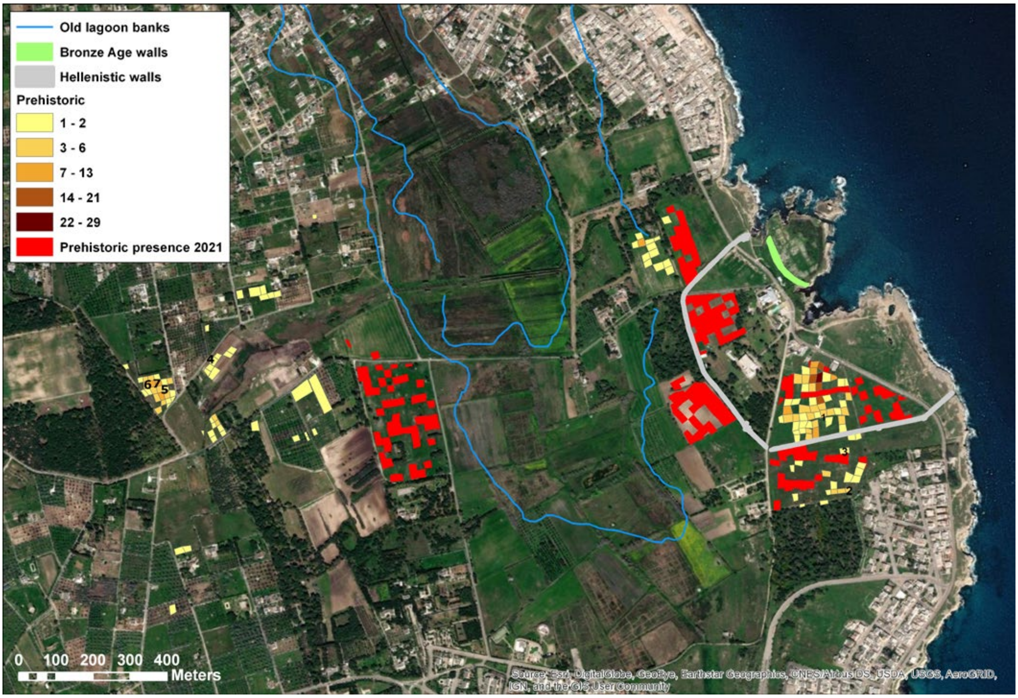


*Figure 6 - Distribution of prehistoric material in the area 3 of Fig.2. Layout of BA walls based on Scarano 2012. Layout of Hellenistic walls based on De Giosa 2011.*

as an attractor for late-Paleolithic/Mesolithic human groups, due to the rich resources of this kind of biome, during a sharp climate changing phase. This is consistent with the idea of a wide-range economy, during the final Paleolithic and Mesolithic periods, aimed at the exploitation of diversified basins and resources (Tagliacozzo, 2003).

***Later Prehistory***

After the late Palaeolithic / Mesolithic horizon it seems to be possible to notice a considerable gap in anthropic activities attested. Neolithic traces are ephemeral in the record. Considering both lithics and ceramic artefacts, no material of the sample analysed so far seem to belong to the Copper Age-EBA. This is not entirely surprising as within the area this horizon is often rather ephemeral in the surface record and is usually recognised only in a limited number of contexts (see Cazzella and Recchia 2021).

Also, in terms of general distribution of the material (Fig. 5, 6), the hinterland seems to be remarkably poor in terms of representation of the various prehistoric periods. A "void" seems to be recognisable, particularly during prehistoric times, while later periods are somewhat better attested.

Such a skewed distribution of the evidence demands an explanation. One of the potential factors affecting this trend could be (at least partially) the intense agricultural activity conducted in this zone, particularly around the internal plateau (Fig. 2.1, 2.2) during subsequent periods.

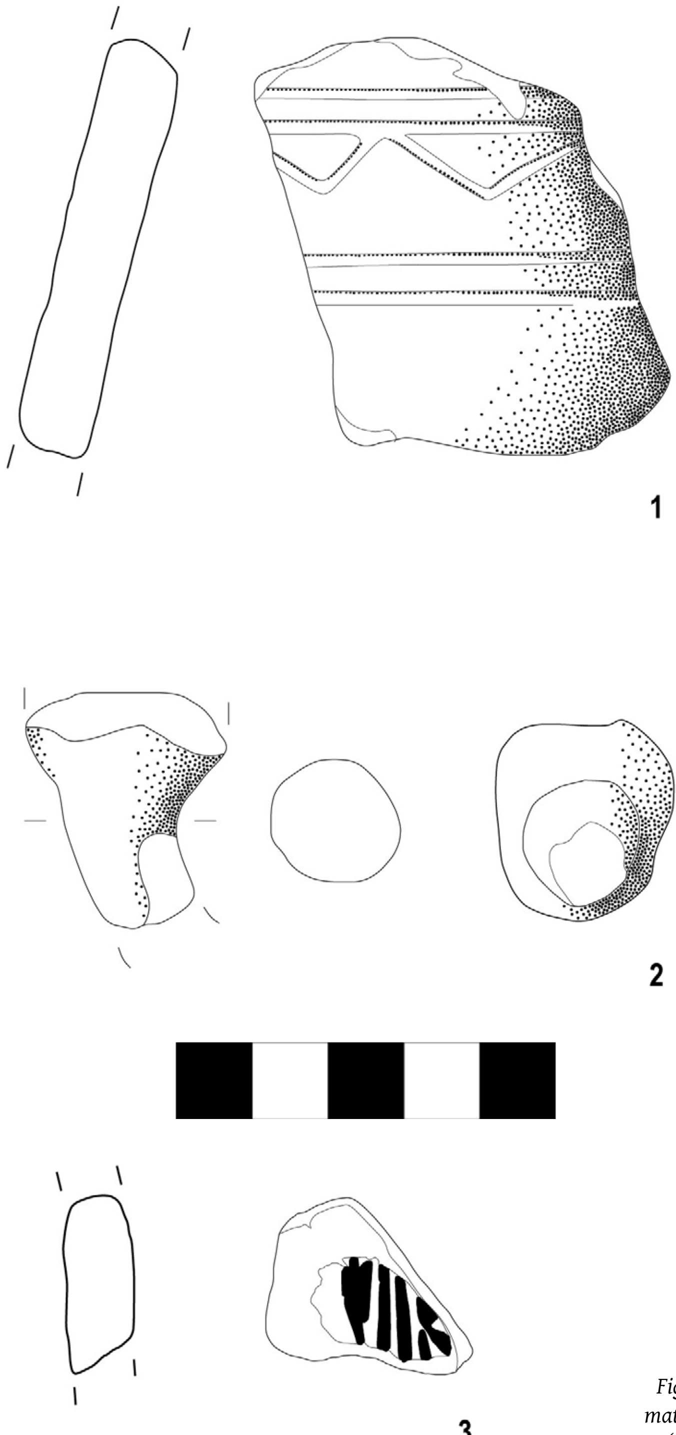


*Figure 7 - Later prehistoric material discussed in the text (drawing by the author).*

Also, erosion might have played an important role in erasing traces of earlier frequentation. Still, as mentioned, the relative sparseness of the surface record from the hinterland is paired with the richness of the material coming from the coastline and the margin of the Tamari basin. This trend is so apparent that has led us to reformulate some of the main assumptions on which the survey was based.

The model that represented the benchmark for the interpretation of occupation within the region for late prehistory was based on the results by Recchia and Ruggini (2009, see also Ruggini 2009) on the hinterland of the Brindisi area (immediately to the north). This assumed a two-tier landscape occupation, with hamlets dispersed in the interior accompanied by the attestation of long-lived specialised, fortified settlements (Cazzella 2009) (Fig. 7).

Yet, according to our current knowledge, the landscape around Roca Vecchia seems to preserve very faint traces of such small settlements. Besides unobtrusive material scatters or isolated sherds, the only evidence belonging to this period is the looted chamber tomb recovered not far from one of the known dolmens around the site (see Iacono et al. 2020). The structure bears some resemblances with LBA structures from western Greece as well as to another from Roca Vecchia itself and other sites in the Salento region (Iacono and Guglielmino 2021, Scarano 2021). Beside this structure, a seamless distribution of prehistoric ceramic fragments is evident in a radial pattern surrounding Roca Vecchia. The majority of these fragments are dated to the Bronze Age, with their density gradually diminishing as the distance from the site increases. (Fig. 6).

Rather than with the presence of multiple occupation cores, a similar situation seems to be more in line with a unique settlement which has its main nucleus within the peninsula area, but that extends considerably outside the fortifications.

Obviously, a similar reconstruction has some limitations, not the least because the material retrieved often cannot be precisely dated and seem to be part of a flat horizon with little possibility to operate more precise distinctions. The spatial distribution of diagnostic finds can be of some help in reconstructing the diachronic dimension of this activity. While well-dated MBA material such as the decorated Apennine fragment (Fig. 6.1, 7.1 with a decoration comparable to Macchiarola 1987, Mot. No. 177a) seem to be spatially located in an area relatively close to the main settlement (but still outside the main walls), other later materials have been found further from the site, within and beyond the area enclosed by later Hellenistic fortifications. This can be evinced, for instance, by the horizontal roll handle (Fig. 6.2, 7.2) a feature that is more frequently attested from the RBA onward (Cocchi Genick 2004, 78, also note the lack of such feature in the MBA levels and its attestation in those dating to the RBA: see Pagliara et al. 2008, no.5, 27; Scarano 2012). Likewise, the only Aegean type vessel fragment identified so far in the landscape (Fig. 6.3, 7.3) belongs to a vessel dated in all likelihood to LH III B-C early/middle. The date is based on the decoration that includes a panel motif (FM 75[3]) which is likely dated to this period, particularly in the light of what seems to be the ending part of a chain of quirks in central position within the motif. This feature that is attested in Aegean type productions at the main site (e.g. Coluccia 2010). Incidentally, this period corresponds to the highest attestation for Aegean type pottery at Roca Vecchia (Guglielmino et al. 2017;

[3] FM stands for Furumark motif, after Furumark 1941

Iacono 2019), which makes the dating to such a horizon more probable. Such situations might tentatively be considered indicative of a gradual expansion over a long horizon that goes from at least the 15th cent. BC (according to the radiocarbon dates obtained from layers with Appennine material at Roca Vecchia, see Scarano 2012), toward at least the Recent Bronze Age (up to the 12th cent. BC). Naturally enough, we are well aware that the surface record does not mean habitation, and therefore we should pay attention not to equate the presence of anthropogenic traces with an expansion of the dwelled area *tout court*. However, it is possible to safely assert that the range of human activities centred around the main settlement of Roca considerably extended beyond the customary 3-5 ha. traditionally assigned to it.

**Mobility at Roca Vecchia in Early to late Prehistory**

In this section we will sew together the many threads presented so far, showing how the data of the Roca Archaeological Survey can help us to understand patterns of mobility and their effect in the landscape.

The earliest phase recorded by archaeological evidence is framed between a final moment of the Palaeolithic and the Mesolithic, testifying the presence of people with a highly mobile life-style.

In this chronological horizon, a wide-range subsistence economy, exploiting not only the large game, but also small preys and marine resources, is attested in the region (Tagliacozzo 2003). This strategy could be related to a contraction in the extension of the play-radius, with a consequent extensive exploitation of the local resources and a possible characterization of the foraging mobility (characterized by frequent moving of the camp for relatively short range). As collateral consequence, areas like the marshy environment could have acted as main attractors for the camps, given the richness of exploitable resources therein.

Secondly, the intrinsic presence of different siliceous raw materials is robust evidence of long-range mobility. The raw materials identified in the lithic assemblage, indeed, are completely absent in Salento (e.g., Spinapolice 2012 and reference therein). At this stage of the research, two possible hypotheses can explain the presence of these raw materials: 1) a direct trip to sources far more than 100Km from the communities living around the Tamari basin aimed to recover these raw materials; or 2) a collecting mediated by a number of shorter down-the-line exchanges reaching the closest sources.

As we move to later periods, the contrast between a void hinterland and a populated stripe around the coast and the Tamari basin emerges quite clearly. Both patterns are likely far from being unrelated, as it is possible to suggest that, beyond distortions in the representation of the surface record, there was a dependency relation between these two distinguished landscapes: the interior is depleted because consistently, through time, the coast is attracting the majority of human activity. No doubt this "attraction" entailed also various forms of movement, primarily in the short range. The picture can be reliably reconstructed only starting around the mid second millennium BC. Such a configuration of spatial engagements with the landscape could have been potentially the outcome of the relocation of people and groups close to the peninsula of the main site, a kind of short-range migration from other areas (arguably outside of the surveyed area), potentially due to the increasing nodal role of the

Roca in local networks of interaction and its increasing ability to accumulate surplus (Iacono 2019, 156-160). The presence of material showing clear “foreign” features such as Aegean type pottery and Apennine pottery (within Salento these two classes are almost equally rare during the late MBA, see Iacono 2019, Scarano 2006), give us an idea of connections further afield, either direct or (more likely) mediated by the main site.

## Conclusions

The variable nature of mobility as attested in the landscape around Roca Vecchia through time allows us to explore broader issues related to the relationship between the human landscapes and mobility on a much broader canvas than what is normally accomplished through studies with a much narrower chronological focus. The analysis of the surface record has allowed to highlight how the scale of mobility has considerably changed through time, from the immediate remits of different environmental niches exploited by local prehistoric communities, to the building up of larger and larger communities that already toward the end of the Bronze Age seem to have been more akin to the “urban” status than what was previously thought.  Such communities were, in turn, also the product of much larger networks of mobility and interaction that toward the second half of the second millennium BC were transforming this portion of the Central Mediterranean involving areas as distant as the state societies of the Aegean and the Balkans as well as northern Italy (Iacono 2019). Of all these long-range movements of individuals very little is directly recognisable in the material culture collected in the landscape with only one sherd of Bronze Age Aegean type pottery recovered from the surroundings of the site, a figure that marks a sharp contrast with the abundance of such material from the main site. This can potentially suggest that the circulation of this material was somewhat limited to the area of the main site although further investigations are needed in order to prove this.

## References

Aldred, O. 2020. *The Archaeology of Movement*. Abingdon, Oxon; New York, NY: Routledge.

Attema, P., J. Bintliff, M. van Leusen, P. Bes, T. de Haas, D. Donev, W. Jongman, E. Kaptijn, V. Mayoral, S. Menchelli, M. Pasquinucci, S. Rosen, J.G. Sánchez, L.G. Soler, D. Stone, G. Tol, F. Vermeulen and A. Vionis, 2020. “A guide to good practice in Mediterranean surface survey projects.” *Journal of Greek Archaeology* 5:1–62.

Auriemma R. 2004. *Salentum a salo*, Congedo, Galatina.

Banning, E.B., 2002. *Archaeological Survey*. New York: Kluwer Academic/Plenum Publishers.

Bartoloni, G., Delpino, F. (Eds.), 2005. Oriente e Occidente : metodi e discipline a confronto, riflessioni sulla cronologia dell’età del ferro in Italia : atti dell’Incontro di studi, Roma, 30-31 ottobre 2003. Istituti Editoriali e Poligrafici Internazionali.

Bintliff, J.L., Ph. Howard and A. Snodgrass, 1999. “The Hidden Landscape of Prehistoric Greece.” *Journal of Mediterranean Archaeology* 12(2):139–168.

Cazzella, A., 2009. “La formazione di centri specializzati nell’Italia Sud orientale durante l’età del Bronzo.” *Scienze dell’Antichità* 15: 293–310.

Cazzella, A. and G. Recchia, 2021. *Alle origini delle disuguaglianze: dall’affermazione dell’economia produttiva alle prime forme di stratificazione in Italia e nelle isole adiacenti (6000-1000 a.C.* Ragusa: Edizioni di storia e studi sociali.

Cocchi Genick, D., 2004. "Le ceramiche nel ruolo di indicatori cronologici e regionali." in *L'età Del Bronzo Recente in Italia*, edited by D. Cocchi Genick, 22–52. Viareggio (Lucca): M. Baroni

Coluccia, L., 2010. "*22.12 Skyphos di tipo egeo.*" *Ambra per Agamennone Indigeni e Micenei Tra Adriatico Ionio Ed Egeo*, in edited by. F. Radina and G. Recchia, 357, Bari: M. Adda.

Corretti, A., Dinielli, G., Merico, M., 2017. L'età del Ferro nel sito di Roca: La ripresa delle relazioni transadriatiche e le evidenze di attività rituali, in: Radina, F. (Ed.), Preistoria e Protostoria Della Puglia. Istituto Italiano di Preistoria e Protostoria, Firenze, pp. 565–571.

Cotecchia, V. 2014. "Le acque sotterranee e l'intrusione marina in Puglia: dalla ricerca all'emergenza nella salvaguardia della risorsa." *Memorie Descrittive della Carta Geologica d'Italia* 92 (1): 31-510.

Daniels, M.J. (ed.) 2022. *Homo Migrans: Modeling Mobility and Migration in Human History.* Albany: State University of New York.

De Giosa, D., 2011. *Le mura di roca nel panorama dell'architettura militare messapica*, Unpublished Ph.D. Dissertation, University of Salento.

Dell'Anna, S. 2010. "I reperti paleo-mesolitici di Masseria Malepezza (Melendugno, Lecce)." In *Premio Decio de Lorentiis per la valorizzazione e la diffusione degli studi preistorici e delle Scienze della Terra, Atti della I Edizione (2008), San Cesario (Lecce)* : 105-142. edited by M.A. Orlando

Delle Rose, M. and Parise, M. 2005. "Speleogenesi e geomorfologia del sistema carsico delle Grotte della Poesia nell'ambito dell'evoluzione quaternaria della costa Adriatica Salentina." *Atti e Memorie Commissione Grotte "E. Boegan"* 40 (2004): 153-173.

Ferranti, L., Antonioli, F., Mauz, B., Amorosi, A., Dai Pra, G., Mastronuzzi, G., Monaco, C., Orrù, P., Pappalardo, M., Radtke, U., Renda, P., Romano, P., Sansò, P. and Verrubbi, V. 2006. "Markers of the last interglacial sea-level high stand along the coast of Italy: Tectonic implications:" *Quaternary International* 145-146: 30-54.

Furumark, A., 1941. *Mycenaean Pottery*. Stockholm : Lund: Svenska institutet i Athen ; Distributor Paul Åströms förlag.

Guglielmino, R., 2006. "New evidence for Aegean contacts with Apulia during the Late Bronze Age." *Accordia Research Papers* 10, 87–102.

Guglielmino, R., S.T. Levi and R.E. Jones, 2010. "Relations between the Aegean and Apulia in the Late Bronze Age: the evidence from an archaeometric study of the pottery at Roca (Lecce)." *Rivista di Scienze Preistoriche* 60, 257–82.

Guglielmino, R., F. Iacono and L. Coluccia, 2017. "Roca e il mondo egeo tra il XVI e l'XI sec. a.C.: una messa a punto, in *Preistoria e Protostoria Della Puglia*, edited by F. Radina, 549–56. Firenze: Istituto Italiano di Preistoria e Protostoria

Heitz, C. and R. Stapfer, (eds.) 2017. *Mobility and Pottery Production: Archaeological and Anthropological Perspectives*. Leiden: Sidestone Press.

Iacono, F., 2019. *The Archaeology of Late Bronze Age Interaction and Mobility at the Gates of Europe: People, Things and Networks around the Southern Adriatic Sea*. London, UK: Bloomsbury Academic.

Iacono, F. and R. Guglielmino, 2021. The Ionian-Adriatic interface as a landscape of mobility, in *The Archaeology of the Ionian Sea*, edited by Ch. Souyoudzoglou-Haywood and Ch. Papoulia. Oxford: Oxbow, 201–209.

Iacono, F., V. Spagnolo, W. De Neef and L. Coluccia, 2020. Roca Archaeological Survey: Inquadramento e primissimi risultati, *FOLDandR Archaeological Survey Series* 2020(13), 1–14.

Ingravallo, E. 1980. "La Stazione Mesolitica di S. Foca." *Studi di antichità* (2):59-77.

Jenks, G. F. 1967. The Data Model Concept in Statistical Mapping. *International Yearbook of Cartography*, 7, 186-190

Jung, R., R. Guglielmino, F. Iacono and H. Momsen, 2021. "Neutron Activation Analysis of Aegean and Aegeanising Ceramics from Roca Vecchia and the Circulation of Pottery in Southern Italy.", in *Punta Di Zambrone I 1200 B.C.E. - A Time of Breakdown, a Time of Progress in Southern Italy and Greece.*, edited by R. Jung, 459–90. Wien: Österreichische Akademie der Wissenschaften,

Kristiansen, K., 2014. "Towards a New Paradigm? The third science revolution and its possible consequences in Archaeology." *Current Swedish Archaeolog*y 22, 11–34.

Kristiansen, K., M.E. Allentoft, K.M. Frei, R. Iversen, N.N. Johannsen, G. Kroonen, Ł. Pospieszny, T.D. Price, S. Rasmussen, K.-G. Sjögren, M. Sikora and E. Willerslev, 2017. "Re-theorising mobility and the formation of culture and language among the Corded Ware Culture in Europe.", *Antiquity* 91(356): 334–47.

Lankford, J., 1983. Comparative study of the temperature dependence of hardness and compressive strength in ceramics. Journal of Material Science 18, 1666–1674.

Largaiolli, T., Martinis, B., Mozzi, G., Nardin, M., Rossi, D. and Ungaro, S. 1969. *Note illustrative della Carta Geologica d'Italia alla scala 1:100.000. Foglio 214. Gallipoli*, Ercolano (NA) 1969.

Macchiarola, I., 1987. *La Ceramica Appenninica Decorata*. Roma: De Luca.

Martinis, B. 1970. *Note illustrative della Carta Geologica d'Italia alla scala 1:100.000. Foglio 223. Capo S. Maria di Leuca*, Ercolano (NA) 1970.

Martinis, B., Robba, F. 1971. *Note illustrative della Carta Geologica d'Italia alla scala 1:100.000. Foglio 202. Taranto*, Cava dei Tirreni (SA) 1971.

Merico, M., A. Corretti, and G. Dinielli. 2010. 'Roca : indizi di attività cerimoniali dell'età del Ferro.' *Annali della Scuola Normale Superiore di Pisa* 5 (2): 161–80.

Milliken, S., Skeates, R. 1989. "The Alimini Survey: The Mesolithic-Neolithic Transition in the Salento Peninsula." *Bulletin of the Institute of Archaeology* (26):77-98.

Pagliara, C., 2005. "Roca Vecchia (Lecce): Il sito, le fortificazioni e l'abitato dell'Età del Bronzo." in *Emporia: Aegeans in the Central and Eastern* , 629–36. Liège, Austin, Tex: Université de Liège, Histoire de l'art archéologie de la Grèce antique ; University of Texas at Austin, Program in Aegean Scripts and Prehistory

Pagliara, C., R. Guglielmino, L. Coluccia, I. Malorgio, M. Merico, D. Palmisano, M. Rugge and F. Minonne, 2008. "Roca Vecchia (Melendugno, Lecce), SAS IX: relazione stratigrafica preliminare sui livelli di occupazione protostorici (campagne di scavo 2005-2006)." *Rivista di Scienze Preistoriche* 58, 239–80.

Pagliara, C., Guglielmino, R. and Scarano, T. 2009. "Roca (Melendugno Prov. di Lecce)." *Rivista di Scienze Preistoriche*, LIX, pp. 397-398.

Palma Di Cesnola, A. 1993. *Il Paleolitico superiore in Italia: introduzione allo studio*, Firenze 1993.

Palma Di Cesnola, A. 2001. *Il Paleolitico inferiore e medio in Italia*, Firenze 2001.

Piccinno, A. and Piccinno, F. 1978. "Otranto: Laghi Alimini." *Ricerche e Studi*, 11. 122-32.

Plicht, J.V. der, Nijboer, A.J., 2018. Around 1000 BC. Absolute dates for the Final Bronze Age – Early Iron Age transition in Italy: wiggle-match 14C dating of two tree-trunk coffins from Celano. PH 60, 99–108. https://doi.org/10.21827/5beab031371e0

Punzi, Q. 1968. "Le stazioni preistoriche costiere del Brindisino." *Rivista di Scienze Preistoriche* (23):205-221.

Recchia, G. and C. Ruggini, 2009. "Sistemi abitativi dell'età del Bronzo nel territorio di Cisternino." in *Ricognizioni Archeologiche Sull'altopiano Delle Murge La Carta Archeologica Del Territorio Di Cisternino (Brindisi)*, edited by G.-J. Burgers and G. Recchia: 33–62. Foggia: C. Grenzi, Ricci, G., 2016. *Archaeometric Studies of Historical Ceramic Materials* (PhD Thesis). University of Venice, Venice.

Rizzo, A., 2006. *Il contributo della fotografia aerea per lo studio di Roca Vecchia e il suo territorio*, *Archeologia Aerea* 2: 247-268.

Rossi, D. 1969a. *Note illustrative della Carta Geologica d'Italia alla scala 1:100.000. Fogli 203, 204, 213. Brindisi – Lecce – Maruggio*, Ercolano (NA) 1969.

Rossi, D. 1969b. *Note illustrative della Carta Geologica d'Italia alla scala 1:100.000. Foglio 215. Otranto*, Ercolano (NA) 1969.

Ruggini, C. 2009. 'Metodi Di Analisi per Lo Studio Dei Sistemi Insediativi Dell'età Del Bronzo Nelle Murge Brindisine'. In *Ricognizioni Archeologiche Sull'altopiano Delle Murge La Carta Archeologica Del Territorio Di Cisternino (Brindisi)*, edited by G.-J. Burgers and G. Recchia, 15–32. Foggia: C. Grenzi.

Scarano, T., 2012. *Roca I. Le Fortificazioni della Media Età Del Bronzo*. Foggia: C. Grenzi.

Scarano, T., 2021. "Una struttura funeraria ipogeica dell'età del Bronzo presso Grotta Poesia a Roca Vecchia (Melendugno, LE): i dati della campagna di scavo 2008 nel quadro dei costumi funerari protostorici in Puglia." Studi di Antichità 19,: 35–61.

Scharl, S. and B. Gehlen, (eds) 2017. *Mobility in Prehistoric Sedentary Societies*. Rahden, Westf: Verlag Marie Leidorf GmbH.

Spinapolice, E.E. 2012. 'Raw Material Economy in Salento (Apulia, Italy): New Perspectives on Neanderthal Mobility Patterns'. Journal of Archaeological Science 39 (3): 680–89. https://doi.org/10.1016/j.jas.2011.10.033.

Tagliacozzo, A., 2003. "Archeozoologia dei livelli dell'Epigravettiano finale di Grotta Romanelli (Castro, Lecce). Strategie di caccia ed economia di sussistenza." In P.F. Fabbri, E. Ingravallo, A. Mangia (eds) Grotta Romanelli nel centenario della sua scoperta: 1900-2000, Galatina (Lecce), 169-216.

Tozzi, M., 1993. "Assetto tettonico dell'Avampaese Apulo meridionale (Murge meridionali-Salento) sulla base dei dati strutturali." *Geologica Romana* 29 1993: 95-111.

Whitbread, I., 2017. Fabric Description of Archaeological Ceramics, in: Hunt, A. (Ed.), The Oxford Handbook of Archaeological Ceramic Analysis, Oxford Handbooks. Oxford University Press, Oxford, 200–216.

# Preliminary approach to the study of the 'Tappatino' area of *Suasa*

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**Abstract**

This paper presents a reconstruction study of the 'Tappatino', a rustic farmhouse in the Archaeological Park of the Roman city of *Suasa* (Castelleone di Suasa, AN). As a multi-stratified site, a wide range of data from both archive sources and archaeological research has been analysed as a starting point for this study. In addition, topographic surveys and the stratigraphic analysis of the masonry were conducted. Finally, the paper describes the application of the Extended Matrix Framework (EMF) to the 3D reconstruction of this area and suggests a reconstructive proposal for the Roman imperial age.

**Keywords**

*Suasa,* stratigraphic analysis, Roman archaeology, Extended Matrix, 3D reconstructive process

## Introduction

This paper presents a reconstruction study of the rustic farmhouse area known as 'Tappatino', in the Archaeological Park of the Roman city of *Suasa* (Castelleone di Suasa, AN) in the Italian Marche region. *Suasa* is located in the hinterland of Senigallia on a second-order alluvial terrace on the right bank of the Cesano river (Fig. 1). The establishment of this centre occurred during the extensive colonisation of the *ager Gallicus* that immediately preceded the battle of *Sentinum*. The city was initially founded as a *praefectura*, later becoming a *municipium* during the second half of the 1st century BCE and experienced a gradual decline by the end of the 3rd century CE (Dall'Aglio 1991; Destro 2010; Giorgi 2010; Giorgi 2020a; 2020b; 2021). The project for the historical-archaeological analysis of the 'Tappatino' area was born with the aim of developing specific reconstruction models for each chronological phase using the Extended Matrix (EM) method[1].

## Methodology

Before exploring the world of archaeological reconstructions, it is important to acknowledge that any recreated model will only ever be a simulation of the ancient context. The ultimate goal of a reconstructive study is not to produce a definitive model, but rather to make the entire process transparent, readable, and replicable (Demetrescu 2015, 4).

The archaeological approach to 3D involves two categories of 3D models: *reality-based* and *source-based*. The first, also known as surveying, is a quantitative process used to document, interpret, and visualise existing archaeological contexts. The second is more closely related to computer graphics and is a non-synoptic and non-synchronic representation. It is useful

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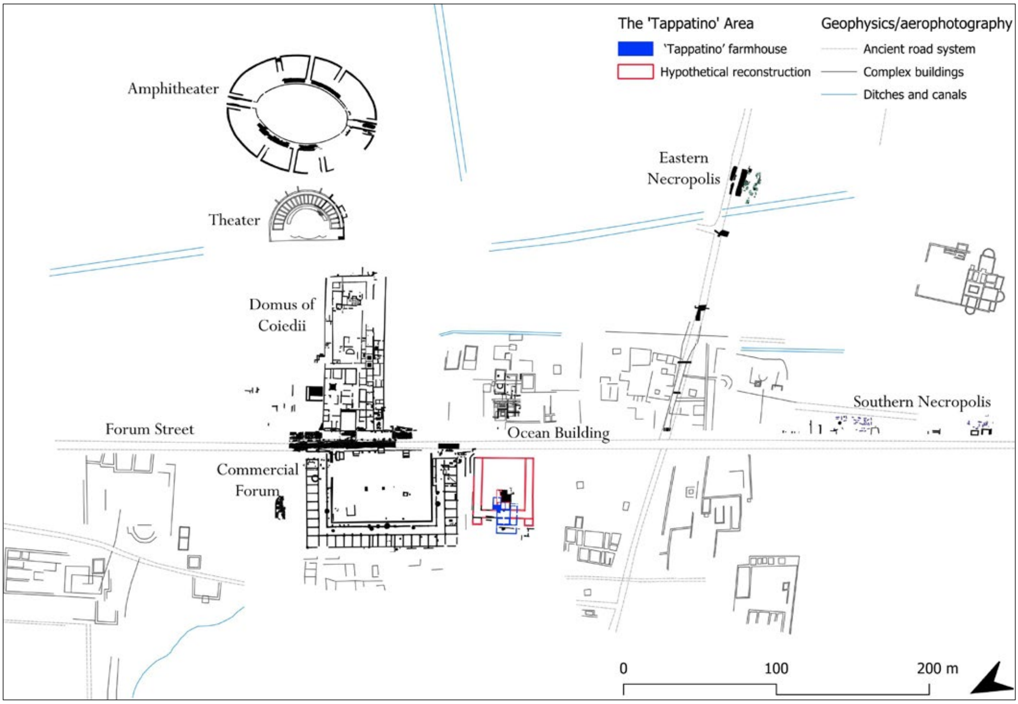


*Figure 1 - Plan of the Roman city of* Suasa *(author's elaboration).*

for documenting, interpreting, and visualising lost archaeological contexts (Remondino and Rizzi 2010; Demetrescu 2015, 43). The *source-based model* combines various sources and documentation, regardless of the granularity of the archaeological data or the discrepancy between the collected documentation and the visual representation of the proposed reconstruction. This mechanism can create misleading models that reinforce the idea of reconstruction as a purely aesthetic endeavour, rather than an analytical and accurate study (Beacham et al. 2006; Denard 2012; Cerato and Pescarin 2013, 290).

The area of the 'Tappatino' in *Suasa* is multi-stratified, which has hindered extensive investigation of the archaeological context and made interpretation of the unearthed evidence difficult at present day. The study of this area was divided into three phases. The first phase focused on analysing the rural buildings comprising the 'Tappatino' by examining their structures and the stratigraphy of the masonry in the central unit. The second phase involved examining data from archaeological research campaigns conducted in the area as part of the *Suasa Project* in 1996 and between 2018 and 2022. The third phase consisted in the post processing of topographic survey data conducted during the research campaigns. The findings contributed to the reconstructive study of this context from the Imperial Roman age to the contemporary age, which is presented here.

The EM method was chosen to assess the reconstructive study, considering the issues related to the development of *source-based models* in the study area (Demetrescu 2015; Demetrescu et al. 2016; Demetrescu e Fanini 2017; Demetrescu 2018; Demetrescu and Ferdani 2021; Ferdani et al. 2020; EM Repository: Demetrescu, Emanuel, 'Extended Matrix Core Language Repository'. Zenodo. [DOI:10.5281/zenodo.5957132]). The EM is a formal language, developed by Emanuel Demetrescu (CNR-ISPC, Rome) that enables the recording of the sources employed and the set of analysis processes conducted to achieve the virtual reconstruction of an archaeological context. This methodology updates the stratigraphic basis of archaeology through the creation of a new SU, the Virtual Stratigraphic Unit (USV). Similar to Harris's Matrix, EM is not a representation of the physical chain of events, but rather a non-redundant chronological sequence. The EM graph is constructed from the bottom up, with each element connected by continuous lines to show stratigraphic relationships and dashed lines to indicate sources used to validate the USV. The graph is divided into structural (USV/s) and non-structural (USV/n) components. Structural units are based on SUs found *in situ*, while non-structural units are hypothetical reconstructions based on sources. Also included in the reconstructive workflow are Special Finds (SFs), which are objects found in secondary deposits. Once a SF is placed in the EM graph, a Virtual Special Find (VSF) can be created to reintegrate it. VSFs have a higher degree of certainty than non-structural USVs, but lower than structural USVs (Demetrescu 2015, 50-51).

The reconstruction of the 'Tappatino' area started with gathering information from various sources, such as excavation data, geophysical surveys, bibliographical and archive sources, and comparison with other contexts. This information was used to create the 'dossier comparatif' (Gros 1995, 322) and develop the preliminary eidotypes. The 3D model was the outcome of this comprehensive process. The dataset was organised within the EM graph to model the different life phases of the area.

The EM approach was applied to the multi-stratified context of the 'Tappatino', thus enabling the mapping of the entire reconstructive process and the organisation of information within a single interconnected environment. Furthermore, the direct link between the 3D environment and the EM graph facilitated the manipulation of geometry with digital tools and sharing both the 3D models and the stratigraphic and reconstructive information. The combination of EM with digital tools for 3D representation of virtual reconstructions and visual inspection of extended matrices is known as the Extended Matrix Framework (EMF) (Demetrescu and Fanini 2017, 500)

## The history of the building

The 'Tappatino' building is a good example of 16th century rural architecture (Fig. 2). The epigraph on the architrave of a door, reading 'OCTAVIANVS VVLPELLVS', indicates that it was the residence of Ottaviano Volpello (fl. XVI), a jurisconsult at the Della Rovere court during the reigns of dukes Guidobaldo II and Francesco Maria II. His memory is still preserved in the valley floor's current name, Pian Volpello (CIL XI,775*; Cimarelli 1642, 160; Lanciarini 1985, 457; Dominici 1993, 214; Antolini 2000, 337–338).

Friar Vincenzo Maria Cimarelli's 17th century historical book provides evidence of the construction of the farmhouse. Ottaviano Volpelli chose to build his residence in the midst of a plain where numerous remains of Roman structures were still visible (Cimarelli 1642, 160). It is well-established that Volpelli's farmhouse was built using the remains of a large Roman structure. This is supported by documents found in the archives of the *Soprintendenza*

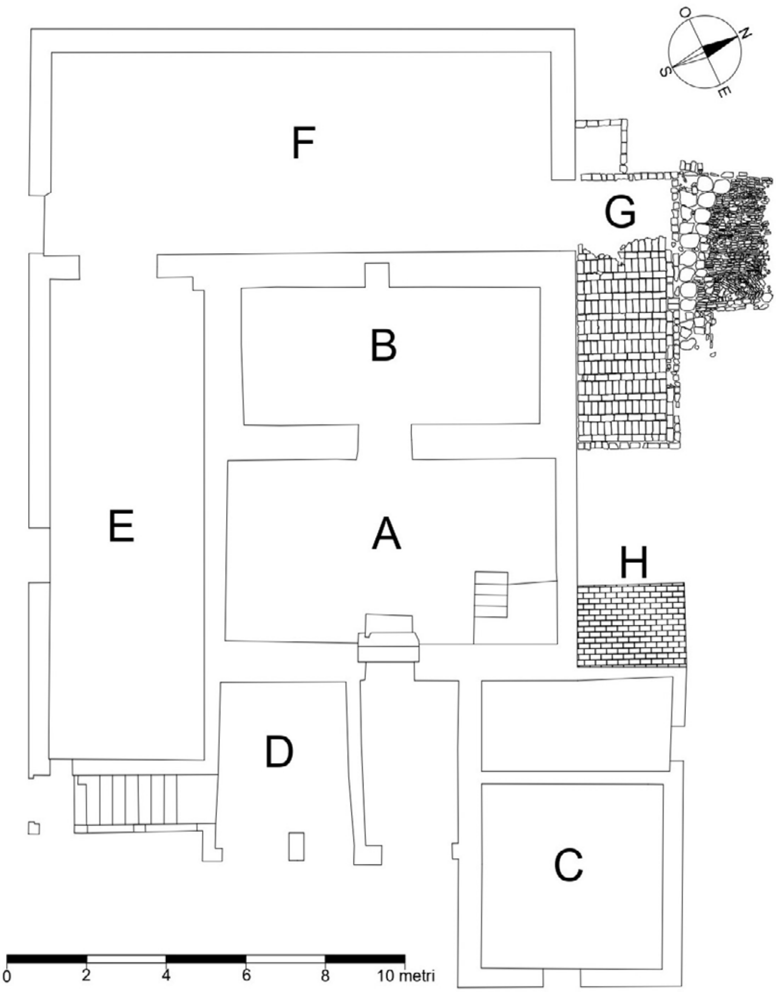


*Figure 2 - Plan of the building known as 'Tappatino' (author's elaboration).*

*Archeologia Belle Arti e Paesaggio* (SABAP) of the Marche region, which mention the presence of Roman walls in the cellar of the 'Tappatino'. However, there are no records of this property prior to 1600.

In 1621, Duchess Livia Della Rovere was granted the investiture for the estate of this feud by the Abbey of San Lorenzo. After the death of her husband Francesco Maria II, the duchess resided in the palace in Castelleone di Suasa until her passing in 1641. Following her death, a series of intricate events led to the transfer of the feudal estate to the Albani family (Polverari 1984, 226-237).

In 1779, after Alessandro Albani passed away, Castelleone di Suasa was inherited by his nephew Giuseppe. The property was leased to Crescentino Corradi, who had previously served as '*soprintendente generale*' for Alessandro Albani, overseeing the Abbey of San Lorenzo in Campo and the Castelleone farm, which included the Volpello estate. The earliest surviving cadastres, dating back to 1807, list the Volpello estate as property of the Abbey of San Lorenzo in Campo under Cardinal Albani. It is recorded as a 'farmhouse' with a pasture plot and the small Oratory of the Crucifix attached. The properties in Castelleone were acquired by the Ruspoli family in 1857. In the subsequent decades, the family made further purchases and transfers. It was likely during these years that the family acquired the 'Tappatino'. The area surrounding the farmhouse and the property itself belonged to Don Mario, the second prince of Castelleone. These areas were subject to restrictions by the *Soprintendenza*. The estate was owned by the Ruspoli family until it was inhabited around the 1930s by the Aguzzi family, who were landholders of Count Ruspoli. Alessandro Edmondo was the last member of the Ruspoli family to own the estate.

In 1972, the *Soprintendenza* carried out the expropriation of a large portion of the archaeological area, excluding the 'Tappatino' area, which remained in private ownership. In 1975, Alessandro Edmondo Ruspoli sold the property to Damiano Aguzzi, who retained ownership until 1990. At this time, the State exercised its right of pre-emption in the sale to Casagrande Alvaro, and the 'Tappatino' was transferred to the SABAP of the Marche region.

## The current state of the building

The farmhouse's current appearance is quite complex (Fig. 2). The original core of the structure consists of a cube-shaped 3-floor main building unit (A), which was later joined by a similar volume (B) attached to the former on the western side. The ground floor volumes contain the cellar formed by two side-by-side rooms characterized by an internal floor level about a meter lower than the external one. The Roman structures are placed here, easily recognizable by their construction technique in *opus vittatum mixtum* (Adam 1994, 153-154; Bianchini 2010, 269, 271). These structures are present in both the dividing wall between the two rooms and throughout all the second room. Specifically, four interconnected wall structures have been identified, arranged in pairs with a north-south and east-west orientation. The maximum conservation elevation of these structures ranges from 2.57 m to a minimum of 1.02 m. Units A and B constitute the main core of today's farmhouse.

A three-arched access portico with a brick floor and a beam and joist arcade with a hollow tile floor (D) is attached to the eastern side of the original unit. The second-floor arcade has three openings corresponding to the lower arch, and a brick floor. The loggia is accessible by a side flight of stairs connected to both the southern volume (E) and the main structure (A).

A two-story volume with a double-pitched roof (C) is leaning against the same facade. To the west of unit B is a two-story volume with a double-pitched roof (F), while to the south of the main core is a single-level unit (E). All these structures, except for the portico, appear to be constructed of bare brick.

Through the examination of archival materials, particularly the ceased cadastres, it was possible to assign a chronological period to these building units. The construction of unit B is attributed to Volpelli's work during the 16th century. This is inferred from the inscription with his name on the architrave of a door on the perimeter of the unit.

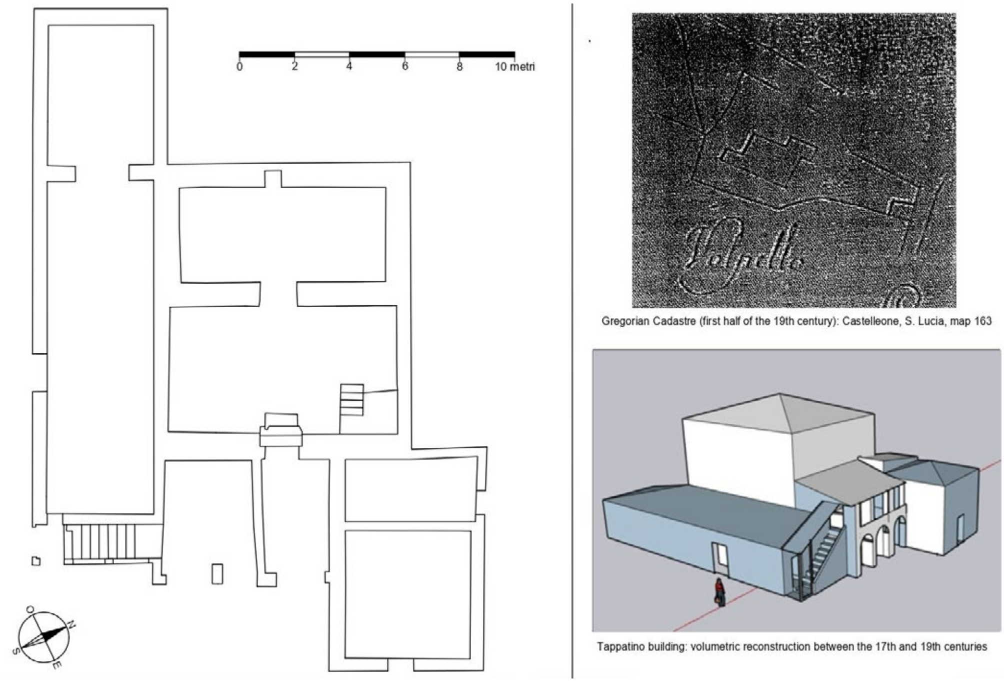


*Figure 3 - The building of 'Tappatino' between the 17th and 19th centuries (author's elaboration).*

Regarding the arcade and the volume attached to the eastern facade (D-C), it is known that they were built after Volpelli's intervention but before 1835. An excavation test conducted at the base of the pillar supporting the two arches of the arcade confirmed the presence of non-antique architectural elements, likely from the 16th century, cast at its base. These structures are also listed within the 1835 Gregorian Cadastre.

In the Gregorian Cadastre, the southern unit (E) has a projecting room to the west that is no longer visible today due to its elimination during the construction work of the western unit (F) (Fig. 3). Archaeological excavations carried out inside unit F in 2020 confirmed this assumption, revealing two levelled walls of the original perimeter of unit E. This unit is likely to be later than the arcade on which it rests, and its presence in the first half of the 19th century is certain. The western unit (F) can be dated between the second half of the 1800s and the first half of the 1900s. This volume does not appear in the Gregorian Cadastre of 1835, but it is present in the Ceased Cadastre of the mid-20th century.

Two small units (G-H), leaning against the northern facade of the main core, were added after the mid-1900s. Plans and photographs sent to the *Soprintendenza* by Damiano Aguzzi in 1977 show their presence, while the roof of the western room was identified in a photograph included in a local history study by Gello Giorgi (Giorgi and Grazzi 1981). Currently, only the floors of these rooms are preserved, and it is unclear whether they were intentionally demolished by Aguzzi or naturally collapsed before the State purchased the property.

A stratigraphic analysis of the masonry was carried out on the external facades of the main unit. A total of ninety-seven stratigraphic units were identified, based on the discontinuities

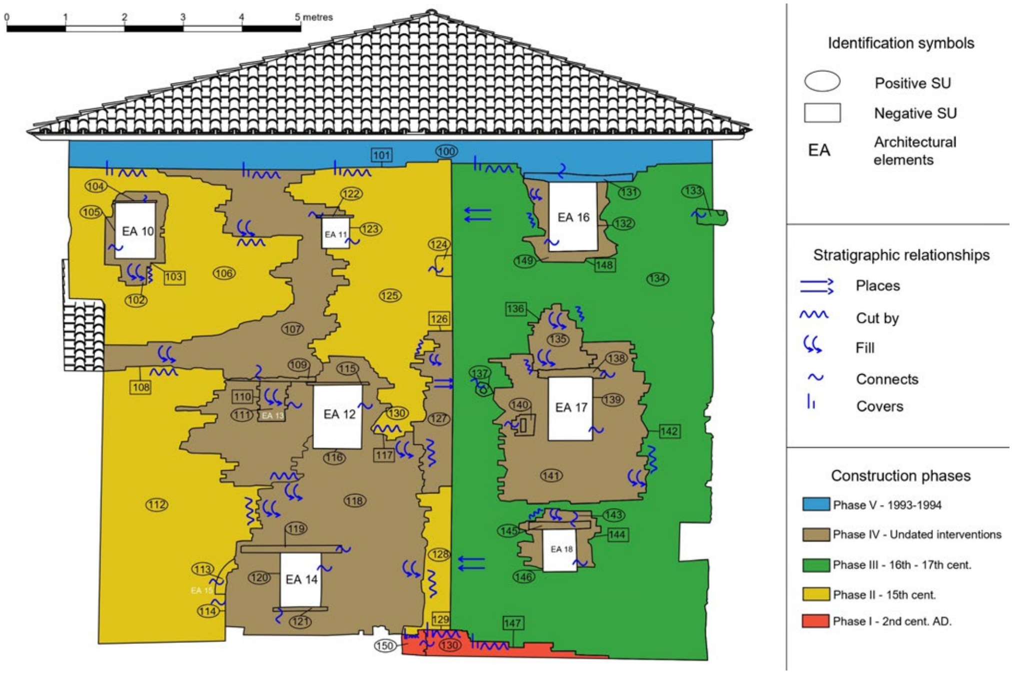


*Figure 4 -Stratigraphic eidotypes of the north facade of the main unit of the 'Tappatino' (author's elaboration).*

in the physical-structural features present in the different masonries analysed. Orthophotos obtained by drone photogrammetric survey were used as a graphical basis, and the different stratigraphic relationships were noted using a predetermined symbology (Urcia 2011; Brogiolo and Cagnana 2012; Fiorini 2019, 19-25). This process established stratigraphic eidotypes of the four exterior elevations of the unit. Furthermore, a preliminary absolute chronology sequence divided into five building phases was proposed and illustrated through chronological diagrams and stratigraphic phase eidotypes (Fig. 4). The sequence can be divided as follows.

**Roman imperial age: ca. 2nd century CE**

This phase is only visible above ground in the north facade. The SU 130 is a fragment of masonry that is oriented in an east-west direction. It is identifiable at about the height of today's floor level and visible for up to six courses. The facing is made of *opus vittatum mixtum* and is characterized by the presence of a course of *vittae* of white-pink limestone alternating with three courses of bricks. This pattern of alternation, consistent in height, is only changed near the base folds. Moving from the fold toward the elevation, two courses of bricks alternate with one course of *vittae*, four courses of bricks alternate with one course of *vittae*, and, finally, two courses of bricks alternate with one course of *vittae*, and then resume with the alternating rhythm of three and one (Fig. 5). The SU 150 is a wall structure with a north-south orientation viewed in section, specifically the wall that extends outward from the interior of the building's cellar. The two Stratigraphic Units are connected.

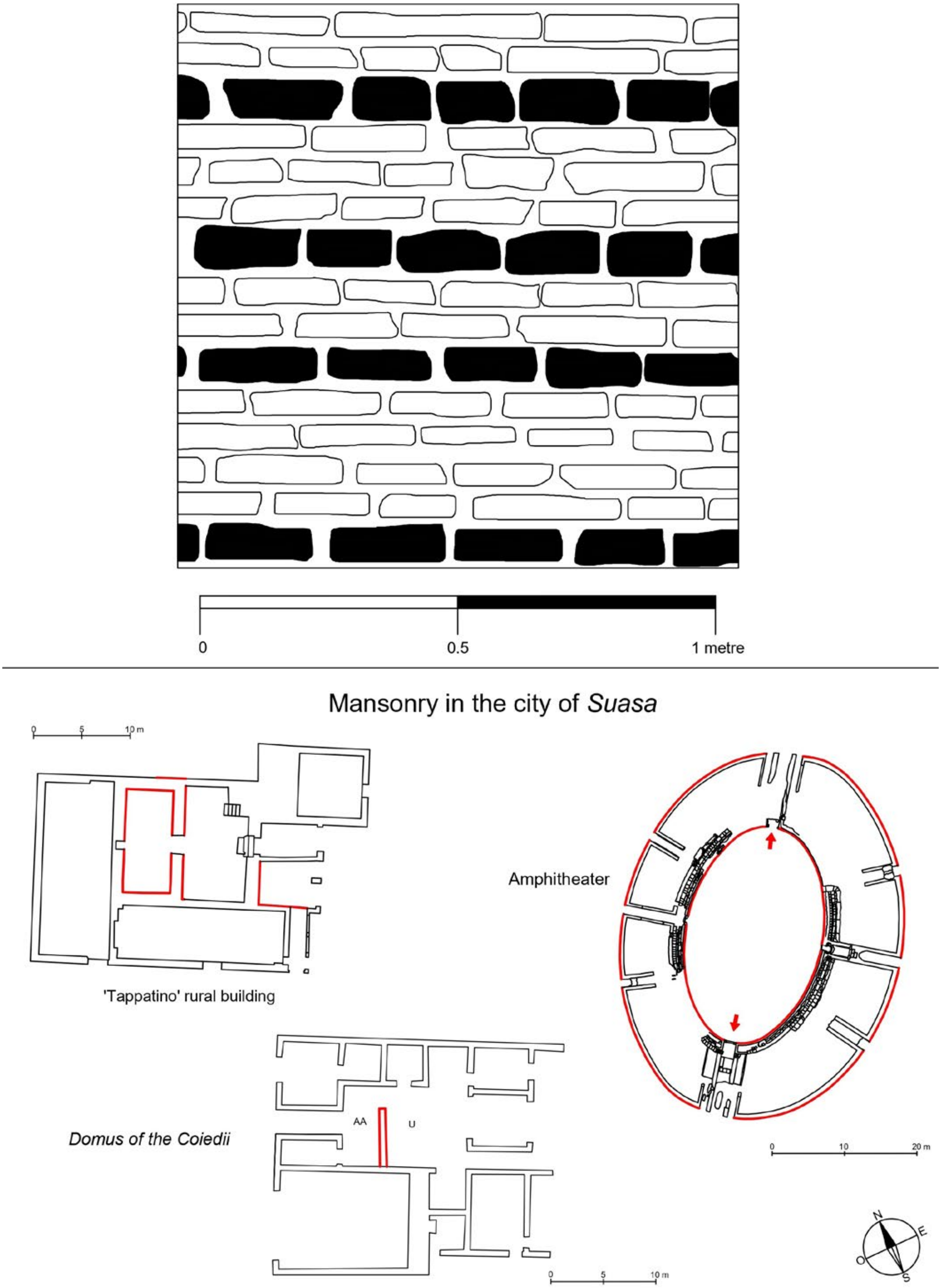


*Figure 5 - Eidotype of the Roman masonry in* opus vittatum mixtum *(author's elaboration).*

The excavation conducted behind the northern facade during the 2019 research campaign located outside the northern perimeter of the 'Tappatino' the continuation of the wall visible in the cellar and confirmed its chronology to be dated to the Roman phase (SU 130 = USM 1519; SU 150 = USM 1555). This was initially only assumed on technical analysis basis.

The masonry construction technique used in these structures is evident in all the contemporary walls within the complex, as well as in two other buildings excavated in the Roman city of *Suasa*. One of these buildings is the *Domus dei Coiedii* complex, where the same construction technique was employed for a wall attached to 'Edificio S' (Ed. S) (Fig. 5). During the initial research campaigns in *Suasa*, it was discovered that it created a division in the original entrance system of the *Domus* (Antolini 2013). The partition wall, which is preserved up to a maximum height of 0.65 m, is leaning against the northern perimeter of Ed. S. Based on the iconographic chronology of the mosaic of the building it is leaning against, the wall has been dated to the 3rd century CE. However, it is important to note that the walls of Ed. S reuse structures from the early 2nd century CE interventions, as evidenced by the careful building technique of the facing of the northern and eastern structures of the room. The same facing, made up of bricks, many of which are triangularly cut, arranged in regular courses and with homogeneous thickness, is typical of other structures of the *Domus* that can be traced back to the early 2nd century CE. Confirming this, the alignment of the north and east walls of Ed. S is also uniform to that of other rooms in the building (De Maria and Dall'Aglio 1988, 102; 136).

It is worth noting that a masonry technique similar to that found in the 'Tappatino' complex can also be identified in the lower walls of the city amphitheatre (Fig. 5). After reviewing the archival material stored in the SABAP, specifically the documentation of the excavation and restoration operations carried out at the end of the last century, references to the presence of masonry in *opus vittatum mixtum* with limestone blocks were found for the podium walls, the northeast and southwest entrances, and the *circuitus*. However, the alternation of brick courses with those of the *vittae* in these masonries appears quite different from that visible in the 'Tappatino' area. This monument has been dated to the 1st century CE based on old excavation data. It is worth noting that the use of *opus vittatum*, particularly with brick levelling, is rare in amphitheatre masonry and is typically found in monuments dating from the late 1st century BCE to the early 2nd century CE (Golvin 1988, 101-104).

Based on these considerations, it is possible to suggest a dating from the mid-2nd century CE for the partition structure of the *Domus* and the structures of the 'Tappatino'. As mentioned earlier, this reconstruction appears to be confirmed by the materials found during the digs in the farmhouse, which date back to the second half of the 1st century and the beginning of the 2nd century CE. More details on this topic will be provided in the section on archaeological research.

### 15th century CE

The phase of construction in the late Middle Ages concerns only the eastern sector of the building (A). It can be identified by the cantonment stones that can be seen on the northern and southern facade. This phase comprises three wall structures, which have

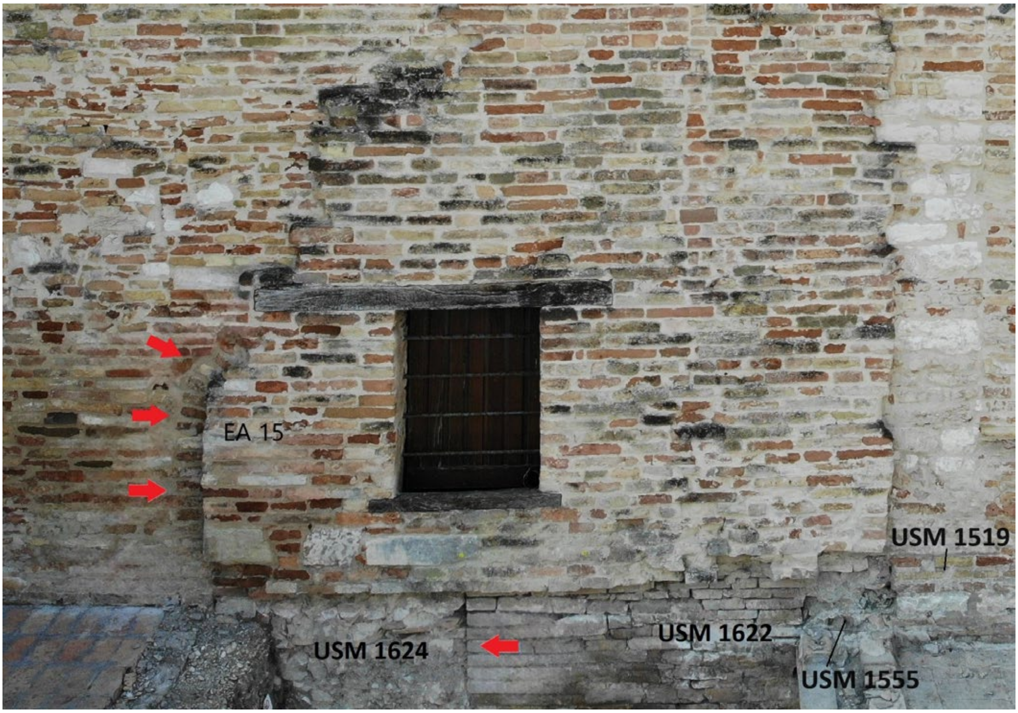


*Figure 6 - Indication of the segmental arch opening visible in the northern facade of the 'Tappatino'.*

been more or less affected by later restorations. Two parallel structures are oriented east-west, and a connecting structure between is oriented north-south. The masonry is uneven and comprises bricks, locally hewed stone, and several reused elements from the Roman period on irregular mortar layers. Unfortunately, further study of this masonry is not possible due to the presence of later whitewashing.

At the entrance of the farmhouse cellar, there is a low arched opening from this phase. The north and south facades contain a partially visible arch that has been plugged and notched by later phases (Fig. 4; EA 15, SU 13 and SU 14). It is not possible to determine with certainty whether there is a blind arch or any remaining opening from this phase due to later reworkings on the south facade.

The dig conducted in 2019 was useful in describing the second phase. It revealed the right arch shoulder, SU 113 belonging to EA 15, partially visible in the north facade (Fig. 6). This arch appears quite similar in elevations and measurements to the one located at the entrance to the cellar (interior width about 1.22 m, intrados 0.50 m) and of the same type as the one walled in the south facade. The structure can be identified as a 15th century CE tower-house associated with sharecropping, based on the presence of segmental arches, brick module, and wall texture.

### 16th–17th centuries CE

The study of this construction phase is limited to the western sector, identified by the prominent cornerstones on the north and south facades. This sector comprises three wall structures, which have been subjected to varying degrees of restoration. Two of these walls run parallel to each other in an east-west direction, while the third wall links them in a north-south direction. The structures' facades are uneven, consisting of irregular mortar layers, bricks, and locally quarried medium-sized stones, as well as several reused elements from the Roman era. In the drainer of the northwest corner of the 'Tappatino', Gello Giorgi identifies a stone duct belonging to an aqueduct (Giorgi and Grazzi 1981, 146). The building features a drainer located in the southwest corner, which Giorgi did not mention. However, further study of this masonry is not possible due to the presence of later whitewashing.

This phase is attributed to Volpelli, who did not use exclusively Roman structures to build his palace, contrary to Cimarelli's report (Cimarelli 1642, 160-161). The inscription on the architrave of the above-mentioned opening and the toponym of this part of the valley floor are an addition to Cimarelli's testimony.

### Contemporary age (unidentifiable)

This phase is characterized by a relatively uniform wall texture, with intact brick walls arranged in regular rows and set in thin mortar layers. The walls are considered to be part of salvage and restoration efforts, and no specific dating elements are present, making it only possible to define a contemporary period prior to the 1980s. A precise chronology of this phase can be determined through analysis of archival documents or archaeometric investigations of the materials used.

### 1993–94

The masonry from this phase is visible on all four sides of the building, mainly in the upper part. It is characterized by regular rows of intact bricks with banding arrangement on thin and regular mortar layers. Evidence of this construction work can be found in the SABAP's archival documents, and it was carried out in the years following the purchase of the 'Tappatino,' between 1993 and 1994[2].

## Archaeological research in the area

The research area is located south of the so-called 'via del Foro,' main road of *Suasa* (Fig. 1). It is separated by a road from the Forum square. The research campaigns allowed the identification of the public nature of this urban sector, the comprehension of its layout and the development of interpretative hypotheses (Fig. 7).

The 1996 excavation campaign uncovered some evidence of the complex that had been obliterated by the farmhouse. However, no further research was conducted in this area at

[2] The pertinent documentation is kept in the *Archivio Perizie* of the SABAP of the Marche region (Report No. 23/89 dated 04/24/1989; first variant Report No. 14/90 dated 06/25/1990; second variant Report No. 41/93 dated 11/29/1993).

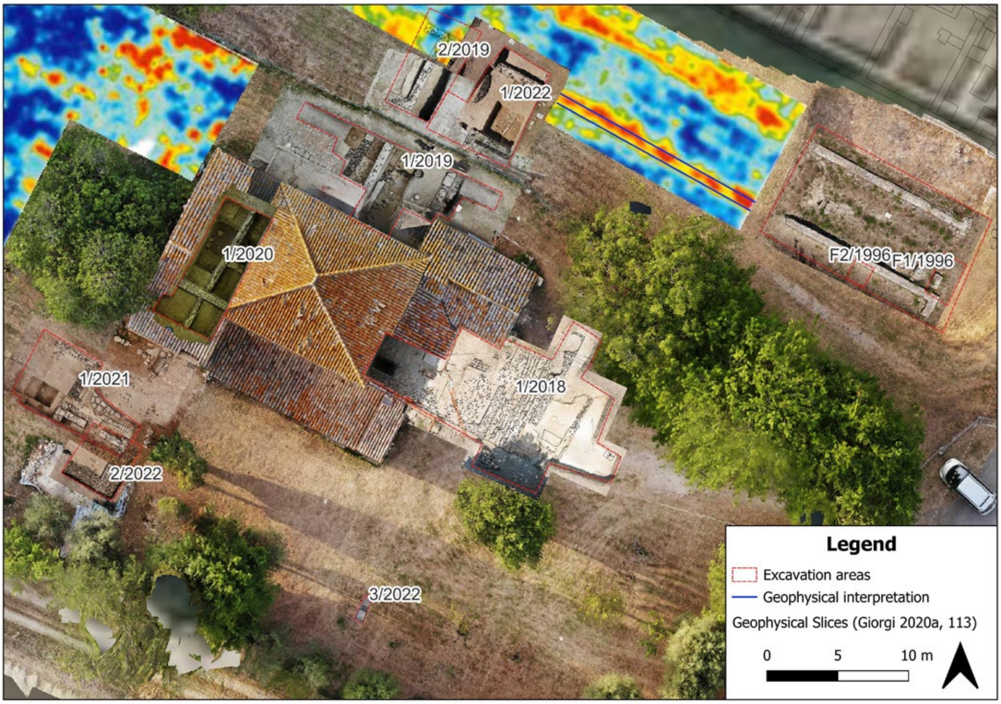


*Figure 7 - Location of the excavation trenches in the 'Tappatino' area (author's elaboration).*

that time. Subsequently, during the campaigns from 2018 to 2022, multiple sectors of the farmhouse area were explored. During renovation works in 2018, promoted by the SABAP to repurpose the 'Tappatino' as a functional building for the fruition of the archaeological area, remains of a republican public building the mosaic floor structures were discovered. These structures were later obscured during the imperial age with the construction of a large public building on a podium, known as 'Edificio 10' (Ed. 10), situated in the middle of a square. In 2019, an investigation was carried out on the area behind the northern elevation of the building. This was encouraged by some anomalies identified through georadar prospecting conducted the previous year. The data collected during this excavation campaign aligned perfectly with those of the previous year, revealing levels and structures likely associated with a republican public context that had been obscured by later imperial phases in this sector as well. The discovery of two parallel wall structures that create a narrow and elongated space closed on the western side and open on the opposite side supports the hypothesis of an imperial public complex. It is possible that a colonnade or a series of pillars once existed in this area, framing a large open space with the building on a podium at its centre. In 2020, as part of the renovation works of the 'Tappatino' led by the SABAP, a trench was excavated in the western part of the farmhouse. The excavations revealed a wall structure belonging to a building complex presumably symmetrical to Ed. 10. However, it is not possible to establish any structural or functional connections between the two complexes based on the data collected so far. The 2021 campaign focused on the southern sector of the farmhouse, documenting a situation characterized by the presence of a Renaissance phase and a Roman phase. The 2022 campaign revisited areas previously investigated in 2019 and 2021, conducting a new campaign of geophysical surveys and opening trenches in continuity with the previous ones. Only the first and third trenches, opened in 2022, are relevant to the area occupied by the imperial complex of Ed. 10. The entire 'Tappatino' building was surveyed via photogrammetry and laser scanning to facilitate its study and the inspection of its walls.

**The survey of the structures and the application of the EMF**

Before beginning the reconstruction process, all photogrammetric and laser scanning surveys conducted during the research campaigns were processed and georeferenced. The area was covered with 44 scans with the *Leica P30* laser scanner. The scans were processed using *Leica Cyclone* software and the *Cloud Compare* environment. The recorded point clouds have an average overlap of 58%, an average robustness of 69%, and a mean error of 0.7 mm.

All photogrammetric processes were conducted using *Agisoft Metashape Pro*. The dataset consisted of 3709 images with an average resolution of 4056 x 3040, including the excavation trenches and elevations of the farmhouse. Georeferenced ground control points (GCPs) were used to merge the dataset across the entire area under investigation. The average total position error for both the GCPs and the control points in the various photogrammetric surveys was determined to be 0.02 m.

The photogrammetric models of the area, through the '3D Survey Collection' (*3DSC*) add-on [DOI:10.5281/zenodo.4459453], were optimised to improve their visualisation process, then used to perform a semantic interpretation of the archaeological context according to the principles of the EM approach, and finally used as a basis for organising and developing the entire reconstruction proposal.

Data collection was aimed at advancing the reconstructive project after setting up the 'virtual terrain' (Berto et al. 2021, 4). Archaeological data, including information on stratigraphic units, Harris' Matrix, drawings, and images, were extracted from excavation records. Extensive literature research was also used for gathering comparisons and ancient structural standards. All this information was gradually incorporated into the EM graph within the *yEd* graphics editor (Fig. 8).

The photogrammetric mesh was subject to semantic analysis, which involved modelling all proxy geometries in *Blender* related to the identified stratigraphic units. This phase enabled the visualization of archaeological remains in the area through a red-coloured mesh. The second phase of the reconstructive process involved adding virtual structural stratigraphic units in blue and non-structural units in green (Fig. 9-10). The proxy models act as a link between *Blender* and *yEd*, communicating via the *'Extended Matrix Tools'* (*EMTools*) add-on [DOI:10.5281/zenodo.4459272] for local representation of the data, and via the web application *EMviq* (*Extended Matrix visual inspector querier*) (http://osiris.itabc.cnr.it/scenebaker/index.php/projects/emviq/; Demetrescu et al. 2023) for their online representation. For this reason, proxies did not require a high quality of modelling detail, as they are only a means of visually representing the reconstructed dataset and highlighting the 'representation models' (RMs) with texture information. The use of USV/s was limited to contexts where the existing remains were suitable to guide the reconstruction process. In contrast, USV/n was used when the reconstruction proposal was linked to the use of external sources.


*Figure 8 - Extended Matrix of the 'Tappatino' area in the Imperial Roman Age.*

The EM of the 'Tappatino' area comprises eight chronological phases, based on the Harris Matrix of the building and excavation areas. A virtual reconstruction has been proposed for five of these phases: the Roman imperial age, the medieval age, the 16th-19th centuries, the 19th-20th centuries, and the second half of the 20th century. The Roman Republican Age phase has been excluded from the reconstruction due to insufficient data. Until a comprehensive reconstruction of all phases will be possible, the following paragraphs propose the EM reconstruction for the imperial Roman period only. The granularity of the archaeological record was organised into activities into which the various EM nodes were grouped as, for example, for the construction of Ed. 10, the two side porticoes and the square.

**Reconstructive proposal of the 'Tappatino' area in the Roman imperial age**

Based on the discussion in this paper, it is possible to reconstruct a building from the Roman imperial age. This building includes a porticoed square measuring 28.39 x 33.30 m, at the bottom of which stood a monumental podium building (Fig. 9-10).

The complex may have been directly accessible from the so-called 'via del Foro' through one or more openings in the eastern wall. This was only partially indicated by the presence of a wall septum discovered during the 1996 campaign in the area where the northern arm of the portico closed off and was reconstructed through USV/s 36 and USV/n 34. The discovery of a fragment of pavement made of large fictile hexagonettes with a mosaic tile in the middle, found at an elevation of 137.92 m asl, has allowed for the proposal of a reconstruction of the pavement plan of the square (USV/s 21). The square appears to have been bordered on the north and south sides by two L-shaped columned porticoes that met at the building at the bottom, intersecting it. The arcaded arms were 4.40 m wide (15 feet) and 38.86 m long (134 feet) in the east-west direction. In the north-south direction, they measured 15.14 m (52 feet). The

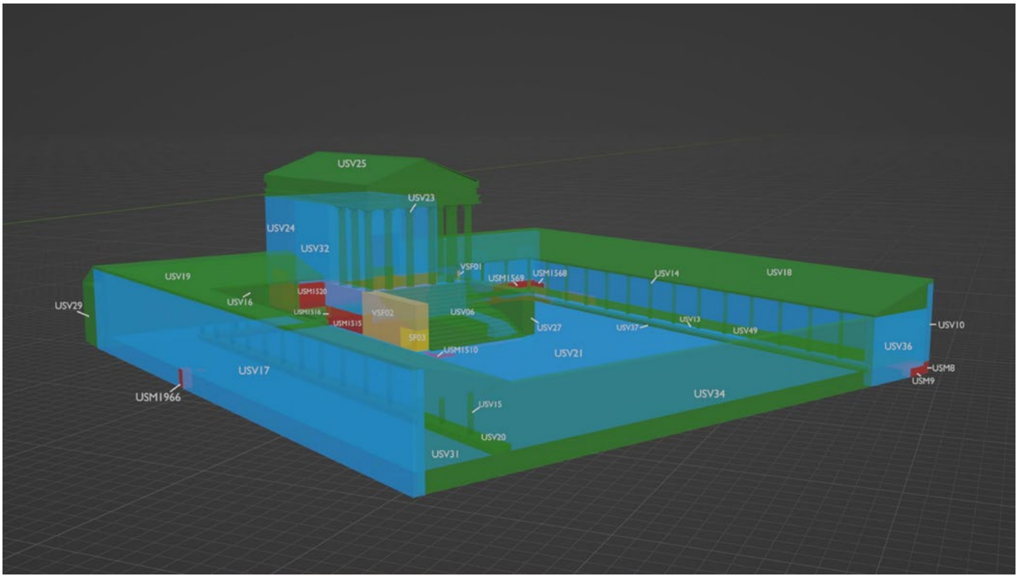


*Figure 9 - Northern bird's-eye view of the proposed Imperial Roman reconstruction of the 'Tappatino' area. EM colour scale (author's elaboration).*

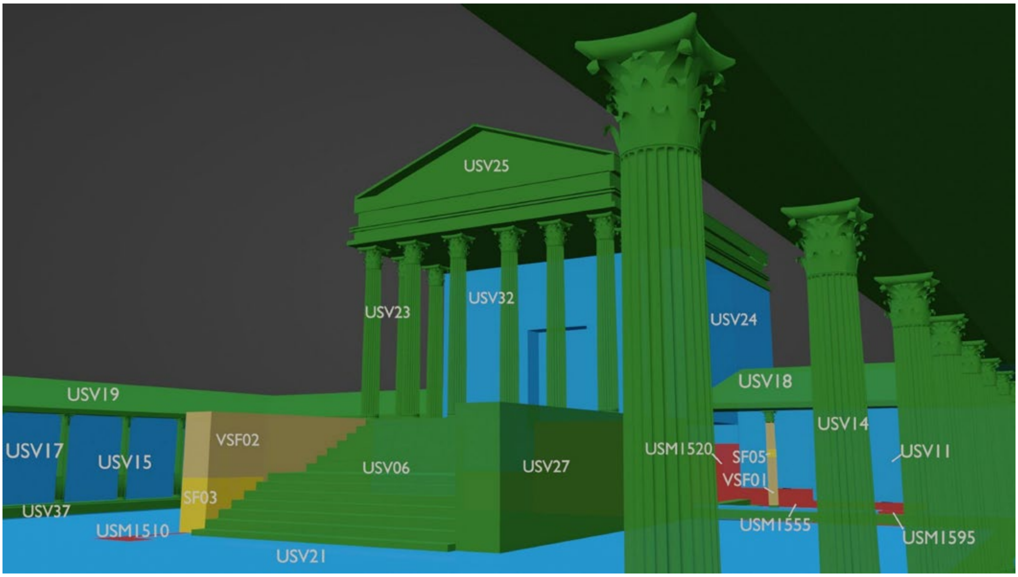


*Figure 10 - Proxy representation of the reconstructive proposal for the Roman imperial age of the 'Tappatino' area with view from the interior of the northern portico. EM colour scale (author's elaboration).*

northern sector of the complex, where excavation operations were concentrated, provides the most information for reconstruction purposes. The reconstruction of the southern portico was based on the principle of Vitruvian symmetry (Vitr. I, 2, 4) with reference to the northern portico.

The discovery of tile foundations for the installation of marble slabs has allowed for the reconstruction of their layout (USV/s 12; USV/s 13; USV/s 22) and the proposal of a hypothesis regarding the presence of a colonnade (USV/n 14) facing the square. The rhythm of the columns was established based on a pink marble slab found intact *in situ*. The width of the slab is known to be 0.60 m. According to Vitruvius' assumption that foundation structures should have a thickness equal to one and a half times the diameter of the columns above (Vitr. III, 4, 1), columns with a diameter of 0.40 m were reconstructed. During the 2019 excavation activities, a column rubble (SP 05) was discovered, which allowed for a proposal of virtual restoration (VSF 01) of one of the columns of this portico arm. The dimensions and placement of the marble slab indicated the existence of a column at the inner corner of the portico. A colonnade was reconstructed with an intercolumniation of three slabs (1.05 m) and a height of 8½ diameters (3.40 m) (Vitr. III, 3, 4; 10). The closing wall of the northern portico, examined in various sections, had a course that was perfectly parallel to the slabs and an elevation in *opus vittatum mixtum*. This was supplemented by USV/s 10 and 11, based on data from both excavation campaigns and geophysical prospecting in 2018 and 2022.

The available data for the southern arm only allowed for the assumption of an analogous situation to the northern one based on the principle of symmetry and planimetric comparisons. The enclosing wall was divided into two structures, distinguished by their orientation, to highlight their varying degrees of certainty (USV/s 17 and USV/n 16). The presence of a wall septum identified in trench 3 of the 2023 campaign confirms the existence of the east-west septum. Trench 3 is also significant for the discovery of a fragment of a pelte floor. Based on the evidence, it can be assumed that the floor covering of both porticoes was at an elevation of 137.92 m asl (USV/s 31 and USV/n 49). Thus, in this context, the square and porticoes were on the same level and were separated by a slightly elevated row of columns.

At the bottom of the square there was a probably hexastyle building on a high podium with a front staircase and a pronaos leading to a covered quadrangular room (Fig. 11). The podium (USV/s 24, USV/s 32), with its highest point of preservation visible in the cellar, is 2.88 m high above the square level. In ancient times, this structure probably reached a height of about 3 m (1 *pertica*), as can be deduced from the absence of any traceable signs of vaulted pillars or entablature housings, and by comparing with the Roman high podium temple in nearby *Ostra*, which shows structural and chronological similarities to the *Suasa* structure (Dall'Aglio and Franceschelli 2020, 153-163; 532-533).

Based on the height of the *podium*, the heights of all its structures and the end wall of the portico that crosses it seamlessly in a north-south direction were adjusted to divide its substructures into two different rooms. Access to the upper part of the structure is provided by a double flight of stairs, the first of which leads to a terrace without a roof of approximately 2.20 m in width, while the second leads directly to the pronaos. Thus, two different elevation levels were to be defined within the same building to accentuate its verticality and monumentality. The 14 steps were reconstructed based on the overall height difference that needed to be bridged, the traces present on the conglomerate, and the position of the retaining wall. Both ramps were designed to have an odd number of steps, seven for each ramp, with treads of 0.43 m and rises of 0.25 m, in accordance with Vitruvian rules (Vitr. III, 4, 4.). The building's casements were to be framed and part of them were found collapsed (SF03) and virtually integrated via VSF 02. At the end of the rise, at least three m from the plaza below, the interior

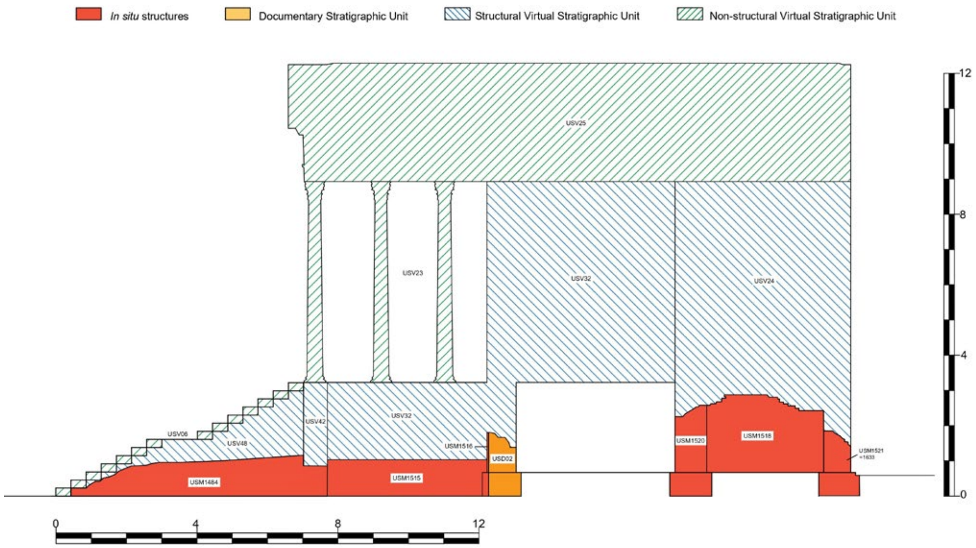


*Figure 11 - Reconstructive proposal of the E-W section of 'Edificio 10' (author's elaboration).*

of the building (9.32 x 13.09 m, about 35 x 45 feet) could be accessed at the end of the rise. The internal dimensions of the pronaos and the covered room were established by placing the line of the front colonnade (USV/n 23) at the negative trace left by the housing of a large stone block within the conglomerate. The pronaos measures 7.61 x 4.33 m (26 x 14 feet) and the covered room measures 8.66 x 4.33 m (approximately 29 x 14 feet). Based on the known width of the recess for housing the colonnade's foundation stone block and the previously mentioned Vitruvian assumption, the columns can be estimated to have a diameter of 0.60 m (Vitr. III, 4, 1). The front of the columns was hexastyle, with two columns on the side flaps of the pronaos and intercolumniums of approximately 1.20 m, creating a systyle rhythm for the facade (Vitr. III, 4, 1). According to the Vitruvian canon, the columns were intended to be 5.70 m high. The reported building measurements also suggest a reconstruction of a tetrastyle front with wider columns and *intercolumnium*. However, due to issues with the building's statics, this hypothesis seems less likely. The roof and entablature of the structure were identified as USV/n 25 and reconstructed by comparing it with the *Ostra* case mentioned above (Dall'Aglio and Franceschelli 2020, 533).

## Discussion and conclusion

The 'Tappatino' area during the Roman imperial phase must have appeared as a public area separated from the so-called 'Commercial Forum' by a road axis. The reconstructed plan for this area and its location within the topography of *Suasa* is similar to the case of *fora adiecta* in the smaller centres of Cisalpine Gaul (Villicich 2000, 61–63). In these contexts, the duplication of collective public spaces is associated with the presence of additional public areas with religious character. Useful comparisons for the *Suasa* case were identified, such as the case of *Alba Pompeia*. This is a perfect example of addition to the urban interweaving, despite its strictly religious character. It is located in close proximity to both the Forum and Theatre areas and appears to be inspired by the scheme of *Vespasian's Templum Pacis* (Filippi 1997, 69–70; Maggi 2000, 69). The mentioned scheme, despite significant differences in monumental appearance, was widely used in both Cisalpine and the other transalpine regions. This is evident in the case of *Avenches* and the public complex B at *Alba Helvorum* (Béal et al. 1989, 122–133). The plan of the latter is the most comparable to the case under study. It consists of a quadrangular square with a sacred building at the back, two L-shaped portico arms passing through it and small open exedras along the perimeter wall of the portico. The overall orientation of the structure also appears identical to the *Suasa* case. All these complexes have only been partially investigated, and their religious function appears to be based solely on assumptions related to the presence of a central building with a frontal staircase. In the city of *Suasa*, a sacred area from the imperial age has not yet been identified, and according to Cimarelli's words (Cimarelli 1642, 160-161), just below the 'Tappatino' there is a temple dedicated to Jupiter. Therefore, it is probable that the sacred complex mentioned by Cimarelli could be Ed. 10.

However, the dimensions of the podium of this structure deviate from the usual Vitruvian ratio of 1:2, and the so-called cella has an almost square shape (9.72 x 9.32 m, 33 x 32 feet). Consequently, comparisons can also be drawn with the typology of the curia on a high podium from the imperial age (Balty 1991). The case study of the Verona curia (Frothingham 1914, 128–145; Marconi 1937, 35–38; Cagiano De Azevedo 1940, 34; Beschi 1960, 444–456; Cavalieri Manasse 1987, 12–15; 24–29; 1990, 579–616) provides an interesting point of reflection for a different approach to understanding the *Suasa* context. It is important to note that this is not a direct comparison, as the 'Tappatino' complex has evident structural differences. Mistakenly identified as the *Capitolium* by Frothingham (Frothingham 1914, 128-145), this structure comprises a U-shaped, vaulted perimeter ambulatory that can be accessed at the end of the long arms. It encloses three interconnected vaulted rooms in the northern part. The rooms at the level of the podium supports likely had complementary functions to those of the curia. In a monumental typology generally lacking a podium, the construction of this element in such monumental terms and its related internal structures must have served a specific purpose (Cavalieri Manasse 1987, 27). Based on the chronological indications from excavation tests, the entire complex appears to date back to the Tiberian age. The hypothesis that this area was associated with the imperial cult cannot be dismissed. In fact, the strong connection between this cult and the curia is well known (Gros 1984, 125; Hänlein-Schäfer 1985, 55-56; 64; 67-68; Balty 1991, 279-286). The identification of Ed. 10 as a curia raises concerns from a topographic perspective, since the typical relationship between curia and basilica is completely absent. Moreover, the absence of information regarding the topographical positioning of the *Capitolium* and the basilica in *Suasa* currently impedes the study of this area of the city in relation to its spatial arrangement and the structural pathways (Grassigli 1994). However, the unique nature of Ed. 10 should not be surprising, considering the topographic and structural peculiarities found in *Suasa's* civic complexes, such as the so-called 'Commercial Forum' and the amphitheatre.

The digital reconstruction project of the 'Tappatino' represents a significant step forward in studying and communicating the construction history of this site. By using the EM approach, it was possible to analyse the discovered archaeological structures and provide the necessary tools for creating a comprehensive reconstruction. This method has allowed for equal emphasis to be placed on all stages of the reconstruction process, offering new ways to interact with the reconstructions, both from a research and enjoyment perspective. As research in the field advances and new data from geophysical surveys and targeted excavations are incorporated, this study will either confirm or refine the existing models and develop 'representation models' for each of the recognized phases and publish them on the web app *EMviq*. In addition, these new data will open up the possibility to investigate the relationship between the complex of 'Edificio 10' and the surrounding complexes of the Forum and the so-called 'Ocean Building' (De Maria and Giorgi 2013, 87; Giorgi 2010, 371-378; 2020a, 101), in order to place the proposed reconstruction within a broader frame of the ancient *Suasa* landscape.

## Bibliography


Adam J.P. 1994. *L'arte di costruire presso i romani: materiali e tecniche*. Translated by Guidobaldi M.P. 3 ed. Milano: Longanesi & C.

Antolini S. 2000. 'Suasa'. *Supplementa Italica*, 18: 317–94.

Antolini S. 2013. 'Una fistula iscritta da Suasa'. *Picus* 33: 299–307.

Balty J. Ch. 1991. *Curia Ordinis: recherches d'architecture et d'urbanisme antiques sur les Curies Provinciales du monde Romain*. Vol. 2. Memories de la Classe des Beaux-Arts, T. XV. Bruxelles: Palais des Academies.

Beacham R., H. Denard, and F. Niccolucci. 2006. 'An Introduction to the London Charter'. In *The E-Volution of Information Communication Technology in Cultural Heritage: Where Hi-Tech Touches the Past. Risks and Challenges for the 21st Century*, edited by M. Ioannides, D. Arnold, F. Nicolucci, and F. Mania, 263–69. Budapest: Archeolingua.

Béal J.C., J. Dupraz, and E. Boucharlat. 1989. 'Architecture et urbanisme antiques d'Alba (Ardèche): Documents Nouveaux'. *Revue Archéologique de Narbonnaise* 22: 99–145.

Berto S., E. Demetrescu, B. Fanini, J. Bonetto, and G. Salemi. 2021. 'Analysis and Validation of the 3D Reconstructive Process through the Extended Matrix Framework of the Temple of the Roman Forum of Nora (Sardinia, CA).' *Environmental Sciences Proceedings*, 10(1), 18. https://doi.org/10.3390/environsciproc2021010018.

Beschi L. 1960. 'Verona Romana'. In *Verona e il suo territorio*. Vol. 1. Verona: Istituto per gli studi storici veronesi.

Bianchini M. 2010. *Le tecniche edilizie nel mondo antico*. Roma: Dedalo Edizioni.

Boschi F., F. Vermeulen, and E. Giorgi. 2020. *Picenum and the Ager Gallicus at the Dawn of the Roman Conquest. Landscape Archaeology and Material Culture*. Oxford: Archaeopress.

Bridel Ph. 1982. *Le Sanctuaire de Cigognier*. Lausanne: Association pro Aventico.

Cagiano De Azevedo M. 1940. *I Capitolia dell'Impero Romano*. Città del Vaticano: Tipografia Poliglotta Vaticana.

Cavalieri Manasse G. 1990. 'Il Foro di Verona: recenti indagini'. In *La città nell'Italia settentrionale in età romana*, 579–616. Roma: Publications de l'École Française de Rome.

Cerato I. and S. Pescarin. 2013. 'Reconstructing Past Landscapes for Virtual Museums.' In *Good Practice in Archaeological Diagnostics: Non-Invasive Survey of Complex Archaeological Sites*, edited by C. Corsi, B. Slapšak, and F. Vermeulen, 285–96. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-01784-6_17.

Cimarelli V. M. 1642. *Istorie dello Stato d'Vrbino da' Senoni detta Vmbria Senonia e de Lor Gran Fatti in Italia, delle città, e luochi che in essa al presente si trouano, di quelle che distrutte gia furono famose et di Corinalto che dalle ceneri di Suasa hebbe l'origine.* Brescia: Opere storiche Fontana, Bartolomeo eredi.

Dall'Aglio P.L. 1991. 'La viabilità romana'. In *Archeologia delle valli marchigiane: Misa, Nevola e Cesano*, edited by P.L. Dall'Aglio, S. De Maria, and A. Mariotti, 12–23. Perugia: Electa/Ed. Umbri.

Dall'Aglio P.L. and C. Franceschelli. 2020. *Ostra: una città romana e il suo territorio nelle Marche centrali (Scavi 2006-2019)*. Bologna: Ante Quem.

De Maria S. and P.L. Dall'Aglio 1988. 'Nuovi scavi e ricerche nella città romana di Suasa (AN). Relazione Preliminare.' *Picus* 8: 73–156.

De Maria, S., and E. Giorgi. 2013. 'Urbanistica e assetti monumentali di Suasa. Novità dalle ricerche recenti'. In *Epigrafia e Archeologia*, edited by M. Giuliodori and G. Paci, 79–142. Ichnia 13. Tivoli: Tored.

Demetrescu E. and B. Fanini. 2017. 'A White-Box Framework to Oversee Archaeological Virtual Reconstructions in Space and Time: Methods and Tools.' *Journal of Archaeological Science: Reports* 14: 500–514. https://doi.org/10.1016/j.jasrep.2017.06.034.

Demetrescu E., B. Fanini, and E. Cocca. 2023. 'An Online Dissemination Workflow for the Scientific Process in CH through Semantic 3D: EMtools and EMviq Open-Source Tools'. *Heritage* 6 (2): 1264–76. https://doi.org/10.3390/heritage6020069.

Demetrescu E. and D. Ferdani. 2021. 'From Field Archaeology to Virtual Reconstruction: A Five Steps Method Using the Extended Matrix.' *Applied Sciences*.

Demetrescu E., D. Ferdani, N. Dell'Unto, A.M. L. Touati, and S. Lindgren. 2016. 'Reconstructing the Original Splendour of the House of Caecilius Iucundus. A Complete Methodology for Virtual Archaeology Aimed at Digital Exhibition.' *SCIRES-IT-SCIentific RESearch and Information Technology* 6 (1): 51–66.

Demetrescu, E. 2018. 'Virtual Reconstruction as a Scientific Tool'. In *Digital Research and Education in Architectural Heritage*, 102–16. Springer.

Denard H. 2012. 'A New Introduction to the London Charter.' In *Paradata and Transparency in Virtual Heritage*, edited by A. Bentkowska-Kafel, H. Denard, 57–72, London: Ashgate.

Destro M. 2010. 'L'età Tardoantica e la fine della città'. In *Archeologia nella valle del Cesano da Suasa a Santa Maria in Portuno*, edited by E. Giorgi and G. Lepore, 93–98. Bologna: Ante Quem.

Dominici L. 1993. *La regale San Leo*. San Leo: Associazione Pro San Leo.

Ferdani D., E. Demetrescu, M. Cavalieri, G. Pace, and S. Lenzi. 2020. '3D Modelling and Visualization in Field Archaeology. From Survey To Interpretation Of The Past Using Digital Technologies'. *Groma: Documenting Archaeology* 4. https://doi.org/10.12977/groma26.

Filippi F., 1997. *Alba Pompeia: Archeologia della città dalla fondazione alla tarda antichità*. Alba: Famija albeisa.

Frothingham A. L. 1914. 'Discovery of the Capitolium and Forum of Verona.' *American Journal of Archaeology* XVIII: 129–45.

Giorgi E. 2010. 'Suasa alla luce delle ultime ricerche'. In *Archeologia nella valle del Cesano da Suasa a Santa Maria in Portuno*, edited by E. Giorgi and G. Lepore, 39-46. Bologna: Ante Quem.

Giorgi E. 2020a. 'Suasa. Genesi e sviluppo di un municipio romano dell'Agro Gallico'. *Atlante Tematico Di Topografia Antica. Roma,* 30: 95–114.

Giorgi E. 2020b. 'The Cesano Valley at the Outset of the Roman Conquest and the Genesis of Suasa.' In *Picenum and the Ager Gallicus at the Dawn of the Roman Conquest. Landscape Archaeology and Material Culture*, edited by F. Boschi, E. Giorgi, and F. Vermeulen, 61–79. Oxford: Archaeopress Access Archaeology.

Giorgi E. 2021. 'L'appoderamento agrario suasano alla luce delle nuove ricerche'. *Agri Centuriati* 18: 9–26.

Giorgi G. and L.A.Grazzi 1981. *Suasa Senonum e l'Ager Gallicus nella valle del Cesano. Con catalogo dei reperti archeologici*. 2nd Edificio Parma: Centro saveriano azione missionaria.

Golvin J.C. 1988. *L'amphitheatre Romain: Essai sur la theorisation de sa forme et de des fonctions*. Paris: Diffusion de Boccard.

Grassigli G. L. 1994. 'Sintassi spaziale nei fori della Cisalpina. Il ruolo della curia e della basilica'. *Ocnus. Quaderni Della Scuola Di Specializzazione in Archeologia* 2: 79–96.

Gros P. 1995. 'Hercule à Glanum. Sanctuaires de transhumance et développement urbain.' *Gallia* 52: 311–31.

Gros P. 1984. 'L'augusteum de Nîmes.' *RAN* 17: 123–34.

Hänlein-Schäfer H. 1985. *Veneratio Augusti: Eine Studie Zu Den Tempeln Des Ersten Römischen Kaisers*. Roma: Giorgio Bretschneider.

Lanciarini V. 1985. *Il Tiferno Mataurense e la provincia di Massa Trabaria: memorie storiche*. Vol. II. Roma: Tip. Failli.

Maggi S. 2000. 'Le sistemazioni forensi nelle città della Cisalpina romana: dalla tarda repubblica al principato augusteo (e oltre)', *Revue belge de Philologie et d'Histoire*, 78(1): 270-272

Marconi P. 1937. *Verona Romana*. Bergamo: Istituto italiano d'arti grafiche.

Polverari A., 1984. *Castelleone di Suasa I. Vicende storiche*. Castelleone di Suasa: Amministrazione comunale.

Remondino F. and A. Rizzi. 2010. 'Reality-Based 3D Documentation of Natural and Cultural Heritage Sites—Techniques, Problems, and Examples'. *Applied Geomatics* 2 (3): 85–100. https://doi.org/10.1007/s12518-010-0025-x.

Villicich R. 2007. *I complessi forensi nei centri minori della Cisalpina romana*. Bologna: Ante Quem.

# Water for men or water for the Gods? The *caput aquae* of the aqueduct of Santa Maria in Stelle (Verona)

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**Abstract**

The hypogeum of Santa Maria in Stelle, Verona, is mainly known as a place of Christian worship, built between 4th century CE and 5th century CE. This paper traces the previous phases of the monument, through the analysis of archaeological records, ancient cartography, and historical sources, and explores the reasons for its construction and the people involved. In fact, the site was not originally a place of worship, but a service facility, acting as the *caput aquae* of a small aqueduct, which has been traced back to Pomponius Cornelianus, consuland curator, who lived between 2nd century CE and 3rd century CE.

**Keywords**

Roman archaeology, ancient topography, archival research, Roman water supply systems, Verona, Regio X

## 1. Introduction

### *1.1 Gap in previous studies*

Santa Maria in Stelle is a village on the eastern side of the Pantena Valley, 8 km from Verona, famous for the presence of a hypogeum, known in the literature as 'Pantheon', which can be reached through an underground tunnel under the church of Santa Maria Assunta. It is a Christian complex dating back to the end of the 4th century CE, with two apses decorated with wall paintings and mosaic floors. The history of this complex began before its Christian phase, perhaps in the 3rd century CE, when it was only a water channel. Previous studies have focused on interpretations of the Christian paintings (Dorigo 1968; Toynbee 1970, 648-653; Zuliani 1974, 1-8; Dalla Barba Brusin 1977, 258-272; Bisconti and Braconi 2012, 648-653; Lusuardi Siena and Baratto 2013, 182-185; Brandenburg 2014, 239-258; Antolini 2020, 25-62), but earlier phases of the structure have not previously been investigated in depth. Therefore, the water supply system, has thus far been neglected as a subject of study except superficially as integrated into studies of the subsequent phases.

Various interpretations of the water supply system have been put forward over time: a cave dedicated to Trofronio, the tomb of the *Pomponii*, an *aedes catechizandorum*, a nymphaeum and an oratory for private worship. All these interpretations differ on the function of the hypogeum in a second phase of its construction, contemporary with the realisation of the apses and the paintings, while they agree on the formal function of the building as a water supply system. Thus, the debate remains open.

This paper will attempt to reconstruct the former function of the complex based on archaeological and archival data, as well as the reasons that probably led to its construction and the people involved in the project. At the same time, it will try to prove that all building activities inside the hypogeum were adapted over time to the presence of the water supply system, which was always in operation.

### *1.2 The water supply system and its context*

The fragmentary nature of the documents relating to the Roman phase does not allow scholars to clearly place the complex of Santa Maria in Stelle within the broader context of settlement dynamics of the Pantena valley. The archaeological remains offer only limited insight into the Roman presence, with epigraphic material representing the most significant source of information (Franzoni 1987, 93-98; Franzoni 1991, 87-96). As previously observed by Lanfranco Franzoni (1991, 90), the pervasive occurrence of inscriptions associated with the *gens Valeria* in the area could indicate the presence of their properties in the valley (Cenati, Gregori and Guadagnucci 2015, 200-204). It is regrettable that these archaeological observations are absent, which precludes any possibility of confirming whether this wealthy family, attested in Verona since its foundation (Buchi 1987, 13-45), may have owned a villa in the Pantena valley. However, we can assume that the ancient landscape was occupied by rural settlements, perhaps centred around a *pagus*, of which no evidence remains. Similarly, no evidence of centuriation has been found (Capuis et al. 1990, 133-136; Muzzioli 2010, 36-37), although its presence has recently been hypothesised without any convincing arguments being proposed (De Zuccato and Checchi 2019, 146). Due to this lack of information, in order to better understand the settlement dynamics of the Pantena Valley, it is therefore necessary to analyse the neighbouring contexts, which provide more information: Verona and Montorio (Fig. 1).

Verona (Fig. 1, A) has been inhabited since the Protohistory by indigenous people who settled on the slopes of the hill of San Pietro (Malnati, Salzani and Cavalieri Manasse 2004, 347-378.), where a settlement is thought to have existed in the Bronze and Iron Ages. The plain, on the other hand, was occupied extensively only during the Roman period (Cavalieri Manasse 2018, 42-43; Bruno and Cavalieri Manasse 2022, 43-55). Scholars agree in identifying a first phase of the Roman *colonia* – established in 89 BCE – which overlapped with the indigenous site, and a second, linked to the granting of the title of *municipium* – founded in 49 BCE – during which the urban layout of the plain was defined.

The hill of Montorio Castle (Fig. 1, C) has been inhabited since the Iron Age. In the same area a Palaeovenetian necropolis has been identified, dated between 7th and 6th century BCE, later abandoned in 4th century BCE (Salzani 1996, 295; Biondani, Corrent and Salzani 2000, 61; De Angelis 2002, 188; Alloro and Pasa 2003, 19-21; Malnati, Salzani and Cavalieri Manasse 2004, 352-355; Guidi, Candelato and Saracino 2008, 18). Later, the Roman population settled directly on the remains of a Rhaetian settlement, which was abandoned at the end of 1st century CE and moved further east, to the site of the modern village of Montorio (Malnati, Salzani and Cavalieri Manasse 2004, 347-378) (Fig. 1, D).

In addition to these contexts, another crucial element must be considered: the *Via Postumia* (Basso, Bruno and Grossi 2019, 20-21) (Fig. 1, E). This road, planned in 148 BCE, connected Verona and *Vicetia* and probably included connections to the Pantena valley.


*Figure 1 - Map of the surveyed area: A: Verona; B: S. Maria in Stelle; C: Montorio Castle; D: Montorio; E:* Via Postumia*; F: branch of the* Via Postumia*, probably leading to the Pantena valley (elab. by the author; map data: © Google Earth).*

The aforementioned elements permit the formulation of the hypothesis that the Pantena valley was part of the same settlement dynamic that started in the mid-2nd century BCE, and was most prominent after 89 BCE, in which a new process of landscape reorganisation likely commenced in Verona following the settlement of the *colonia* (Fig. 2). It can be reasonably assumed that the valley was included in the local road system and that a route connected the valley to the *Via Postumia*, perhaps at today's Porta Vescovo (Fig. 1, F). This road could have been partially discovered in Grezzana (Fig. 3, 17), and the funerary monuments found along its route could be interpreted as a sign of its importance (Gabrielli 2023, 155; De Zuccato and Checchi 2019, 147-153). In particular, the discovery of a circular mausoleum, dating from late 1st century BCE/early 1st century CE, 18m in diameter and not far from the aforementioned route, could be interpreted as further evidence of the presence of an ancient road system of great importance (De Zuccato and Checchi 2019, 150-152; Franzoni 1991, 92-94). The presence of a place of worship in the area has also been hypothesised, as

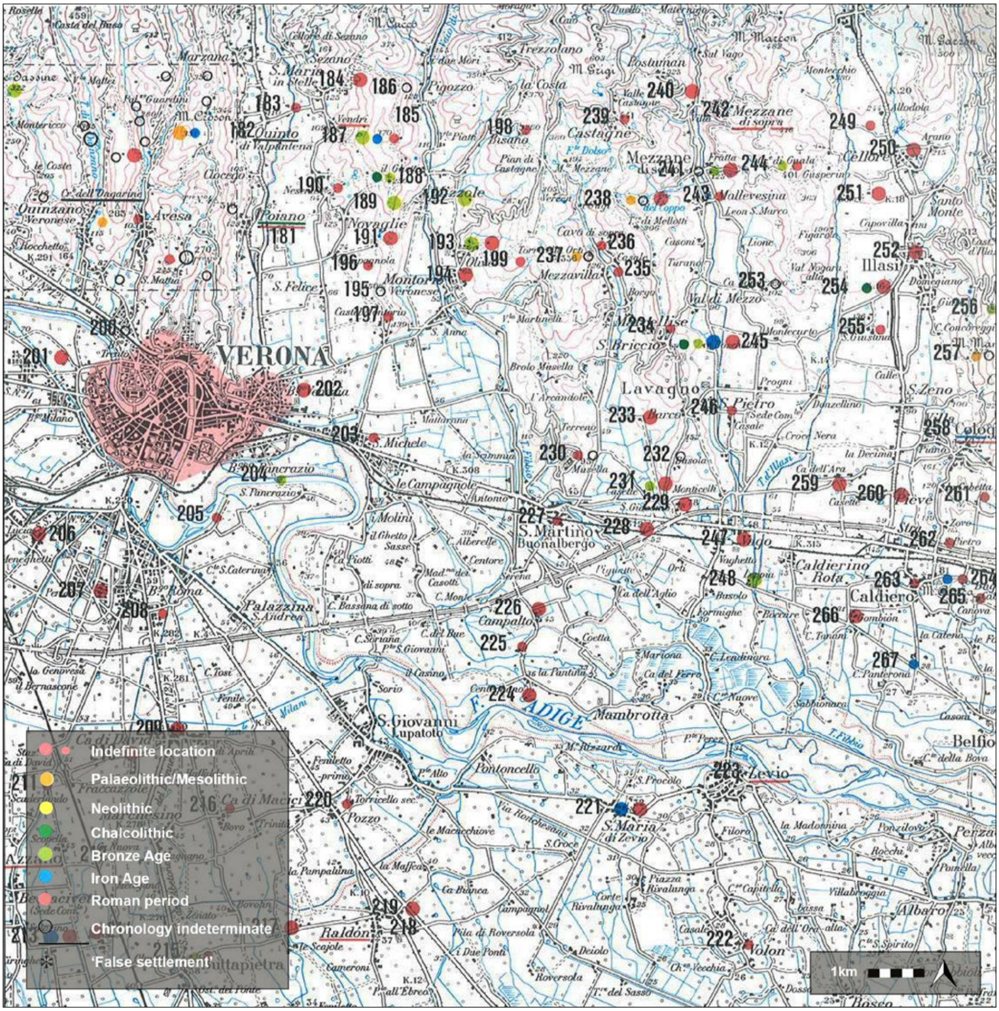


*Figure 2 - Archaeological map of the surveyed area where the site of Santa Maria in Stelle is identified with the n. 184 (adapted from Capuis et al. 1990: 98).*

evidenced by the discovery of a bronze *tabula ansata*[1] (De Zuccato and Checchi, 152). However, this reconstruction is not supported by tangible evidence.

Finally, regarding the water supply systems, we know that there was no connection between the aqueduct of Santa Maria in Stelle and the water supply systems of Verona (Gangale Risoleo 2018, 279-280) (Fig. 4). Instead, Verona was supplied by two aqueducts, one from the east and the other from the west (Gangale Risoleo 2017, 229-256; Gangale Risoleo 2022, 145-147). This is why the aqueduct of Santa Maria in Stelle should be analysed as a separate infrastructure; its blueprint also doesn't reach Verona[2].

[1] The tabula is inscribed with the following text: *M(arcus) Domitius / Servus / v(otum) s(olvit) l(ibens) m(erito).*

[2] Some scholars included the aqueduct of Santa Maria in Stelle in the water supply systems of Verona: Buonopane 1987, 292–294; Ghiotto 2006, 79.

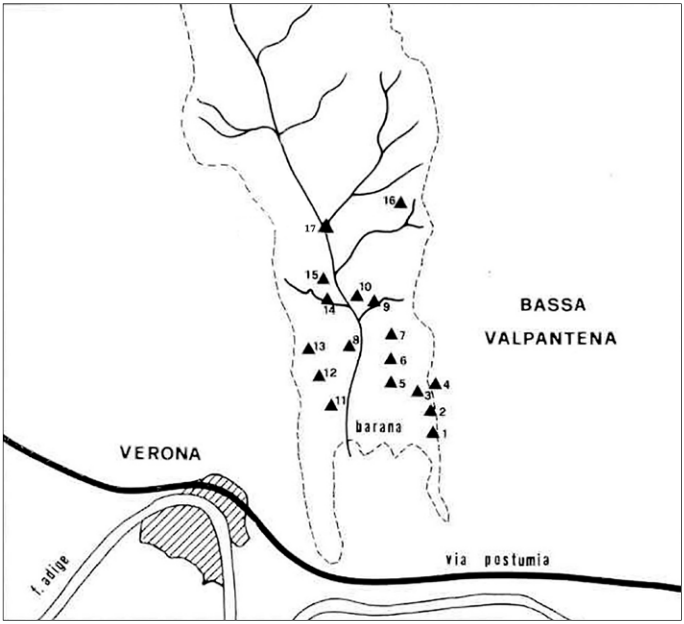


*Figure 3 - Sites within the Pantena valley where evidence from the Roman period has been discovered: 1. Montorio Castle, 2. Gazzol (villa Balladoro), 3. Novaglie, 4. Pipaldolo, 5. Nesente, 6. Vendri, 7. Santa Maria in Stelle, 8. Cassiano, 9. Sezano, 10. Cellore di Sezana, 11. Poiano, 12. Palesago, 13. Quinto, 14. Marzana, 15. Cuzzano, 16. Romagnano, 17. Grezzana (adapted from Franzoni 1991: 87).*

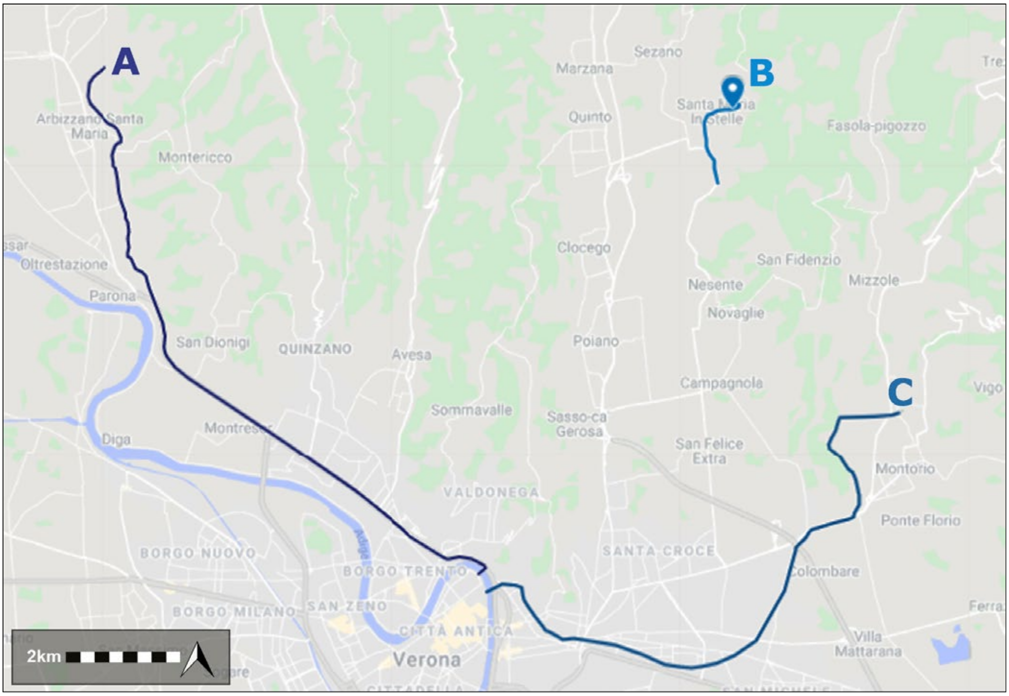


*Figure 4 - The aqueducts in the surroundings of Verona: A: the aqueduct of Novare-Parona; B: the aqueduct of Santa Maria in Stelle; C: the aqueduct of Montorio (elab. by the author; map data: © Google My Maps).*

## 2. The complex and its building phases

### *2.1 The current situation*

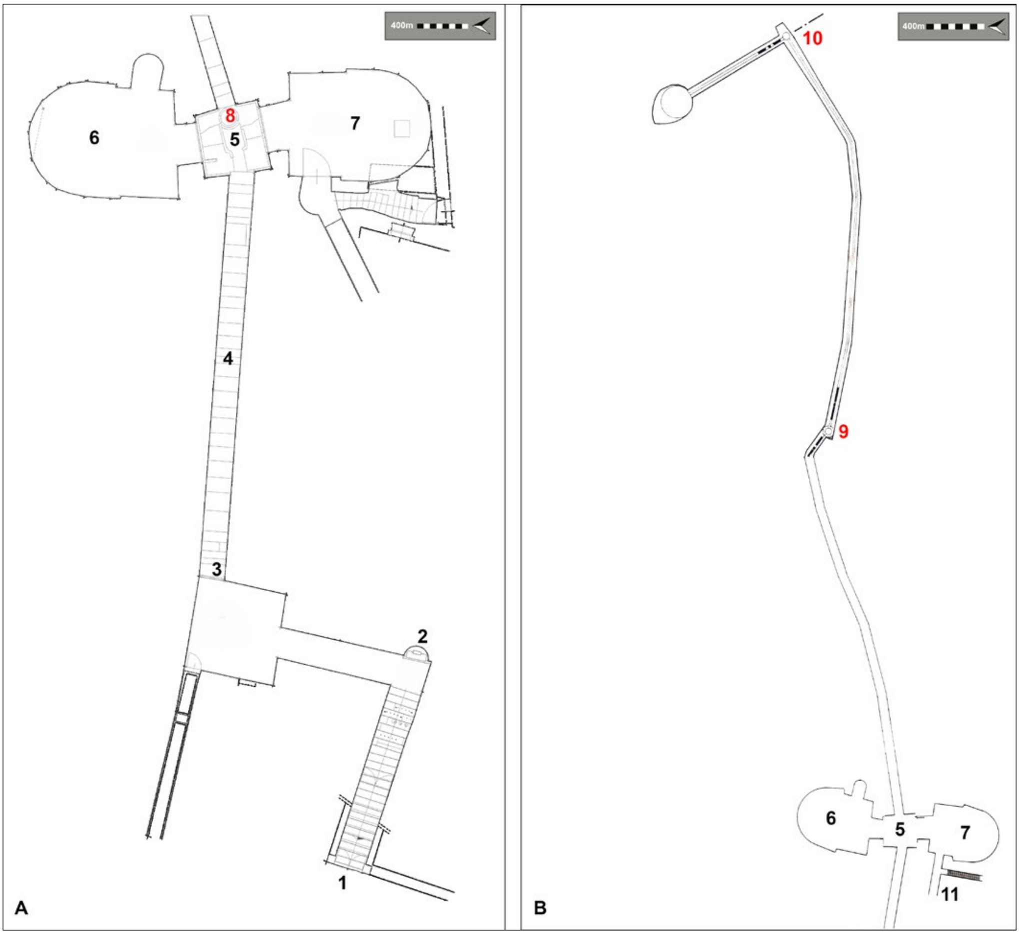


*Figure 5 - The plan of the hypogean area (A-B), dropshafts are indicated in red: 1. current entrance, 2. statue of* Cornelianus*, 3. inscription, 4. first corridor, 5. connecting chamber, 6. northern apse, 7. southern apse, 8. previous location of the inscription (15th century CE), 9. dropshaft, 10. dropshaft, 11. entrance in use since at least in 15th century CE and perhaps earlier (adapted from Gangale Risoleo 2018: 272, fig. 6; 275, fig. 8).*

The hypogeum is currently accessed by a staircase on the side of the church of Santa Maria in Stelle (Fig. 5, 1). At its entrance is a statue (Fig. 5, 2), made in modern times by assembling several pieces, perhaps discovered in the surrounding area, and traditionally attributed to the figure of *Cornelianus*, the supposed founder of the complex. Then, a first corridor leads to the apsidal rooms. At the beginning of this corridor there is an inscription (Fig. 5, 3), originally placed in another part of the complex, attributing the construction of the building to the Cornelian family. The corridor (Fig. 5, 4) leads to an atrium between the two apses (Fig. 5, 5). The northern one is decorated with early Christian paintings (4th–7th century CE) and a

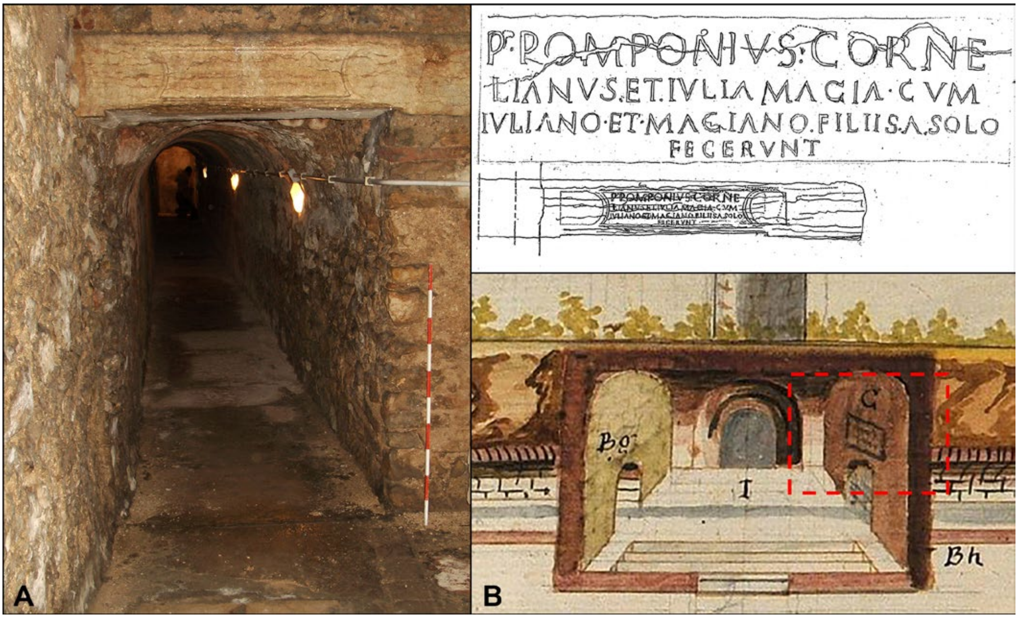


*Figure 6 - The inscription inside the hypogeum: A. the current position (photo by L. Marino); B. the original position in a drawing from the end of 18th century CE, marked with letter C (BCVR, ms. 1002, c. 1r., detail).*

mosaic floor (Fig. 5, 6). The southern apse (Fig. 5, 7) is also decorated with paintings from the same period and a mosaic floor, badly preserved. A water channel runs along the connecting rooms and in this first room there is a double basin (Fig. 5, 8). There are two more basins along the course of the channel before it reaches the spring (Fig. 5, 9 and 10).

***2.2 Reconstructing the ancient building through sources.***

By analysing documents of 15th century CE and some drawings of 17th century CE onwards, it is possible to reconstruct some details of the complex that have been erased in modern times. Thanks to the descriptions of Felice Feliciano (*CIL* V, 3318, 3706=Feliciano 1465, c. 129r) and Pietro Donato Avogaro[3] (Peebles 1962,1-47; Lodi 1996, 247; Ferrari 2003, 799-801; Gangale Risoleo 2018, 266), it is possible to reconstruct the access to the hypogeum from at least 15th century CE[4] (Fig. 5, 11). Thanks to their descriptions, we can also relocate the inscription attributing the origin of the whole complex to the family of *Cornelianus*[5] (*CIL* V, 3318=Feliciano 1465: n. 149): *Publius Pomponius Cornelianus* and *Iulia Magia*, together with the sons *Iulianus* and *Magianus*, built it from the ground up.

The inscription was not located at the beginning of the corridor (Fig. 5, 3; Fig. 6, A), but on the wall, above the same corridor, in the atrium between the two apsidal rooms (Fig. 5, 5; Fig. 6,

[3] BSVP: cod. 647.
[4] BSVP: cod. 647, c. 1*v* r. 17: *in specu(m) triginta gradib(us) descendis.*
[5] *P(ublius) Pomponius Corne/lianus et Iulia Magia cum / Iuliano et Magiano filiis a solo / fecerunt*. My previous interpretation of the position of the inscription according to Pietro Avogaro was wrong (Gangale Risoleo 2018, 276).

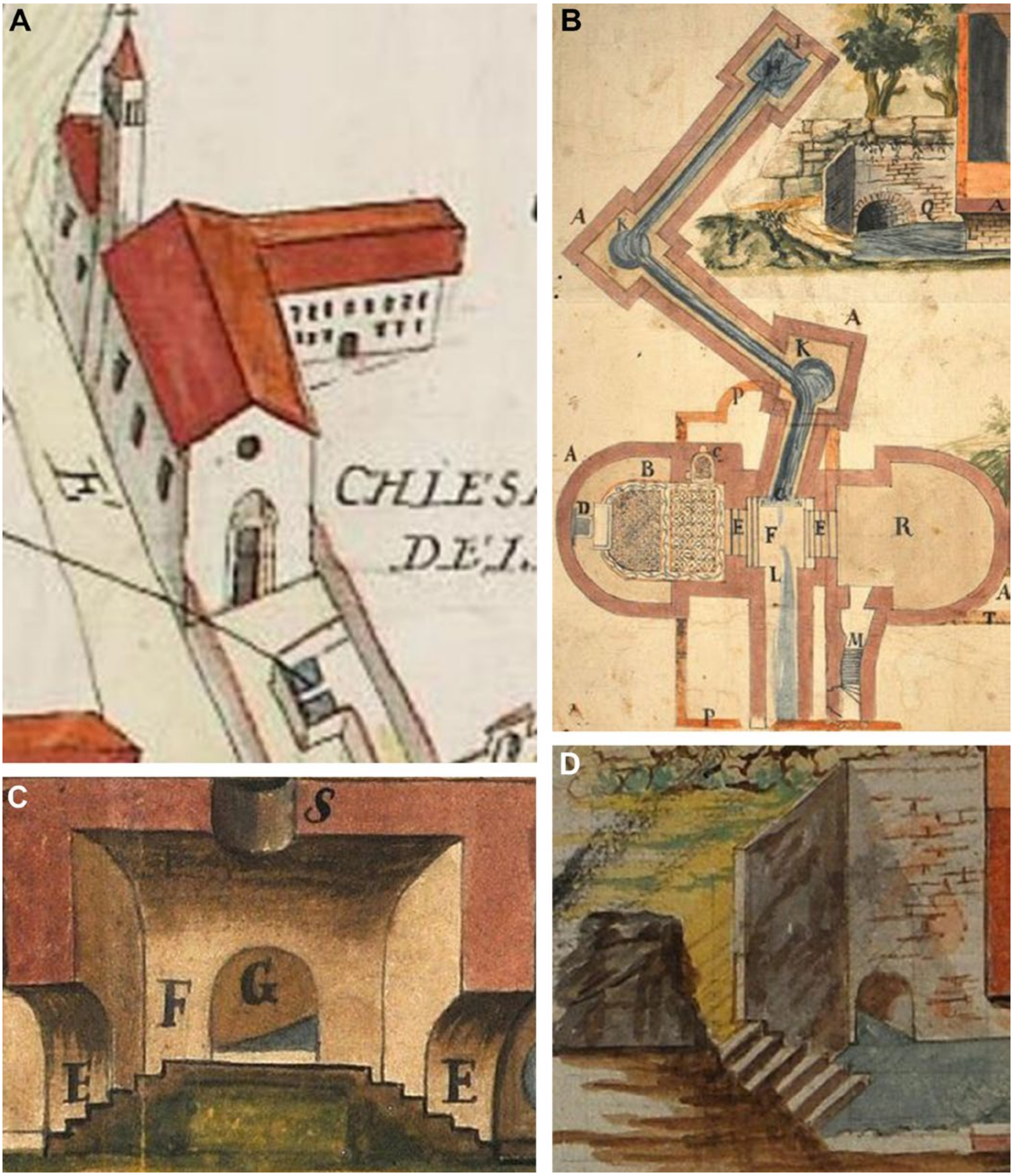


*Figure 7 - A series of 18th century CE drawings that allow us to reconstruct certain features of the monument that are now lost: A. details of the presence of a basin at the current entrance to the hypogeum (ASVR, Campagna famiglia, mappe e disegni, 337, concession to publish n. 17/2024); B: the absence of a pavement along the water channel (BCVR, ms 1002, 2r, detail); C: the presence of a staircase that allowed access to the last dropshaft located between the two apses (BCVR, ms 1002, 2r, detail); D: the presence of some steps at the basin located at the current entrance to the hypogeum (BCVR, ms 1002, 4r, detail) (all pictures elab. by the author).*

B). In addition to these elements, there is a series of drawings from the 17th–18th century CE[6] that show a basin in the place of the modern entrance (Fig. 7, A and D). Furthermore, thanks to Cristofali's 18th century CE drawings[7] (Gangale Risoleo 2018, 276), we can reconstruct the presence of some steps that descended inside the outermost basin and others that were built in the centre of the atrium that communicated with the two apsidal rooms, to connect the two spaces without interfering with the aqueduct channel (Fig. 7, C). From these drawings we can also presume new information on the pavement of the first part of the channel (Fig. 7, B). In fact, the channel didn't have a pavement until 1817, when the local priest decided to build one after a serious flood (Pighi 1903, 16; Gangale Risoleo 2018, 275).

### *2.3 The first phase of the complex*

#### *2.3.1 The water supply system*

So far, we can distinguish the different phases of construction of the complex, the first of which (Linington and Falamaki 1970, 83–84) was part of a water supply system. After this phase, the northern apses (Fig. 5, 6) were built first, cut into the rock, while the southern apses (Fig. 5, 7) were partly cut and partly built (Linington and Falamaki 1970, 83). This means that the water channel was built against a cliff (Gangale Risoleo 2018, 274–275).

However, the hydraulic function of the complex seems never to have been interrupted, because even when the complex became a place of worship, new solutions were found to keep the water flowing: a side access (Fig. 5, 11) (Gangale Risoleo 2018, 274-275) that did not interfere with the channel and some steps to overcome it were built at the point of passage between the two apsidal rooms (Fig. 7, C). However, we do not know whether the water had a function within the ritual practices or whether it was used only for civil purposes. It is also doubtful that the hypogeum ever had a funerary function (David and Maccani 2007, 16; Gangale Risoleo 2018, 274-275), as this would be difficult to reconcile with the passage of fresh water. The funerary inscription of *Pomponia Aristoclia*[8] (*CIL* V, 3706) was probably placed in the hypogeum later.

The identification of the different building phases is a key point for understanding the complex transformations and, above all, its original phase when it was not a place to receive the faithful, but a service passageway for the management and maintenance of the water supply system.

The aqueduct, in this first part, is characterised by the presence of three dropshaft cascades (Fig. 8) (Chanson 2000, 56-67, 69-70)[9], located at the intersections of the blueprint, and we

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[6] ASVE: *Provveditori ai beni inculti*, Verona, r. 102, m. 86, dis. 5; *Campagna famiglia*, mappe e disegni, 157, 'Uso acque di S. Maria in Stelle' (1688 nov. 10); *Campagna famiglia*, mappe e disegni, 154, 'Confini possessi Giusti in Villa delle Stelle' (1735 gen. 29); *Campagna famiglia*, mappe e disegni, 337, 'Rilievo acque di spettanza Giusti' (1748 giu. 26).

[7] BCVR: ms. 1002, cc. 2 r. e 4 r.

[8] Other inscriptions of a funerary type are attested within the hypogeum, and it is likely that they come from the surroundings.

[9] The scholar defines *dropshaft cascades* as hydraulic systems used in the Roman world to dissipate energy and possibly to collect sediment where there were steep gradients along the short sections of an aqueduct, as opposed to steep chutes, located along longer sections (with greater horizontal development). It is thought that they also had the function of re-oxygenating the water and improving its quality (Vitr. *de arch.* VIII, 6, 6; Plin. *NH* 31, 58; see also Sherwood, et al. 2020, 349, 350).

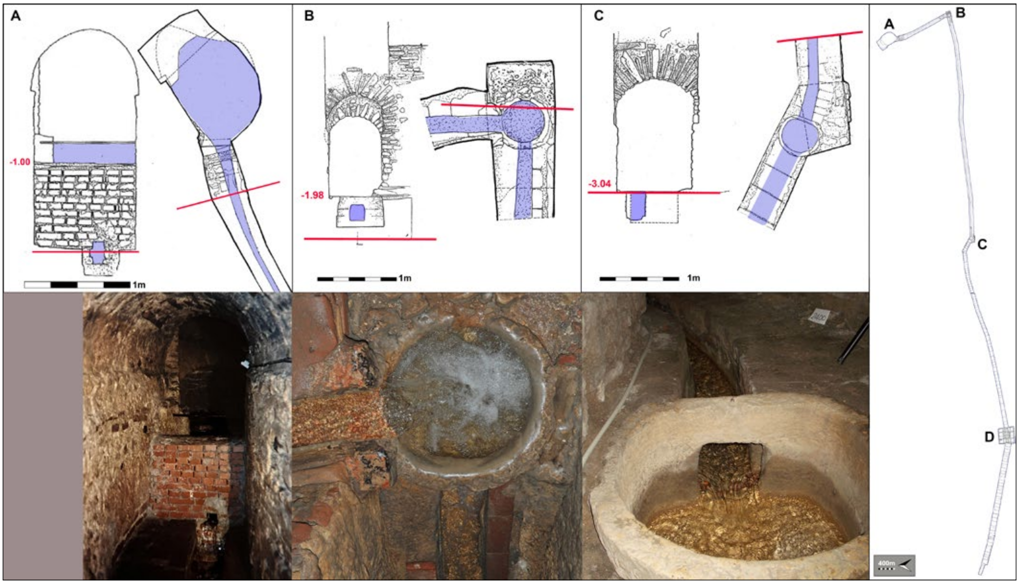


*Figure 8 - The dropshafts located along the first section of the aqueduct: A. first basin; B. first dropshaft; C: second dropshaft; D: third dropshaft (adapted from Gangale Risoleo 2018: 272, fig. 6; photos by L. Marino).*

have assumed the presence of a fourth basin, perhaps a reservoir (*piscina limaria*?), at the modern entrance (Fig. 7, A and D).

There are three stone basins associated with the dropshaft cascades, probably installed to allow the water to decant and scatter the debris transported along its course (Gangale Risoleo 2018, 270-271). This hypothesis seems to be confirmed by a note from 18th century CE[10] which mentions the presence of a large amount of gravel at the supposed reservoir and inside the channel, which caused the flow to slow down. The same circumstance is reported by Giovanni Battista Pighi at the beginning of the 20th century CE (Pighi 1903, 15), who testifies that in the 18th century the channel had to be reclaimed by raising the upstream section. Furthermore, in 1818 (Pighi 1903, 16), a flood swept a lot of debris downstream, destroying the walls of the basin at the entrance to the hypogeum and filling it up to its source. The water, unable to find an outlet, flooded the church above.

The basins at the dropshafts and the reservoir may have had the same function (Fig. 8), allowing the debris to settle to the bottom. At the same time, the dropshafts controlled the flow of water: the water goes from an altitude of -1m to -4.13m over about 130m, giving a slope of 2.4%[11] (Pace 2010, 18–21). It is possible, however, that the gradient was greater and that the current geometry is the result of modern works carried out with the aim of reducing the slope and avoiding possible flooding inside the channel.

[10] ASVR: *Campagna famiglia*, mappe e disegni, 337, 'Rilievo acque di spettanza Giusti' (1748 giu. 26).

[11] Vitruvius (*de arch.* VIII, 6, 1) recommends a slope of no less than 5% (*rivi libramenta habeat fastigata ne minus in centenos pedes sicilico*) while Pliny says that it must correspond to 2% (*NH* 31, 31: *libramentum aquae in centenos pedes silici minimum erit; si cunicolo veniet in binos actus lumina esse debunt*).

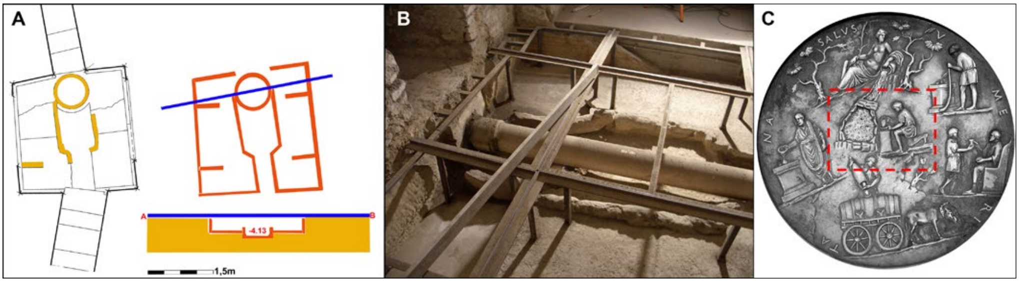

*Figure 9 - The third dropshaft located between the apses and its comparison with a water basin depicted in the so-called 'pátera de Otañes': A: plan of the dropshaft (adapted from Gangale Risoleo 2018: 272, fig. 6); B: photo of the dropshaft (photo by L. Marino); C: patera de Otañes (adapted from Iglesias Gil and Ruiz Gutierrez 2012: 351, fig. 2).*

The first two basins at the dropshafts have a very simple configuration (Fig. 8, B and C): a stone basin with an outlet hole, the bottom of which is at a lower level than the supply channel at the edge of the basin. This configuration was modified in the second basin (Fig. 8, C). Here, in modern times, a pavement has been built so that the water flows underneath it, thus varying the height of the incoming and outgoing water in relation to the settling basin.

A third basin is in the atrium between the two apsidal rooms (Fig. 8, D; Fig. 9, A and B). The basins were probably made of stone to prevent erosion caused by the acceleration of the water flow due to the presence of the dropshafts (Chanson 2000, 59, 67, fig. 18).

This basin is currently covered by a metal grating (Fig. 9, B), and it is not possible to determine its correct height in relation to the two apsidal rooms. It is at −0.50 m above sea level, while the stone slabs placed laterally are at −0.35/−0.40 m above the level of the hypogeum (−4.00/−4.14 m above sea level). It was intercepted during the laying of a fibre-cement pipe in 1957[12] (Franzoni 1991, 101; Gangale Risoleo 2018, 269, fig. 4), but has certainly been affected by the various restorations carried out in the hypogeum. The presence of a staircase was previously reconstructed here, but it no longer exists. It was discovered in 1972[13] (Franzoni 1991, 101) during some investigations carried out by the former Soprintendenza Archeologica of Padua. Franzoni proposed that it was reconstructed like the other two basins at the dropshafts but is also composed of a rectangular part that framed the circular one, narrowing slightly to the size of the water channel. The lack of evidence does not allow a precise reconstruction. The morphology seems to be different from the others, but it is difficult to determine whether these differences are decorative or otherwise functional[14]. One hypothesis is that it contained a filtering system that has now been lost[15]; however, a ritual function cannot be ruled out.

Dropshafts are often associated with the presence of inspection manholes (Fig. 10, C); perhaps because they are recognised as sensitive points within the channel, requiring careful inspection and frequent maintenance (Zanovello 1997, 668). Ancient sources recommend that they should be located every ca. 35m[16] (Sherwood, et al. 2020, 348, 350). It is likely that they

[12] ADSVR: disegno 173/124, Verona 22.02.57, Acquedotto rurale di S. Maria in Stelle.
[13] ASAVR: L. Benvegnù, *Verona. Ipogeo di S. Maria in Stelle*, 1° agosto 1972.
[14] Some examples in Dessales 2013: 80-113.
[15] Maybe a 'disposif d'èvacuation' (Dessales 2013, 77). See also Alarcão and Etienne 1977, 51 ss. and plate LXXVI.
[16] Vitruvius mentions the construction of these vertical shafts (*de arch.* VIII, 6, 4: *...parietes cum camera in specu struantur*

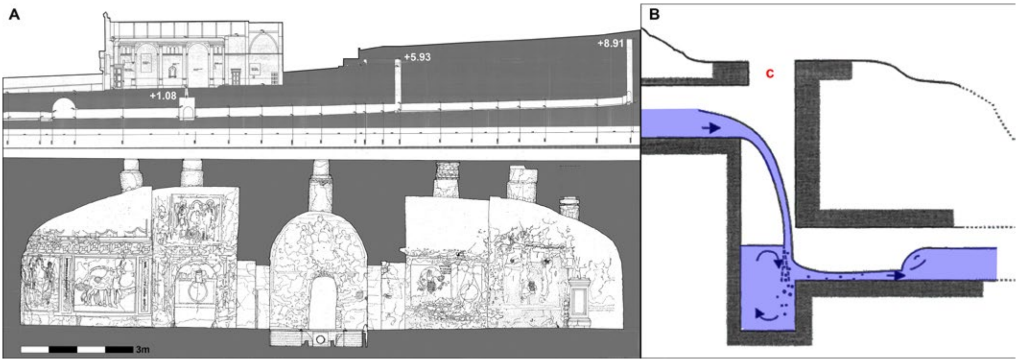


*Figure 10 - The relationship between dropshafts and inspection manhole: A: section of the first branch of the conduit and the central part of the hypogeum (adapted from Marino and Galante 2008: 50); B: sketch of the operation of a dropshaft where the letter C marks the inspection manhole (adapted from Chanson 2000: 61, fig. 10).*

were built during the construction phases of the *specus*, to orient the underground excavation during construction, and to allow air circulation as well (Mari 1991, 165; Tölle-Kastenbein 1993, 109–111). In the hypogeum, these are all arranged according to the basins (Fig. 10, A). The one in the atrium between the apsidal rooms, now bricked up, is located at a height of 7.30 m; and the others remain at ca. 13m and 16m, respectively.

The area of the aqueduct in the hypogeum illustrated so far is about 160m long and can be identified as the *caput aquae*[17] of the water supply system (Fig. 11). The aqueduct continued downstream, along a reconstructed route of about 1.25km. Thanks to Pietro Avogaro's indications (Lodi 1996, 254; see also Gangale Risoleo 2018, 268-269), we can partially reconstruct its course, at least in 15th century CE. From the hypogeum it continued towards Villa Giusti-Puttini and then ended in the locality of Vendri (Lodi 1996, 232; see also Franzoni 1991, 86-87 and Gangale Risoleo 2018, 269-270) (Fig. 11, B). This information is partly confirmed by modern cartography[18], although the route has been modified to some extent to coincide with the modern road. This may have happened in 1837, when the public washhouse was built (Antolini 2006, 74-76) (Fig. 11, C). The aqueduct was still functional in this period.

*et ita perducatur, puteique ita sint facti uti inter binos sint* actus) and also Pliny (*HN* 31, 31: *libramentum aquae in centenos pedes sicilici minimum eri, si cunicolo veniet, in binos actus lumina esse debebunt*).

[17] This word refers to the place where an aqueduct begins and doesn't describe a precise structure. Ancient sources give different interpretations, but they don't explain it in detail: a) *Frontinus* (*Aq*. 5, 5) reports that *Aqua Appia* started from a conduit placed *a capite*, where the source started, but doesn't explain the morphology of the structure placed at the beginning of the aqueduct (Del Chicca 2004, 8-9, 155-156, 303); in another passage he underlines that he measured the amount of water of Rome's aqueducts starting from the *capita ductum* (*Aq*. 64, 4; Del Chicca 2004, 50-53, 303); b) *Vitruvius* (*de arch.* 8, 6, 3) doesn't describe a drive structure but he uses *caput fontis* to indicate the water source in general (Gros 1997, 1140-1141, 1185); c) Ulpian (43, 20, 1, 8) proposes a brief description of the term *caput aquae*, specifying that from a legal point of view it is the place where the water comes from if it's spring water, and it is the place where the conduit starts if the water comes from a river or a lake (Capogrossi Colognesi 1966, 13-15). For a brief archaeological overview of these structures see: Tölle-Kastenbein 1993, 25-32; Trevor Hodge 2002, 67-79; Pace 2010, 810. A good example is the *caput aquae* of Trajan's aqueduct in Rome (Quilici 2009, 455-458; O'Neill 2014, 201-214).

[18] ADSVR: disegno 173/124, Verona 22.02.57, Acquedotto rurale di S. Maria in Stelle; see also Gangale Risoleo 2018, 269, fig. 4.

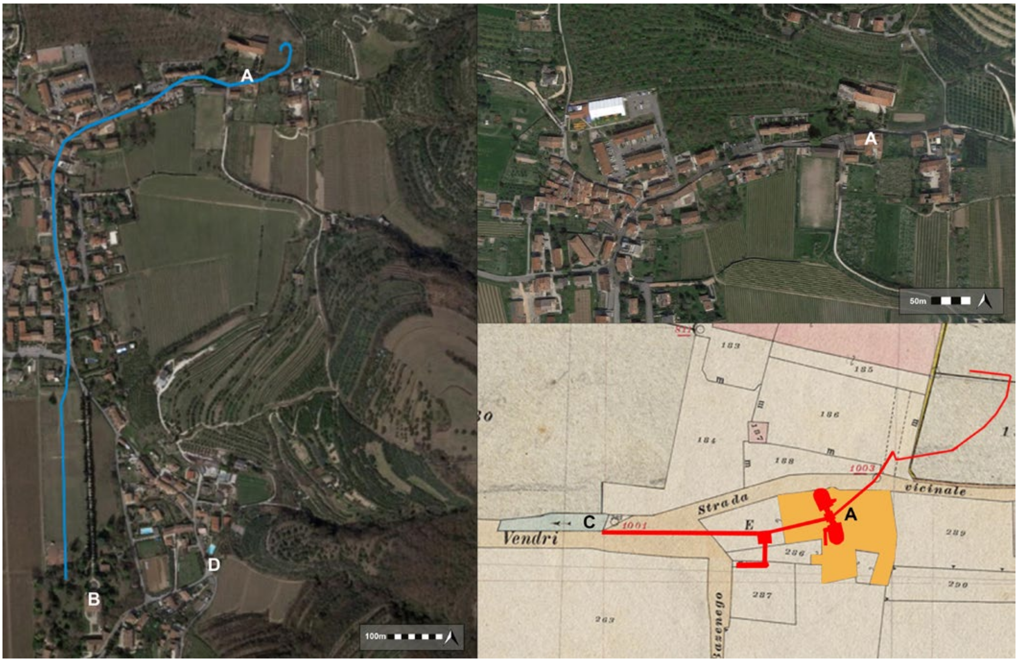


*Figure 11 - The aqueduct of Santa Maria in Stelle from the church (A) to the villa Giusti-Puttini in Vendri (B), the public washhouse (C), and the church of San Zeno in Vendri (D) (elab by the author; map data: © Google Earth).*

### *2.3.2 Pomponius Cornelianus and his family in Santa Maria in Stelle*

Among the features that we have highlighted to reconstruct the first phase of the complex, two elements could be related: the presence of the steps at the end of the hypogeum (Fig. 7) - where we have hypothesised a reservoir -, and the inscription that could attribute the construction of the water supply system to *Pomponius Cornelianus* and his family (Fig. 6). This inscription states that *Pomponius Cornelianus* and his family built an unspecified building from the ground up (*a solo*)[19].

We have reconstructed its former position inside the hypogeum at least during the 15th century CE, fixed in one of the walls of the atrium (Fig. 6), above the section of the water channel that leads to the supposed *reservoir*. We could hypothesise that it was moved in 19th century CE, when the staircase that still gives access to the hypogeum was built. However, it is also likely that the position of the inscription in the 15th century CE was not the original one, and we propose to link the inscription to the steps near the reservoir. These steps were probably the remnants of a service staircase that gave access to the underground through a structure on a higher level that provided access for maintenance work. The reservoir was covered, and part of it was above ground. The inscription of *Cornelianus* may have been placed here to celebrate the family that built the complex. The inscription must therefore have once

[19] For comparison see *CIL* XI, 1222 (=*EDR*081079: *a solo erexit*) and *CIL* XI, 7285 (=*EDR*079090: *ad solum deiectis*); see also Tomasi 2021: 13–26, 97–107; Riera 1994: 108 (*CIL* 6, 1258=*EDR*104280), 118–119.

been exposed on the front of this building, rather than hidden in the water channel. It is possible that this structure collapsed, leaving the reservoir in the open air, and its materials were used to build some of the villas in the area (Lodi 1996, 209-263).

However, it must be stressed that the inscription does not mention an aqueduct[20] and the reference to the building remains generic. It could be interpreted as a structure built from the foundations, but it is also possible that the intention was to indicate that the water supply system had been built from the source.

*Pomponius Cornelianus* is known from three other inscriptions, thanks to which we can outline his *cursus honorum* and his presence in Verona and the Veneto region. Two of these are dedicated to Jupiter, the Preserver, and come from Santa Maria in Stelle. One of them is lost (*CIL* V, 3243)[21]. The second, carved on an altar, is now in the Museo Lapidario Maffeiano in Verona (*CIL* V, 3254=EDR093827; Modonesi 1995, 30-31, n. 24)[22]. A third, found in Schio (*CIL* V 3106=*EDR*145645; Venturi 1825, 88; Franzoni 1975, 37, n. 13; Ghiotto 1997, 183-189; Ghiotto 2006, 69-82)[23] and carved on an altar, is dedicated to the Augustan *Nymphis* and *Lymphis*.

Thanks to these inscriptions we know that *Pomponius Cornelianus* was *consul*, *curator rerum publicarum* and received the title *clarissimus iuvenis*. There is also a connection with water, because at the beginning of his career, as a young senator, he contributed to the discovery (or restoration) of a spring near Schio (Vicenza), for which he donated an altar to the *Nymphae Lymphaeque Augustae* (Bassignano 1987, 323-324)[24]. It is also interesting to note his offering in favour of *Iuppier Conservator* - a worship particularly widespread in Verona (Bassignano 1987, 335) - as gift for the good health of the dedicant and his family. The involvement of the whole family is reflected in the inscription, which dates to the construction of the water supply system.

This makes it possible to identify *Pomponius Cornelianus* with the *consul suffectus* of the same name of 237 CE (*PIR*, III, p. 76, nn. 533–534)[25], or at least to date his activity in the Severan period. It is not clear whether the family originated from Verona or Vicenza, although the oldest inscription places the young *Pomponius* in the territory of Vicenza (Cenati, Gregori and Guadagnucci 2015, 199).

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[20] It is interesting to report on other people with the same *cognomen* (probably derived from the *nomen Cornelius*) who were involved in the construction of water supply systems: *P. Cornelius Cornelianus* was a manufacturer of lead pipes (*EDR*158985) and water distribution boxes (*CIL* XV, 7775 a-b=*EDR*141323, *EDR*141325) in *Castrum Novum* (Civitavecchia), and six members of the *Gens Cornelia* (*L. Cornelius Longus*, *M. Cornelius Avitus*, *L. Cornelius Longus*, *C. Cornelius Servinus*, and *M. Cornelius Cornelianus*), offered funds for the construction of the aqueduct of the *municipium Flavium Ebusum*, today's Ibiza (*CIL* II, 3663). See also Priuli 1986, 194-195; Bruun 1989, 337; Marì Casanova 2021, 2-5.

[21] To Jupiter *Optimus Maximus*, the Preserver, for the good health of *Publius Pomponius Cornelianus*, *Iulia Magia* and his sons *Iulianus* and *Magianus…* {*Iovi / Conservat(ori) pro salute / P(ubli) Pompon[i] / Corneliani et Iuliae / Magia[e] e[i]us et Iu[l]/ian[i] et [Magiani f(iliorum)] - - -]*}.

[22] To Jupiter *Optimus Maximus*, the Preserver, from *Publius Pomponius Cornelianus consul* and public administrator [*I(ovi) O(ptimo) M(aximo) / Conservatori / P(ublius) Pomponius / Cornelianus / consularis / curator / rerum / publicarum*].

[23] To the Nymphs and the Augustan Lymphae for the return of the waters, *Publius Pomponius Cornelianus*, a young senator, dedicated following a vow [*Nymphis Lymphisq(ue) / Augustis ob reditum / aquarum / P(ublius) Pomponius / Cornelianus c(larissimus) i(uvenis) / ut vovit.*]; Museo Naturalistico-Archeologico of Vicenza (inv. n. E1-62).

[24] Other similar texts come from *Ateste* (*CIL* V, 2476=*EDR*130474), from *Vicetia* (*CIL* V, 3184=*EDR*146340) and from *pagus Arusnatium* (*CIL* V, 3915=EDR112946).

[25] See also Eck 1980, 300, n. 76; Alföldy 1982, 345, n. 40; Breuer 1996, 266, V42; Franzoni 1975, 37, n. 13; Sartori 1960, 246-247.

We also know that his sons had similar careers. The eldest one, *Pomponius Iulianus*, was governor of the province of Arabia around 235-236 CE (*PIR* III, p. 77, nn. 543–544; CIG 4584 add. S. 1181)[26] and perhaps also became a *consul* like his father. The second son, *Pomponius Magianus*, was governor of Thrace under Gordian III between 241 and 244 CE (*PIR* III, p. 77, n. 549)[27] and may also have become a *consul*. It is not clear whether the inscription on the *consul Publius Pomponius Magianus* from Pozzuoli (*CIL* X, 8180=*EDR*169759) can be linked to him. Instead, *Pompon(ius) Iulianus* (*PIR* III, p. 77, n. 543)[28], *praefectus ducenarius* of the *Legio II Parthica*, must be linked to another branch of the family.

In conclusion, we can hypothesise an intervention of the family of *Cornelianii* for the construction of the water supply system in 3rd century CE. However, we cannot exclude the existence of an older system belonging to the same family, which probably owned some *praedia* in the valley.

### 3. Reasons for construction

We have outlined the main features of the structure of the *caput aquae* of the aqueduct of Santa Maria in Stelle and hypothesised its chronology, but one crucial point remains to be analysed: why did the *Cornelianii* family decide to build this infrastructure?

Hugo Brandenburg (2014, 239–258) has suggested that the complex was a private water supply, later transformed into an *oratorium* of Christian devotion, perhaps decorated in imitation of some public buildings, with the aim of celebrating in a private context the splendour of a cult that had initially manifested itself only on the initiative of the Empire. The scholar places the intervention in a context suspended between private initiative and imitation of imperial initiative (Brandenburg 2014, 239). *Cornelianus*, owner of several *praedia* in the valley, would have decided to build a water supply system for agriculture, but perhaps also to embellish his villa with a nymphaeum or *balneum*[29]. Moreover, the presence of all the members of the *Cornelianii* family in the inscription seems to confirm the private nature of the building.

The aqueduct reached a property of the *Cornelianii*, which could not have been far from the source. The reconstruction of the aqueduct's path leads to Vendri (Fig. 11, B). Like the spring itself, this place belonged to the Giusti family in the 15th century CE, and there was a villa with a well from which spring water was drawn[30]. It is therefore plausible to assume that the pre-existing channel was reused, and that the arrival point coincides with the site of the villa of the *Cornelianii*. There is no evidence of villas in the Pantena valley (Franzoni 1987, 93), but some remains from the Roman period can be identified in Vendri: two altars with a crowning *foculus*, part of the front of a sarcophagus and an altar dedicated to *Iuno* (*CIL* V, 3233)[31]. We have

[26] See also: Breuer 1996, 266-267, V43.

[27] See also: Breuer 1996, 267, V44.

[28] See also CIL VI, 793=*EDR*138686; see Breuer 1996, 267-268, V45.

[29] For comparisons of aqueducts in the *suburbium*, see: Thomas and Wilson 1994, 139-196; Wilson 1999, 314-331; Dell'Era 2000, 249-262; Taylor 2000, 57-61; Bruun 2003, 485-501; De Franceschini 2005, 144-156, 163-166, 199-202, 209-214, 222-236; Marzano 2007, 165-171; Munzi 2007, 215-229; Bannon 2009; Viitanen and Korhonen 2014, 249-252; Bruun 2015, 132-150; Sánchez 2015, 289-299; Gangale Risoleo 2020, 25-40. See also Bruun 2009, 575-604; Maganzani 2012, 153-157.

[30] ASVR: *Campagna famiglia*, mappe e disegni, 155, 'Irrigazione possessi Giusti (1598 lug. 02)'; see Gangale Risoleo 2018, 270.

[31] To the holy *Juno Luna Regina*, *P. Vitullius Philologus*, *sexvir augustalis*, offered, as requested [*Iun(oni) Lun(ae) reg(inae)*

a good comparison in nearby Montorio (Fig. 1, D), where a villa–dated between the middle and late imperial period–was built on the route of an aqueduct that supplied a *balneum* (Capuis, et. al. 1990, 135; Gangale Risoleo 2017, 238-239).

However, the need to celebrate the construction of the building with an inscription perhaps underlines that the private initiative had an impact on the surrounding area[32]. We can therefore assume that the water supply system provided water not only to the *Cornelianii* family, but to all the inhabitants of the valley, and that the same *balneum* that is supposed to belong to the villa, was perhaps sometimes made available to the people of the *pagus*, where the family properties were located (Maréchal 2021, 211-230)[33].

Worship also had an important communitarian function, but if we consider the attested rituals within the Pantena Valley (Fig. 3), we can only gather some indications from inscriptions and toponymy (Franzoni 1991, 84-87). These indicate the presence of female cults (*Venus*, *Iuno* and *Matrona*) and some dedications to the *Lares*. An exception to this is Vendri (Fig. 3, 6), where the end of the aqueduct has been traced. The presence of a *vicus Veneris* since 832 CE (Franzoni 1991, 86) and an old note led to the hypothesis that the remains of a temple dedicated to Venus may be located underneath the local church of Vendri, dedicated to San Zeno (Fig. 11, D) (Orti Manara 1848, 45; Antolini 2013). Unfortunately, there are no archaeological remains that can be used to confirm this reconstruction.

Returning to Santa Maria in Stelle, it can be postulated that the complex also had a ritual function (maybe also connected to *Venus*?) which may have been in continuity with the subsequent developments, such as the establishment of the complex as a place of Christian worship in the 3rd century CE. Furthermore, the discovery of an epigraphic cylindrical altar at Santa Maria in Stelle[34] has been interpreted as an indication to define the sacred perimeter of the complex (Orti Manara 1848, table II; Franzoni 1991, 96) (Fig. 12).

Hypothetical ideas for this interpretation can be linked to the shape of the last dropshaft (Fig. 9, A and B) and its comparison with a detail from the so-called 'pátera de Otañes'[35] (Iglesias and Ruiz Gutiérrez 2012, 349-365; Iglesias and Ruiz Gutiérrez 2014, 277-294) (Fig. 9, C). This was found in Cantabria and depicts different scenes around a spring that, thanks to an inscription, are known to be *Salus Umeritana*. The basin in the centre of the scene has a similar shape to that of Santa Maria in Stelle, and the poor man next to it, who is barefoot and wearing a short tunic, filling a jar, has been interpreted as collecting healing waters (Iglesias and Ruiz Gutiérrez 2014: 285).

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*sacr(ae) / P. Vitullius / Philologus / VIvir Aug(ustalis) / (ex) imperio (posuit)*]; the inscription is described in Verona in 16th century by Francesco Caroto (Franzoni 1987, 93) and has now been walled up in the villa Giusti-Melloni (Antolini 2013, 7-9). The discovery of three parallelepipedal elements in the floor of the basement of the villa has been linked to an ancient structure (Antolini 2013, 7, footnote 1). See also Franzoni 1991, 86-87 and Capuis, et al. 1990, 133-134.

32 Bruun (2015, 141) suggests another interpretation for this kind of initiative. He thinks that behind the high cost of building a private aqueduct may lie the aim of selling water to the neighbourhood, even giving away part of the land needed to trace the aqueduct in exchange for water.

33 It could be identified as a *rusticum balneum* as attested by Columella (*Rust.* 1.6.19–20).

34 The altar is currently housed in the Museo Archeologico al teatro romano di Verona, and another identical specimen is kept on private property.

35 The inscription on the front links to a place called 'Salus Umeritana' which is supposed to be in the surroundings of *Flaviobriga* (Iglesia and Ruiz Gutiérrez 2014, 285-292). It is also interesting to note that on the back of the patera there is a graffito, made in a second phase, that links the object to *Lucius P. Cornelianus* (Iglesias and Gutiérrez 2014, 287-290).


*Figure 12 - The anepigraphic cylindrical altar found at Santa Maria in Stelle: A: a drawing from the 19th century (adapted from Orti Manara 1848, table II, n. 9); B: a photograph of the altar inside the Museo Archeologico al Teatro Romano di Verona (photo by the author).*

We cannot exclude a dedication to *nymphae*, which is very common for the sacred value attached to running water in antiquity (Riera 1994, 119; Corbier 1984, 242; Petraccia and Tramunto 2013, 175-191; Bassani 2019, 17-19)[36], and which we have already linked to *Cornelianus*. Among other things, it should be stressed that *Lympha* has a direct link with agriculture and the success of the harvest (Bassignano 1987, 323). It is also plausible to assume that all these functions coexisted, making the spring multifunctional and a centre of attraction for the valley. In this sense, an interesting comparison could be made with a monument erected in the late republican period by the *Gens Allia* at Ponte Rovescio (Chiusi, ancient *Clusium*)[37], along the route of the *Via Cassia* and perhaps dedicated to a water cult, which, according to a bronze lamina, was active at least until the 1st century CE (*CIL* XI, 2097)[38].

## 4. Conclusion

In conclusion, although the evidence is limited, it is possible to hypothesise that the aqueduct of Santa Maria in Stelle was located in a *suburbium*, a distance from Verona, but well integrated with the social and political dynamics of the town. This *suburbium* was populated by *villas* belonging to members of the local elite, integrated into the rural social dynamics, and using water both as a symbol of status and as a means of fidelity to the territory, because we must not forget that most of the water was used for agriculture (Bruun 2015, 136).

## Abbreviations

ADSVR: Archivio della società Acque Veronesi s.c.a r.l.
ASAVR: Archivio Soprintendenza Archeologica del Veneto, Nucleo operativo di Verona.
ASVE: Archivio di Stato di Venezia.
ASVR: Archivio di Stato di Verona.

[36] In Rome, the *statio aquarum* was placed under the protection of the nymph Iuturna.

[37] The discovery of some inscriptions (*NSc* 1876: 35-36; *CIL* XI, 7119 a-f; *CIL* XI, 7207), albeit incomplete, allow scholars to link the monument to the *Gens Allia*. See Menichetti 1992, 362, n. 6.5; Paolucci 2005, 71-75; Faralli 2012, 115-118; Giontella 2012, 123-124; but also Pack 1988, 33, 83-84; Raimondi 2001, 111-113; Chellini 2002, 48.

[38] *Sentius Lucilianus* erected as a gift for the *Nymphae* of the Ogulnia spring {*Sentius [L] ucilianus Nymphis aq[uae] Ogulni/ae d(onum) p(osui)it*}; it is in the National Etruscan Museum of Chiusi (inv. 62941). See also Menichetti 1992: 362, n. 6.4; Pack 1988: 53; Paolucci 2005: 27; Paolucci 2023: 60–61.

BCVR: Biblioteca Civica di Verona.
BSVP: Biblioteca del Seminario Vecchio di Padova.

**Bibliography**


Alarcão, J., and Etienne, R. eds. 1977. *Fouilles de Coninmbriga, I, L'architecture.* Paris: E. de Broccard.

Alloro, L., and Pasa, M., eds 2003. *Il castello di Montorio. Analisi storica, socio-economica e architettonica.* Montorio: Lite S.r.l.

Alföldy, G. 1982. 'Senatoren aus Norditalien. Regiones IX, X und XI', in *Epigrafia e ordine senatorio*, vol. 2, atti del convegno (Roma 1981), 309–368. Roma: Edizioni di storia e letteratura.

Antolini, L. 2006[2]. *L'ipogeo di S. Maria in Stelle: Guida storico-artistica.* Montorio: Tipolitografia Baschera Luigi SAS.

Antolini, L. 2013. *La chiesa di San Zeno a Vendri.* San Giovanni Lupatoto: Edizioni Stimmgraf.

Antolini, L. 2020. *L'ipogeo di Santa Maria in Stelle in Valpantena.* Vago di Lavagno: Editrice La Grafica.

Bannon, C.J. 2009. *Gardens and Neighbors. Private Water Rights in Roman Italy.* Ann Arbor: University of Michigan Press.

Bassani, M. 2019. 'Shrines and Healing Waters in Ancient Italy. Buildings, Cults, Deities', in *Rethinking the Concept of 'Healing Settlements': Water, Cults, Construction and Contexts in the Ancient World*, edited by Bassani M., Bolder-Boos M. and Fusco U., 9-20. Oxford: Archaeopress.

Bassignano, M. S. 1987. 'La religione: divinità, cultura, sacerdozi', in *Il Veneto nell'età romana I. Storiografia, organizzazione del territorio, economia e religione*, edited by Buchi E.,311–376. Verona: Banca Popolare di Verona.

Basso, P., Bruno, B., and Grossi, P. 2019. 'Introduzione. Le strade romane del territorio e della città', in *Verona e le sue strade. Archeologia e valorizzazione*, edited by Basso P., Bruno B., and. Grossi P.,17-34. Sommacampagna: Cierre Edizioni.

Biondani, F. Corrent, G., and Salzani, L. 2000. 'Montorio (Verona). Ricerche di superficie sul Colle del castello'. *Quaderni di Archeologia del Veneto* 16, 61-62, 73-74.

Bisconti, F., and Braconi, M. 2012. 'L'ipogeo di S. Maria in Stelle: il programma iconografico e le vie significative', in *La pittura romana nell'Italia settentrionale e nelle regioni limitrofe*, Antichità Altoadriatiche, XLI, edited by Oriolo F., and Verzàr M., 141-148, 389-391. Trieste: Editreg.

Brandenburg, H. 2014. *Das Hypogaeum von S. Maria in Stelle (Verona) und die Bildaustattung christlicher Kultbauten des 4. und frühen 5. Jahrhunderts,* in *Otium cum dignitate, Festschrift für Angelika Geyer zum 65. Geburtstag, Studien zur Archäologie und Rezeptionsgeschichte der Antike*, edited by Graen D., Rind M., and Wabersich H.,239–258. Oxford: BAR Publishing.

Breuer, S. 1996. *Stand und status. Munizipale Oberschichten in* Brixia *und Verona*. Bonn: Habelt.

Bruno, B., and Cavalieri Manasse, G. 2022. 'Verona in destra d'Adige prima della fondazione del *municipium*', in '*"Metalli, creta, una piuma d'uccello..." Studi di archeologia per Angela Ruta Serafini'*, edited by Gamba M., Gambacurta G., Gonzato F., Pettenò E., and Veronese F., 43-57. Mantova: SAP Libri.

Bruun, C. 1989. *The Water Supply of Ancient Rome: A Study in Imperial Administration*. Helsinki: Finnish Society of Sciences and Letters.

Bruun, C. 2003. 'Le fistule aquarie e i proprietari terrieri nel suburbium di Roma', in *Suburbium. Il suburbio di Roma dalla crisi del sistema delle ville a Gregorio Magno*, edited by Pergola P., Santangeli Valenzani R., and Volpe R., 485-501. Roma: École francaise de Rome.

Bruun, C. 2009. 'Water legislation in the Ancient World (c. 2200 B.C. – c. A.D. 500)', in *Handbook of Ancient Water Technology*, edited by Wikander Ö., 539-604. Leiden: Brill.

Bruun, C. 2015. 'Water Use and Productivity in Roman Agriculture: Selling, Sharing, Servitudes', in *Ownership and Exploitation of Land and Natural Resources in the Roman* World, edited by Erdkamp P., Verboven K., and Zuiderhoek A., 132-149. New York: Oxford University Press.

Buchi. E. 1987. 'Porta Leoni e la fondazione di Verona romana'. *Museum Patavinum* 5 (1): 13-45.

Buonopane, A. 1987. 'Acquedotti e terme', in *Il Veneto nell'età romana I. Storiografia, organizzazione del territorio, economia e religione*, edited by Buchi E., 292-294. Verona: Banca Popolare di Verona.

Capogrossi Colognesi, L. 1966. *Ricerche sulla struttura delle servitù d'acqua in diritto romano*. Milano: Giuffrè Editore.

Capuis, L., Leonardi, G., Pesavento Mattioli, S. and Rosada, G. 1990. *Carta archeologica del Veneto*, vol. 2, *Carta d'Italia IGM 1: 100.000. Fogli 35-48-49-62-63-75*. Modena: Franco Cosimo Panini.

Cavalieri Manasse, G. 2018. 'Verona: la città oltre le mura'. *Anales de Arqueologia Cordobesa* 29: 41-84.

Cenati, C., Gregori, G.L., and Guadagnucci, A. 2015. 'Abitare in campagna in età romana: indizi epigrafici dai territori di *Brixia*, Verona e *Mediolanum*'. *Studi Classici e Orientali* 61 (1): 187-240.

Chanson, H. 2000. 'Hydraulics of Roman Aqueducts: Steep Chutes, Cascades and Dropshafts'. *American Journal of Archaeology* 104: 47-72.

Chellini. R. 2002. *Acque Sorgive Salutari e Sacre in Etruria (Italiae Regio VII). Ricerche Archeologiche e di Topografia Antica*. Oxford: BAR Publishing.

Corbier, M. 1984. 'De *Volsinii* a *Sestinum*: *cura aquae* et évergétisme municipal de l'eau en Italie'. *Revue des études latines*, 62: 236-274.

Dalla Barba Brusin, D. 1977. 'Un probabile 'aedes catechizandorum' nell'ipogeo di S. Maria in Stelle in Val Pantena'. *Aquileia Nostra* 48: 258-272.

De Angelis, D. 2002. 'La necropoli di Ponte Florio (Montorio-Verona)', in *Preistoria veronese. Contributi e aggiornamenti,* edited by Fasani L., Salzani L., Aspes A., and Brogiolo. G., 188. Verona: Museo Civico di Storia Naturale.

De Zuccato, G., and Checchi, A. 2019. 'Un'antica strada a Grezzana: dati archeologici', in *Verona e le sue strade. Archeologia e valorizzazione*, edited by Basso P., Bruno B., and. Grossi P., 145-154. Sommacampagna: Cierre Edizioni.

Del Chicca, F., ed. 2004. *Frontino. De aquae ductu urbis Romae*. Roma: Herder.

Dell'Era, F. 2000. 'Villa e paesaggio: gli impianti idraulici'. *Bullettino della Commissione Archeologica Comunale di Roma* 101: 249-262.

Dessales, H. 2013. *Le partage de l'eau: fontaines et distribution hydraulique dans l'habitat urbain de l'Italie romaine*. Roma: École Française de Rome.

David, M. and Maccani, C. 2007. 'I pavimenti musivi dell'ipogeo tardoantico di Santa Maria in Stelle (Verona). Problemi di documentazione e interpretazione', in *Atti del XII Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Moisaico (AISCOM) (Padova-Brescia, 14–17 febbraio 2006)*, edited by Angelelli C., and Paribeni A., 13-23. Tivoli: Scripta manent.

De Franceschini, M. 2005.*Ville dell'agro romano*. Roma: L'Erma di Bretschneider.

Dorigo, W. 1968. 'L'ipogeo di Santa Maria in Stelle in Val Pantena (Verona)'. *Saggi e memorie di storia dell'arte* 6: 7, 9-31, 151-161.

Eck, W 1980. 'Die Präsenz senatorischer Familien in den Städten des Imperium Romanum bis zum späten 3. Jh.', in *Studien zur antiken Sozialgeschichte. Festschrift Friedrich Vittinghoff*, edited by Eck W., Galsterer H., and Wolf H., 283-322. Köln: Böhlau.

Faralli, S. 2012. 'L'allestimento dell'atrio del Museo di Chiusi: il monumento della Gens Allia', in *Il Museo Nazionale Etrusco di Chiusi tra storia e collezioni*, edited by Salvini M., 115-119. Siena: Salvietti & Barabuffi Editori.

Feliciano, F. 1465. *Soli deo honor laus et gloria. Opus Patavii incoeptum, Bononiae absolutum in hanc formam redigere fec. Io. Marchanova ar. et me. doc. Pat. anno gratiae 1465 kl. Octobris* (Modena, Biblioteca Estense – Universitaria, Estense, *ms.*, Lat. 992=alfa.L.5.15, Iohannes Marcanova Collectio antiquitatum 15. sec.).

Ferrari, S., ed. 2003, *Ville venete: la Provincia di Verona*. Venezia: Marsilio.

Franzoni, L. 1975. *Edizione archeologica della carta d'Italia al 100.000. Foglio 49: Verona*. Firenze: Istituto Geografico Militare.

Franzoni, L. 1987. 'Il territorio veronese', in *Il Veneto nell'età romana II. Note di Urbanistica e di archeologia del territorio*, edited by Cavalieri Manasse G., 59-105. Verona: Banca Popolare di Verona.

Franzoni, L. 1991. 'La presenza romana. Il Ninfeo di Santa Maria in Stelle', in *Grezzana e la Valpantena*, edited by Turri E., 84-103. Grezzana: Pro loco, Comune di Grezzana.

Gabrielli, A. 2023. '<<Altri li credono o barbarici o romani>>: l'archivio De Stefani e le indagini archeologiche nella bassa Valpantena'. *Archeologia Veneta*, 46: 145-163.

Gangale Risoleo, D. 2017. 'Gli acquedotti romani di Verona'. *Atlante tematico di Topografia Antica* 27: 229-256.

Gangale Risoleo, D. 2018. 'L'acquedotto romano di S. Maria in Stelle a Verona: una concessione privata per la captazione delle acque?', in *Cura aquarum. Adduzione e distribuzione dell'acqua nell'antichità*. Antichità Altoadriatiche, LXXXVIII, edited by Cuscito G., 265-283. Trieste: Editreg.

Gangale Risoleo, D. 2020. 'Water for the Villas: Water Distribution for Production Processes', in *The Role of Water in Production Processes in Antiquity*, edited by Sánchez López E. H., 25-40. Heidelberg: Propylaeum.

Gangale Risoleo, D. 2022. 'Verona and the Water: the History of a Tangible Urban Relationship', in *Aquam Ducere IV*, atti del convegno di studi internazionale "L'acqua e la città in età romana" (Feltre, 3–4 novembre 2017), edited by Tamburrino E., 143-156. Rasai di Seren del Grappa: Edizioni DBS.

Ghiotto, A. R. 1997. 'La dedica *Nymphis Lymphisque Augustis* dalla chiesa di S. Martino alle Aste presso Schio'. *Quaderni di Archeologia del Veneto* 13: 183-189.

Ghiotto, A. R. 2006. 'La figura di *Publius Pomponius Cornelianus* tra Schio e Verona', in *Studi in memoria di Adriano Rigotti*, edited by Allegri M., 69-82. Rovereto: Osiride.

Giontella, C. 2012. '...nullus enim fons non sacer...'. *Culti idrici di epoca preromana e romana (regiones VI-VII)*. Pisa: Fabrizio Serra Editore.

Guidi, A., Candelato, F. and Saracino, M. 2008. 'Il popolamento del territorio veronese durante l'età del ferro', in *I Veneti antichi: novità e aggiornamenti. Atti del convegno di studio (Isola della Scala 2005)*, 15-45. Sommacampagna: Cierre Edizioni.

Gros, P., ed. 1997$^{2}$. *Vitruvio. De Architectura,* vol. 2, translation and comment of Corso, A., and Romano, E. Torino: Giulio Einaudi Editore.

Iglesias Gil, J. M., and Ruiz Gutiérrez, E A. 2012. 'Cultos, supersticiones y usos terapéuticos de las aguas en la Hispania romana: manifestaciones en el área central de la Cordillera Cantábrica', in *L' eau: usages, risques et représentations dans le Sud-Ouest de la Gaule et le Nord de la péninsule Ibérique, de la fin de l'âge du Fer à l'Antiquité tardive (IIe S.a. C.-VIe S.p.C.)*, edited by Bost J.P., 349-365. Bordeaux: Aquitania.

Iglesias Gil, J. M., and Ruiz Gutiérrez, E. A. 2014. 'Flaviobriga y el santuario de Salus Umeritana', in Mangas Manjarrés, J., and Novillo López, M. A., eds, *Santuarios suburbanos y del territorio de las ciudades romanas*, 277-294. Madrid: Universidad Autonoma de Madrid.

Linington, R. E., and Falamaki, M. 1970. 'Prospezioni soniche ed elettriche a S. Maria in Stelle, Verona'. *Prospezioni archeologiche* 5: 77-84.

Lodi, S. 1996. 'Lo *Iustianum*: una villa umanistica nei pressi di Verona'. *Italia medioevale e umanistica* 39: 209-263.

Lusuardi Siena, S., and Baratto, C. 2013. 'Sguardo sull'edilizia religiosa e civile nella *Venetia et Histria* in età tardoantica', in, *Storia dell'Architettura nel Veneto. L'età romana e tardoantica*, edited by Basso P., Cavalieri Manasse G., 166-217. Venezia: Marsilio.

Maganzani, L. 2012. *Disposizioni in materia di acque*, in *Revisione ed integrazione dei Fontes Iuris Romani Anteiustiniani (FIRA). Studi preparatori, vol. I: Leges*, edited by Purpura G., 44-216. Torino: Giappichelli.

Malnati, L., Salzani, L., and Cavalieri Manasse, G. 2004. 'Verona: la formazione della città', in *Des Ibères aux Venètes*, atti del convegno (Roma, 2000), edited by Agusta-Boularot S. and Lafon, X., 347-378. Roma: École francaise de Rome.

Maréchal, S. 2021. 'By Invitation Only. Accessibility of Villa Baths in the Roman North-west'. *Oxford Journal of Archaeology* 40 (2): 211-230.

Mari, Z. 1991. 'Nuovi cippi degli acquedotti aniensi. Considerazioni sull'uso dei cippi acquari'. *Papers of the British School at Rome* 59: 151-175.

Marì Casanova, J. J. 2021. 'El acueducto romano de Ebesus'. *Mayurqa*, 3: 1-17.

Marino, L., and Galante, D., 2008. 'Nuovi rilievi all'ipogeo di S. Maria in Stelle in Valpantena'. *Restauro Archeologico* 1: 47-52.

Marzano, A. 2007. *Water Supply*, in *Roman Villas in Central Italy: A Social and Economic History*, edited by Marzano A., 165-171. Leiden: Brill.

Menichetti, M. 1992. 'Foglio 119 Massa Marittima', in *Atlante dei siti archeologici della Toscana*, 277-296. Roma: L'Erma di Bretschneider.

Modonesi, D. 1995. *Museo Maffeiano. Iscrizioni e rilievi sacri latini*. Roma: L'Erma di Bretschneider.

Munzi, M. 2007. 'Acquedotti municipali e privati', in *I giganti dell'acqua: acquedotti romani del Lazio nelle fotografie di Thomas Ashby (1892–1925)*, edited by Le Pera S., and Turchetti R., 215-229. Roma: Palombi.

Muzzioli, M. P. 2010. 'Le ricerche sui resti della centuriazione cinquant'anni dopo'. *Atlante Tematico di Topografia Antica* 20: 7-49.

O'Neill, E. 2014. 'L'acquedotto di Traiano tra il ninfeo di S. Fiora e il lago di Bracciano. *Atlante Tematico di Topografia Antica* 24: 197-214.

Orti Manara, G. 1848. *Di un antico monumento dei tempi romani che trovasi nella terra delle Stelle presso Verona*. Verona: Lit. Guelmi.

Pace, P. 2010[2]. *Acquedotti di Roma e il De Aquaeductu di Frontino*. Roma: Betmultimedia.

Pack, E. 1988. '*Clusium*: ritratto di una città romana attraverso l'epigrafia', in *I Romani di Chiusi*, edited by Paolucci G., Roma: Multigrafica editrice.

Paolucci, G. 2005. *Documenti e memorie sulle antichità e il Museo di Chiusi*. Pisa: Istituti Editoriali e Poligrafici Internazionali.

Paolucci, G. 2023. 'Tabella in lamina di bronzo da Ponte Rovescio, Chiusi', in *Gli Dei ritornano. I bronzi di San Casciano*, edited by Osanna M., and Tabolli J., 60-61. Roma: Treccani.

Peebles, B.M. 1962. 'A Displaced Manuscript Located, the Writings Surveyed', in *Studies in Pietro Donato Avogaro of Verona*, edited by Avesani R., and Peebles B. M, 1-47. Padova: Editrice Antenore.

Petraccia, M. F. and Tramunto, M. 2013. ‘Il termalismo curativo nei testi epigrafici: il caso delle Ninfe/Linfe’, in Aquae Salutiferae. *Il termalismo tra antico e contemporaneo*, atti del convegno internazionale (Montegrotto Terme, 6–8 settembre 2012), edited by Bassani M., Bressan M., and Ghedini F., 175-191. Padova: Padova University Press.

Pighi, A. 1903. *Santa Maria in Stelle e il così detto Panteon. Brevi cenni storici*. Legnago: Tipografia Marcati.

Priuli, S. 1986. ‘Le iscrizioni sulle *fistulae*’, in *Il trionfo dell’acqua. Acque e Acquedotti a Roma. IV sec. a.C. – XX sec.* (catalogo della mostra, Roma, 31 ottobre 1986–15 gennaio 1987), 187-195. Roma: Paleani editrice.

Quilici, L. 2009. ‘La Madonna della Fiora presso Manziana. La scoperta del *caput aquae* dell’acquedotto di Traiano’. *Orizzonti* 10: 455-458.

Raimondi, R. 2001. ‘Il territorio della Valdichiana occidentale in età etrusca e romana’. *Atlante Tematico di Topografia Antica* 10: 109-125.

Riera, I. 1994, ed., *Utilitas necessaria. Sistemi idraulici nell’Italia* romana. Milano: Progetto quarta dimensione.

Salzani, L. 1996. ‘Ponte Florio (Verona)’, in *Dalla terra al museo*, catalogo della mostra, edited by Salzani L., Belluzzo G., 295-297. Legnago: Fondazione Fioroni.

Sánchez, E. 2015. ‘Erogationes extra urbem in Iberian aqueducts: additional evidence for irrigation in Roman Hispania?’. *Water History* 7: 289-299.

Sartori, F. 1960. *Verona romana. Storia politica, economica, amministrativa*, in *Verona e il suo Territorio*, I, 161-259. Verona: Istituto per gli Studi Storici Veronesi.

Sherwood, A.N., Nikolic, M., Humphrey, J. W., and Oleson, J.P. 2020[2]. *Greek and Roman Technology. A Sourcebook of Translated Greek and Roman Texts*. London: Routledge.

Taylor, R. 2000. *Public Needs and Private Pleasures: Water Distribution, the River Tiber and the Urban Development of Rome*. Roma: L’Erma di Bretschneider.

Thomas, R., and Wilson, A. 1994. ‘Water supply for roman farms in Latium and South Etruria’. *Papers of the British School at Rome* 62: 139-196.

Tölle-Kastenbein, R. 1993. *Archeologia dell’acqua: la cultura idraulica nel mondo classico*. Milano: Longanesi.

Tomasi, P. 2021. More urbico lavatur. *Epigrafia termale delle regiones VIII e VII*. Pavia: Pavia University Press.

Toynbee, J.M.C. 1970. ‘The Early-Christian Paintings at Santa Maria in Stelle Near Verona’, in *Kyriakon-Festschrift J. Quasten*, vol. II, 648-653. Münster: Verlag.

Trevor Hodge, A. 2002[2]. *Roman Aqueducts & Water Supply*. London: Duckworth.

Venturi, G. 1825. *Compendio della storia sacra e profana di Verona*. Verona: Tip. Pietro Bisesti.

Viitanen, E.M., and Korhonen, K. 2014. ‘Producers, Owners, Lead Pipes and Water in Context: the Practice of Stamping Lead Pipes in the Surrounding of Rome’, in *Centro y periferia en el mundo clásico. Actas XVIII Congreso Internacional Arqueologia Clásica CIAC*, 249-252, Merida: Museo Nacional de Arte Romano.

Wilson, A. I. 1999. ‘Deliveries extra urbem: Aqueducts and the Countryside’. *Journal of Roman Archaeology* 12: 314-331.

Zuliani, F. 1974. ‘I frescanti di Santa Maria in Stelle’, in *Maestri della pittura veronese*, edited by Brugnoli P.,1-8. Verona: Banca Mutua Popolare di Verona.

Zanovello, P. 1997. ‘L’approvvigionamento idrico di Ateste’, in *Les aqueducs de la Gaule romaine et des régions voisines*, edited by Bedon R., 659-688. Limoges: Presses Universitaires de Limoges et du Limousin.

# Notes

# High resolution spatial documentation of Renaissance church interiors through multiple non-invasive survey techniques

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**Abstract**

The generation of spatially accurate point clouds through laser scanning, combined with the extraction of high amplitude Ground-Penetrating Radar (GPR) reflections provides a powerful tool to examine both the sub-surface and standing remains in a holistic 3D environment. This preliminary note describes the methodology and results from the examination of two Renaissance churches in central Italy where geophysical prospection and standing building survey have been successfully integrated to support a multidisciplinary study through non-invasive technologies.

**Keywords**

Laser scanning; Geophysical prospection; Ground-Penetrating Radar; Point cloud; Visualization

The study draws upon the investigation of two Renaissance churches in central Italy where a non-invasive approach was required to record both architectural elements and to examine the sub-surface of the buildings. The surveys were undertaken at the churches of Sant'Agostino (San Gimignano, Tuscany) and San Domenico (Città di Castello, Umbria) as part of a joint research project between the University of Cambridge and the British School at Rome (Cooper, Kay and Pomar, 2023). The project is addressing questions regarding the artistic and historical background of the investigated churches through the application of non-invasive archaeological survey techniques. Firstly, the study aims to determine the location of rood screens – architectural structures typical of the churches of the 12th and 13th centuries that divided the liturgical space and determined the visibility of artworks. These screens were removed during the Counter Reformation and are therefore poorly documented (Gilardi 2004; Cooper, 2017). Secondly, the study aims to better understand the original positioning of artworks as these would have been closely integrated with their architectural and liturgical settings (including masterpieces such as the 14th century altarpiece of Simone Martini at Sant'Agostino and the *Mond Crucifixion* of Raphael at San Domenico). Finally, the study investigated the potential traces of removed altars and the location of tombs. These questions have arisen as Italian Renaissance church interiors have been radically transformed over the centuries and conventional scholarship has focused upon building analysis and archival

*Figure 1 - Digital representation of the church of San Domenico (Città  di Castello) with the GPR dataset in point cloud format.*

documentation to achieve a reconstruction of the original aspect for a specific period. Therefore, the current state of scholarship remains dependent on a small corpus of artistic representations and a few excavations leaving many questions unanswered. In essence, art historical research in this area has reached an impasse. This project was therefore designed to offer an original and interdisciplinary solution to the problem.

Geophysical prospection is routinely used to study standing ecclesiastical buildings, with the majority of applications focused on the investigation of the subsurface for the identification of earlier structures[1]. Likewise, 3D laser scanning has become a conventional method for underpinning research, visualization and restoration projects in cultural heritage. The precise measurements and the highly-detailed graphic restitution achieved in terms of texture and the speed of data collection have made this technique, alongside photogrammetry, one of the most widespread for the documentation and critical analysis of complex architecture such as church interiors[2]. Through the combination of high-resolution Ground-Penetrating Radar (GPR) prospection and 3D recording[3], a digital environment can be constructed where the datasets can be analyzed in a point-cloud format (Fig. 1). This integrated approach permits a comprehensive assessment of the subsurface features together with the standing architecture[4].

1 See for example Bruzelius et al., 2018; Piro et al., 2020; Leucci et al., 2021; Campana et al. 2023.
2 For examples, see Bosman et al., 2020; Campana et al., 2010; Macher et al., 2015.
3 For a general bibliography of these techniques applied to archaeology see, among the others, Conyers 2004; Remondino 2011.
4 See also Bornik and Neubauer 2022 for the application of a similar methodological approach.

**Survey methodology**

The architectural complexity and sizable dimensions of the buildings required the investigation to draw upon multiple non-invasive techniques. The project followed the same workflow for the two case-studies. The data acquisition inside the churches was supported by a topographical survey using a robotic total station (Leica TS16). The total station was used to register black and white circular targets recorded in the laser scans and to establish a grid for the GPR survey. In both case studies, the interior total station survey was anchored to a series of exterior GPS points. Five topographical points were recorded outside the churches where there was satellite coverage, by both GPS and total station, to allow the subsequent conversion of the total station local system to real world coordinates. The laser scanning survey was conducted with a Leica RTC 360 with the resolution set at 6 mm at 10 m (35 setups at Sant'Agostino and 67 at San Domenico) to guarantee the generation of an accurate dense cloud as well as a manageable dataset. Data was processed in Cyclone Register 360, Cyclone Core and Cyclone 3DR. After georeferencing and cleaning of the point cloud, a triangular mesh was built with HDR texture[5] to achieve a real colour visualization of the model and a clear image of the detail of the architecture.

The GPR data (recorded with a single channel GSSI 400MHz antenna) was collected with a 0.25m line spacing in regular parallel traverses throughout the full interior of the churches. Data was processed in the software GPR-Slice. The processing included filtering of raw radargrams, slicing and gridding of data and compilation of a GPR volume. For the 2D visualization of the results, horizontal time-slices were exported for interpretation in a Geographic Information System (ESRI ArcMap). For the integration of GPR data within a 3D environment, 3D binary data was extracted from GPR-Slice as ASCII files (.xyzirgb) and imported as point clouds in the software Leica Cyclone 3DR. High amplitude anomalies were then isolated through intensity analysis (using the tool 'inspection value' provided in Cyclone 3DR) in order to visualize the sub-surface recorded features, such as walls and voids, together with the standing architecture.

The study of the church of Sant'Agostino also included photogrammetric documentation of the marble tombstones on the floor of the nave in order to obtain for these features a photographic quality higher than that provided by the laser scanner. The resulting orthophoto, extracted using the software Metashape, was analyzed alongside the GPR dataset to compare the position of the tombstone with the actual location of burials (Fig. 2).

This methodology illustrates how information can be captured using different instrumentation and then combined digitally to answer key research questions. Whilst the GPR survey provided information concerning the sub-surface, the laser scanning allowed the creation of a virtual 3D framework and structure for placing the features in their precise topographical context. The detailed model therefore provided an environment for assisting in the interpretation of the geophysical anomalies in relation to the standing structures.

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[5] The instrument used, a Leica RTC360, has integrated cameras which capture High Dynamic Range (HDR) imagery. After the scan acquisition, the instrument captures a sequence of photographs which can later be used for the real-world colour texture of the point cloud.

*Figure 2 - Digital representation of the interior of the church of Sant'Agostino with high amplitude GPR reflections in point cloud format together with photogrammetric renderings of the tombstones.*

## Church of Sant'Agostino, San Gimignano

The Church of Sant'Agostino was built just before 1300 and by the end of the 14th century it was a prestigious ecclesiastical centre (Razzi, 2014). The church has numerous burials in the floor of the nave and cloister, as well as purportedly a cemetery alongside the building. The interior walls of the church are decorated with magnificent frescoes of the 14th and 15th centuries. As previously noted, of importance to the research project is an altarpiece by the Senese artist Simone Martini, three sections of which are preserved at the Fitzwilliam Museum, Cambridge University. The original position of the polyptych - one of Martini's earliest works (c. 1317) - within the church is unknown and its connection with the burial of Beato Bartolo is subject to debate (Barana 2019; Cooper et al. 2024).

The GPR survey in the nave of the church revealed a far higher number of tombs than recorded in the archival record or which are identifiable through the tombstones today (Fig. 3). The survey identified an additional 15 tombs, whilst some of the tombstones were shown to no longer be in their original position due to the absence of underlying voids (Fig. 2). Some tombstones also had small cavities underneath, too small for inhumations and therefore were feasibly small ossuaries inserted into the pavement. Of interest is that whilst the visible tombstones are aligned with the major altar, other recorded tombs are oriented towards side altars. It is reasonable to consider that the greater the number of tombs that were oriented towards specific side altars, the greater the importance of these altars. This hypothesis may also assist in considering the potential location of artworks within the church. Some anomalies recorded along the perimetral wall of the church could indicate altar bases, although the interpretation is uncertain.


*Figure 3 - Results and interpretation of GPR data collected in the church of Sant'Agostino.*

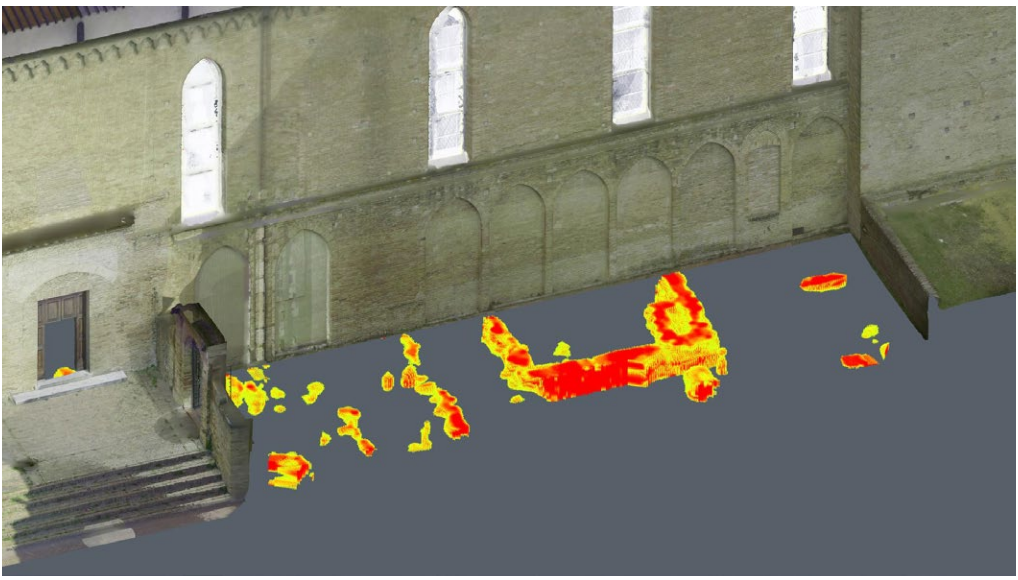

*Figure 4 - 3D visualization of linear high amplitude anomalies related to the potential lost chapel of San Martino (Church of Sant'Agostino).*

A further question raised by the archival research concerning the church was the existence of a chapel said to have belonged to the brotherhood of San Martino. A previous reconstruction had hypothesized this as an annex on the southern side of the church (Razzi, 2014; 30). The GPR data collected along the external southern wall revealed several interlocking high amplitude anomalies, in a regular rectangular position with a squared feature in the eastern corner which may be interpreted as the chapel (Fig. 3). The possibility of placing the point cloud of the high amplitude features alongside the laser scan data of the church revealed with precision the spatial relationship between the features and the church (Fig. 4).

**Church of San Domenico, Città di Castello**

The church of San Domenico was built on behalf of the Dominican order and was consecrated in 1426. The church is included in the group of buildings of the *Ordini mendicanti* with a unique nave and roof (Bozzoni 1982). The nave measures 64m in length and 19m in width. The church was home to several important masterpieces including the Martyrdrom of S. Sebastiano by Luca Signorelli (today in the Pinacoteca Comunale of Città di Castello) and the Mond Crucifixion by Raphael (today in the National Gallery, London).

Between 1662 and 1667 an internal cloister was added to the south side of the convent, enlarging a pre-existing small cloister, few elements of which are still visible. Several years later the body of Beata Margherita was transferred to the main altar which was rebuilt for the occasion (nowadays the Baroque altar is in the Chiesa delle Grazie, Città di Castello). In the 18th century important structural work occurred inside the church, which significantly altered its aspect. The gothic windows were closed, and the walls whitewashed.

The GPR survey covered the full width and length of the church, and at the eastern end detected a narrow linear anomaly crossing the nave (Fig. 5). When analyzed in a 3D environment, the linear feature (indicated in Fig. 6) can be seen lying off-set at the foot of an arch that divides the twin chapels. The geometry and position of the feature, creating a latitudinal partition of the nave, is compatible with the location of a rood screen that may have divided the space before being removed during the Counter-Reformation. To the east of the potential rood screen, a large area of high amplitude reflections was recorded (circled in Fig. 6). Whilst the recorded reflections indicate an area of disturbance, their proximity to the supposed rood screen suggests a feature of archaeological interest. Indeed, it is known that the areas beyond the screens were often occupied by structures such as choirstalls (Cooper, 2017).

Similarly to the survey at Sant'Agostino, whilst the location of two known tombs was recorded, three further anomalies with similar responses were recorded (Fig. 5). In particular, a probable tomb on a north-south orientation was located on the northern side, possibly aligned to face a removed side altar.

**Conclusion**

The combination of spatially referenced GPR data with 3D digital models of monuments recorded using laser scanning, as well as high-resolution photogrammetry, provides a unified and simultaneous spatial representation of the visible and hidden reality. In addition, this

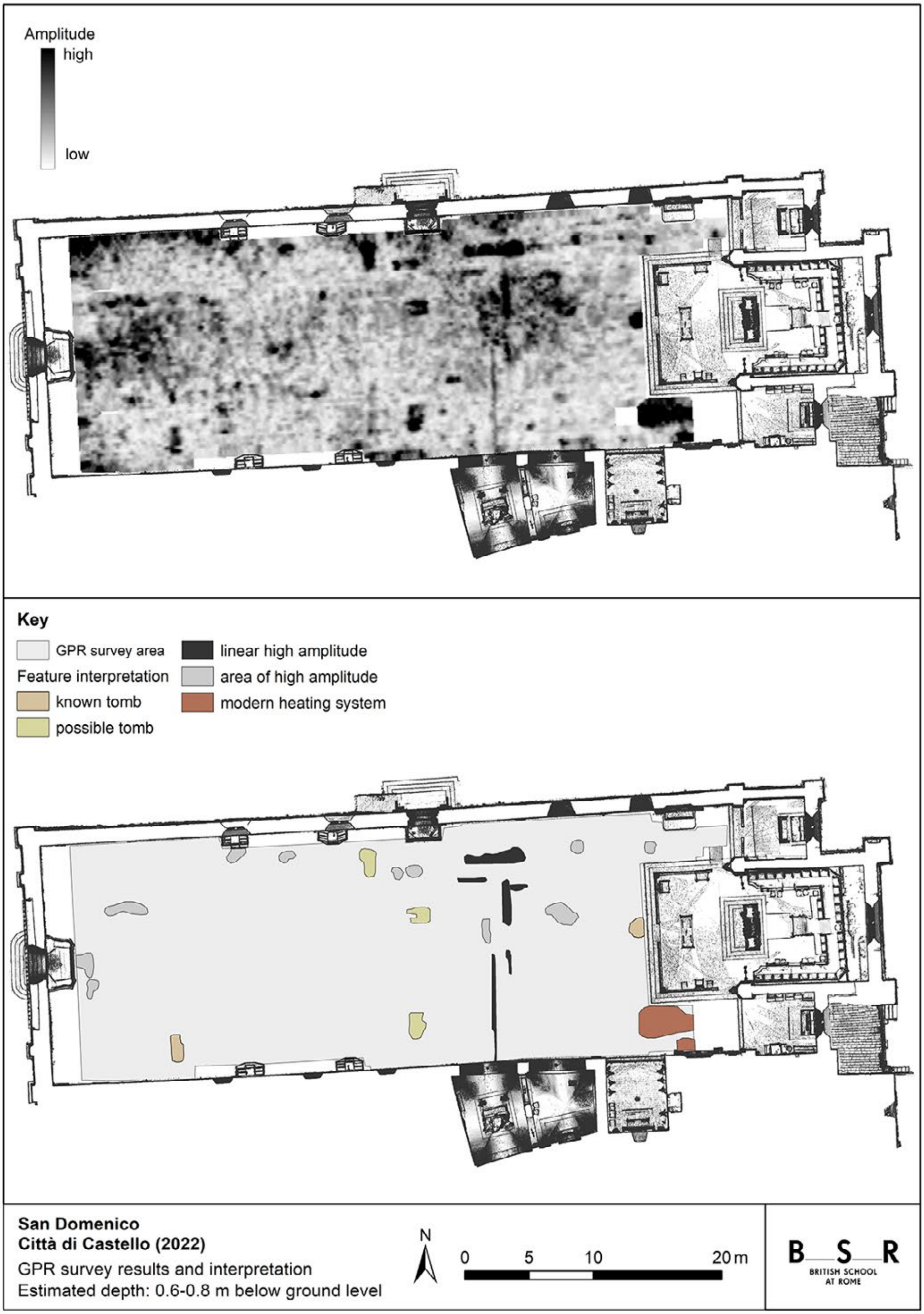


*Figure 5 - Plan of the Church of San Domenico extracted from the 3D model with the GPR results and interpretation.*

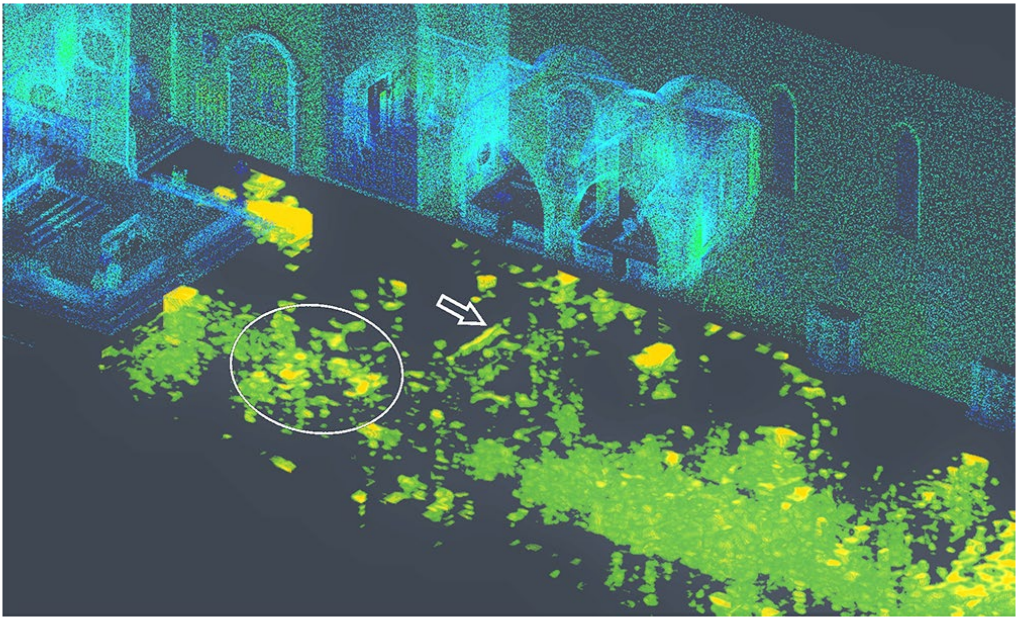

*Figure 6 - 3D visualization of point clouds of the church together with strong GPR reflections. The arrow indicates the linear anomaly that possibly locates the rood-screen, next to which it is circled an area of strong reflections.*

integrated approach permits a direct and diachronic evaluation of the various architectural phases of the buildings.

In these two examples, the multi-method approach to documentation assisted in answering key research questions concerning the original architecture and layout of the Renaissance churches. The GPR survey provided new information regarding previously unknown features, such as altar bases, unmarked tombs in the nave of the churches, as well as linear anomalies consistent with a destroyed chapel at Sant'Agostino and a rood screen in the church of San Domenico.

Managing the high amplitude GPR features as point clouds in a 3D digital environment enables the analysis of sub-surface features in relation to the position of existing architectural elements. For example, it was possible to observe that the hypothesized rood screen in the church of San Domenico was aligned with the pillar dividing the lateral chapels. Furthermore, a potential tomb was discovered in correspondence with a commissioned wall painting.

The documentation of all tombs in the nave of both churches and the accurate digital recording of the architecture will also assist in a holistic comprehension of the original layout and potential viewing positions towards altars, thus their detection can potentially reveal the location of those that no-longer exist. Although not conclusive, the data collected provides significant clues that must be considered when reflecting on the original location of the displaced prestigious artworks made for these churches.

Through the combination of building analysis conducted with multiple techniques combined with an archival study, a much greater understanding has been achieved of these mendicant

Renaissance churches in central Italy. The 3D digital environment generated within Cyclone 3DR has provided a powerful database which stores and manages several georeferenced 3D models and point clouds, where multiple information can be queried by the user. The platform allows for a much greater understanding of the GPR data through both a visual examination and analytical analysis, drawing more deeply on its 3D characteristics.

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## References

Bosman, Lex, Paolo Liverani, Iwan Peverett and Ian P. Haynes. 2020. 'Visualising the Constantinian Basilica'. In *The Basilica of Saint John Lateran to 1600*, edited by Lex Bosman, Ian P. Haynes and Paolo Liverani, 134-167. Cambridge: Cambridge University Press.

Bornik, Alexander, Wolfgang Neubauer. 2022. '3D Visualization Techniques for Analysis and Archaeological Interpretation of GPR Data'. *Remote Sensing* 14, 1709. https://doi.org/10.3390/rs14071709.

Bozzoni, Corrado. 1982. 'Le tipologie'. In *Francesco d'Assisi. Chiese e conventi*, edited by Renato Bonelli, 143-149, Milano: Electa.

Barana Mattia. 2019. 'Il polittico di Simone Martini per gli agostiniani di San Gimignano: nuovi quesiti e qualche risposta', *Prospettive. Rivista di storia dell'arte antica e moderna* 174: 3-17.

Bruzelius, Caroline, Andrea Giordano, Lucas Giles, Leopoldo Repola, Emanuela De Feo, Andrea Basso, Elisa Castagna. 2018. 'L'eco delle pietre: history, modeling and GPR as tools in reconstructing the choir screen at Sta. Chiara in Naples'. *Archeologia e Calcolatori Supplemento* 10: 81-103.

Campana, Stefano, Stefano Camporeale, Rossella Pansini, Simay Guzel, Maria Gabriella Carpentiero, Filippo Barsuglia, Gianluca Catanzariti, Gianfranco Morelli, Giulia Penno, Jacopo Tabolli, Valentina Trotta. 2023. 'SOtto Siena (SOS): verso nuovi paradigmi di archeologia urbana. *Siena e i terremoti. Biblioteca diArcheologia dell'Architettura* 8: 93-103 doi 10.36153/baa8.09.

Campana, Stefano, Fabio Remondino, Matteo Sordini and Alessandro Rizzi. 2010. 'Geomatics techniques for the 3D documentation and visualization of archaeological building'. In *Space, Time, Place. Third International Conference on Remote Sensing in Archaeology. 17th-21st August 2009, Tiruchirappali, Tamil Nadu, India*, edited by Stefano Campana, Maurizio Forte and Claudia Liuzza, 151-154. BAR International Series 2118. Oxford: Archeopress.

Conyers, Lawrence B. 2004. *Ground-Penetrating Radar for Archaeology.* Plymouth: AltaMira press.

Cooper, Donal. 2017. 'Recovering the lost rood screens of Medieval and Renaissance Italy'. In *The art and science of the church screen in Medieval Europe*, edited by Spike Bucklow, Richard Marks and Lucy Wrapson, 220-245. Woodbridge: The Boydell Press.

Cooper, Donal, Stephen Kay and Elena Pomar. 2023. 'Reassessing Italian Renaissance church interiors through non-invasive survey', in *Advances in on- and offshore archaeological prospection. Proceedings of the 15th International Conference on Archaeological Prospection*, edited by Tina Wunderlich, Hanna Hadler and Ruth Blankenfeldt, 155-158. Kiel: Universitätsverlag Kiel University Publishing.

Cooper, Donal, Stephen Kay and Elena Pomar. 2024. "Artworks, Archives, and Non-Invasive Archaeology: An integrated approach to reconstructing the church interior of S. Agostino, San Gimignano". In *Analecta Augustiniana*, LXXXVII: 323-342.

Gilardi, Costantino G. 2004. 'Ecclesia laicorum e ecclesia fratrum: luoghi e oggetti per il culto e la predicazione secondo l'Ecclesiasticum Officium dei Frati Predicatori'. In *Aux origines de la liturgie dominicaine: le manuscrit Santa Sabina XIV L 1 (Collection de l'École Française de Rome; 327)*, edited by Leonard E. Boyle and Pierre-Marie Gy, 379-443. Rome: École française de Rome.

Leucci, Giovanni, Lara De Giorgi, Immacolata Ditaranto, Ilaria Miccoli and Giuseppe Scardozzi. 2021. 'Ground-Penetrating Radar prospections in Lecce cathedral: New data about the crypt and the structures under the church', *Remote Sensing* 13 (9) MDPI, 1692.

Macher, Hélène, Pierre Grussenmeyer, Charles Kraemer and Samuel Guillemin. 2015. 'Overview of 3D documentation data and tools available for archaeological research: case study of the Romanesque church of Dugny-Sur-Meuse (France)'. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *XL*: 323-330.

Piro, Salvatore, Ian P. Haynes, Paolo Liverani and Daniela Zamuner. 2020. 'Ground-Penetrating Radar survey in the Saint John Lateran Basilica Complex'. In *The Basilica of Saint John Lateran to 1600*, edited by Lex Bosman, Ian P. Haynes, Paolo Liverani, 52-70. Cambridge: Cambridge University Press.

Razzi, Raffaello. 2014. *Sant'Agostino di San Gimignano. Le secolari vicende*. Poggibonsi: Progetto Lavoro Società Cooperativa Sociale o.n.l.u.s.

Remondino, Fabio. 2011. '3D recording for cultural heritage'. In *Remote Sensing for Archaeological Heritage Management. Proceedings of the 11th EAC Heritage Management Symposium (Reykjavik, Iceland, 25-27 March 2010). EAC Occasional Paper No. 5*, edited by David C. Cowley, 107-116.

# The so-called *insula dei Lottatori* and block V, III in Ostia: the combination of terrestrial laser scanner (TLS) and drones (UAS) in the field of cultural heritage

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**Abstract**

The paper illustrates the 3D survey of the so-called *Caseggiato dei Lottatori* and the Block V, III in Ostia, where the combination of terrestrial laser scanning survey with UAS photogrammetry was employed. The result is a high-quality 3D model and a set of high-resolution images, essential tools for further research, and for its proper conservation. This article describes in detail the general workflow followed, from survey planning to data archiving. This last stage, still too often disregarded, is placed in its theoretical context by highlighting the main standards available today.

**Keywords**

Terrestrial Laser Scanner, UAS, Photogrammetry, Urban Archaeology, Ostia

## Introduction

The work presented here should be considered as an appendix to the much wider research programme *Ostia ReLOADed. Reconstructing Life in Ostia along the Decumanus*, which are archaeological excavations carried out in ancient Ostia within the OsTIUM ARC Project 2021-2026. Through the study of the ancient city of Ostia, the *Ostia's Transformation – Investigating an Urban Model* project (https://www.ostium-arc.be/project), funded by *Fédération Wallonie-Bruxelles*, UCLouvain and UNamur, aims to understand how, with what means, and for what purpose people have transformed the urban space they inhabited over the centuries.

The *Ostia ReLOADed* research project coordinates various other initiatives such as doctoral dissertations in archaeology (Marano 2016-2017, Tomassini 2022; Glogowski 2023, Vyverman ongoinig), and books (Cavalieri, Marano, and Richard forthcoming). EQP funding by *Fonds de la Recherche Scientifique – FNRS*, the Belgian federal funds for research, has allowed the purchase of scanning, photography and remote sensing technology. With such equipment block V, III has been systematically analysed to provide Marano's dissertation with high-resolution 3D illustrations.

## Topographical Framework

The Ostia block V, III is located within Ostia's *regio V*, which is in the south-eastern sector of the city, enclosed between the *Decumanus Maximus*, the Late-Republican walls and the *Semita dei Cippi*. The existence of five *regiones* in Ostia has been confirmed by epigraphy (CIL XIV, 352), but their current boundaries have been conventionally reconstructed in modern times

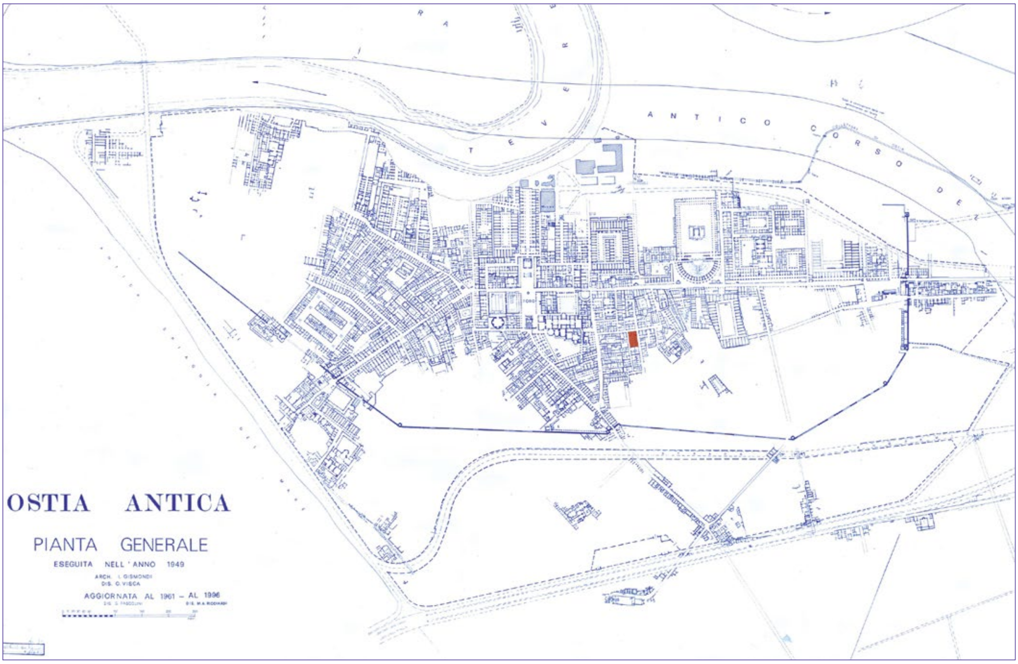


*Figure 1 - Ostia, general plan showing the Caseggiato dei Lottatori (in Descoeudres 2001).*

(Bakker 1999). Block V, III is located at the western sector of Ostia's *regio V* and is delimited by a minor *decumanus* to the north (the *via della Fortuna Annonaria*), by the *via delle Ermette* to the east, by the *via della Casa del Pozzo* to the west, and by an unnamed side-road of *Semita dei Cippi* to the south. The portion of our interest has an elongated rectangular shape (ca. 76x15.5m), is oriented northwest-southeast and hosts five housing blocks, built in different times (V, III, 1-5).

To the north, the so-called *Caseggiato dei Lottatori*, has a rectangular plan (ca. 29x15.5m) and it dates to the earliest decades of the 2nd century CE and continued to be used – through restorations and transformations — until at least the 4th century CE (Fig. 1). It opens towards *via della Fortuna Annonaria* through three entrances: the middle one leads to the vestibule, while the side ones provide access to two separate *tabernae.* The plan is organised around a central courtyard (*atrium*), leading to a vast hall sided by two *alae* and four little rooms. The shape of the central courtyard changed several times. Initially, there was located an *impluvium* surrounded by pillars, whose massive travertine bases still survive. Three other entrances gave access to *via della Casa del Pozzo* and *via delle Ermette*. The *insula* is named after a fighting scene depicted at the centre of a black-and-white mosaic from the vestibule of the *Casa dei Lottatori* (V, III, 1): it is similar to an *emblema*, showing two fighters wrestling, and dating back to the end of the 2nd and the beginning of the 3rd century CE. Two Latin inscriptions tell us the names of the athletes: *Artemi(dorus)* and *Seca[m?].* Possibly, during the mid-Imperial period the northern section of the *insula*, originally a *domus*, was transformed into a *schola*, or a college hosting the fighters' association (Marano 2016-2017, 87, note 336) (Fig. 2).


*Figure 2 - Ostia, plan of block V, III (in eds. Calza et al. 1953).*

The house V, III, 2 is located at the central portion of the block. It has a square plan with a central corridor and four rooms at the sides (ca. 15x15,5m). It was built at the beginning of the 2nd century CE on pre-existing structures and seems to have undergone a limited number of transformations. Four entrances open on *via della Casa del Pozzo* and three on *via Ermete*.

The southern sector of the plot is occupied by three constructions built in the earliest decades of the 2nd century CE alongside the *Caseggiato dei Lottatori*. These buildings share perimetral walls and face respectively *via della Casa del Pozzo* (V, III, 3), the unnamed southern road (V, III, 4) and *via delle Ermette* (V, III, 5). The current shape of building V, III, 3 dates to the 3rd-4th century CE, when a pre-existing building with a *medianum* (i.e. a rectangular living space from which all the other rooms can be accessed) was turned into a *domus* (the so-called *Domus del Pozzo*). The main rectangular plan of the original building (ca. 23x8m) was not significantly altered, while the interior underwent renovation to tailor the needs of the time. All parts of the house are connected by a corridor which also links to the reception hall through a wide anteroom. The reception hall occupies the northern section of the building and can be accessed via a hallway lined with columns. A long and narrow second corridor connects the kitchen/lavatory with the other rooms of the house. Behind the *Domus del Pozzo*, is located a rectangular building (V, III, 5) with five *tabernae* and a staircase (ca. 23 x 7,7 m); in the southern part another building was found (V, III, 4) with rectangular plan and set aside from buildings V, III, 3 and V, III, 5 through an east-west wall (ca. 15,5 x 8,8 m). A corridor (*medianum*) links the reception rooms while a second, T-shaped, corridor, leads to the utility rooms.

The preservation status of the elevation of the five buildings is not homogeneous. Walls were extensively restored in the last century and today reach a considerable height, especially in the northern and central sector of the plot, where these measure over 2 metres high; they are progressively lower in the southern part of the block. Floor slabs in the *Caseggiato dei Lottatori* and in the *domus del Pozzo* are embellished with geometrical mosaics and were repositioned back in 1981, after restoration. Currently, they are gradually subsiding, and some sections of the tiles are detaching.

## General Workflow

In July 2023 a 3D survey was carried out on the whole block V, III (Fig. 3). The aim was to complete the data produced by Martina Marano's research on the reconstruction of the phases of the architectural complex from the Late Republican period to Late Antiquity.

The topographical survey presented several challenges and required careful consideration of the techniques to be used. Due to the limited time available for the survey, the extensive surface of almost 1,200m² and the planimetric complexity of the site, as well as the height of some of the walls, it was not possible to rely solely on a terrestrial laser scanner (TLS). To cover the entire area and produce high-quality orthophotos of the buildings and some elevations, we combined photogrammetric UAS surveys with TLS. This approach is at present very widespread since it offers several advantages, including the ability to survey areas inaccessible to TLS and to obtain a superior quality of the textures used in the final 3D model and


*Figure 3 - Ostia, general view of block V, III (Google Earth base map, orthophoto from A. Peeters).*

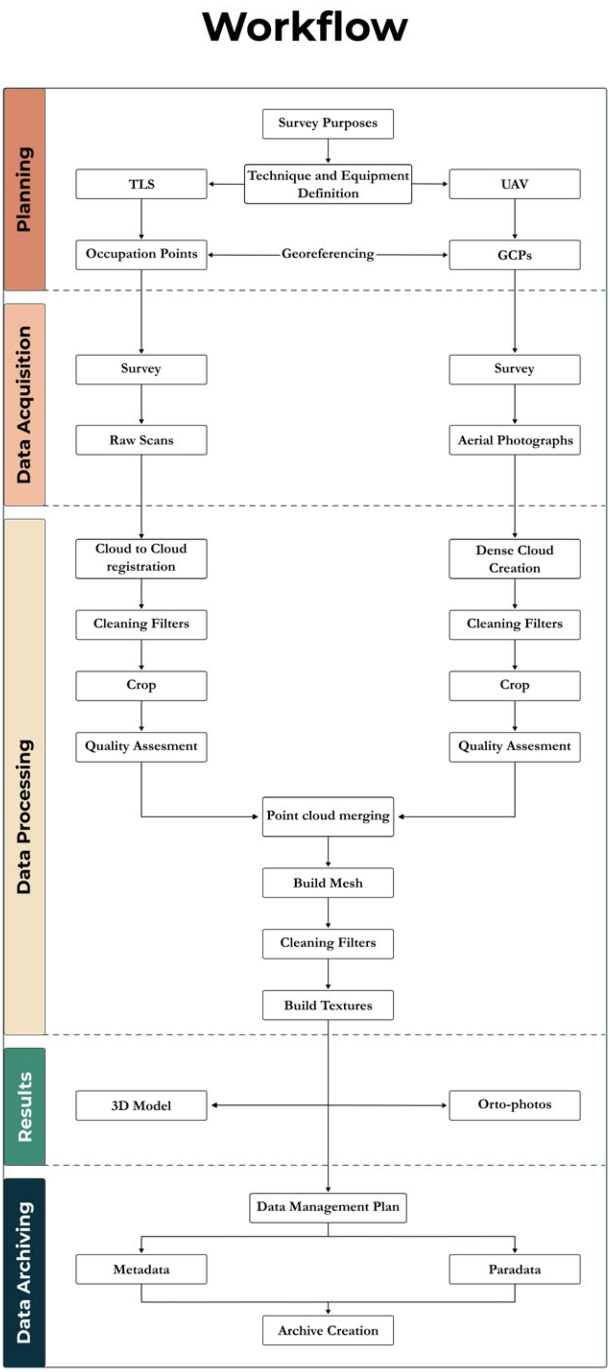


*Figure 4 - General workflow (adapted from Chatzistamatis et al. 2018, 145).*

orthophotos, particularly for the elevations. However, using both technologies also results in a longer survey phase; to better plan the field operations, we drew on many studies published in recent years on methods to merge the data produced by these two technologies (Chatzistamatis et al. 2018; Kompoti et al. 2023; Chandler and Buckley 2016; Jo and Hong 2019; Dawn and Biswas 2019; Angelini 2013).

The survey operations were limited due to constraints imposed by the Ostia Archaeological Park, such as the presence of visitors, and the proximity of the Roma Fiumicino airport. Surveys were only conducted on Mondays when the park was closed and at a maximal altitude of 25m a.g.l. The south-eastern part of the complex was exclusively surveyed using UAS, providing an overall view of block V, III with two levels of accuracy while respecting time constraints. The use of drones for photogrammetric surveying provides a faster alternative to ground-based TLS, albeit with reduced accuracy (Chandler and Buckley 2016).

The general workflow of the field operations (Fig. 4) includes survey planning for TLS (location and number of stations) and UAS (flight plan and location of GCPs), data acquisition, and data processing, final model production and data archiving.


*Figure 5 - Ground Control Points (GCP) located in block V, III (Google Earth base map, orthophoto from A. Peeters).*

The first step was to establish and georeference the ground control points (GCPs), to be used for both surveys to ensure a seamless integration of the point clouds produced by the TLS and the UAS. A total of forty-eight markers within and around the block, along four main northeast-southeast lines were placed (Fig. 5). As far as possible, at least one marker in each room of the architectural complex was placed. Markers were also placed on certain walls' ridges to correct vertical errors. The markers were georeferenced in the reference system of the archaeological park, Monte Mario/Italy Zone 2 (EPSG:3004), using a Topcon HiPer HR GNSS rover, paired with a Topcon HiPer HR base that was located on the park's topographic benchmark of the *Fullonica* at the intersection of *Via degli Augustali* and *Via della Fortuna Annonaria*.

**TLS**

The TLS Topcon GLS-2200 laser scanner was used for the *Caseggiato dei Lottatori* due to its topographical approach. For each scan, a station is set up at a specific point (Occupation Point) and its coordinates are checked by measuring the distance from another station (Backsight Point). In this way, scans are natively georeferenced, which improves survey accuracy and simplifies operations when there are visual obstacles between each scan, as in the present case. Moreover, it is not essential to achieve the same degree of overlap as with a conventional TLS, which relies on markers and matching with surrounding scans for alignment (Ebolese, Lo Brutto, and Dardanelli 2019). To improve measurement accuracy, a stationary tripod with a 360° prism was positioned on a backsight point outside the building to avoid any unwanted elements within the scan. The tripod was only relocated when the prism was no longer visible

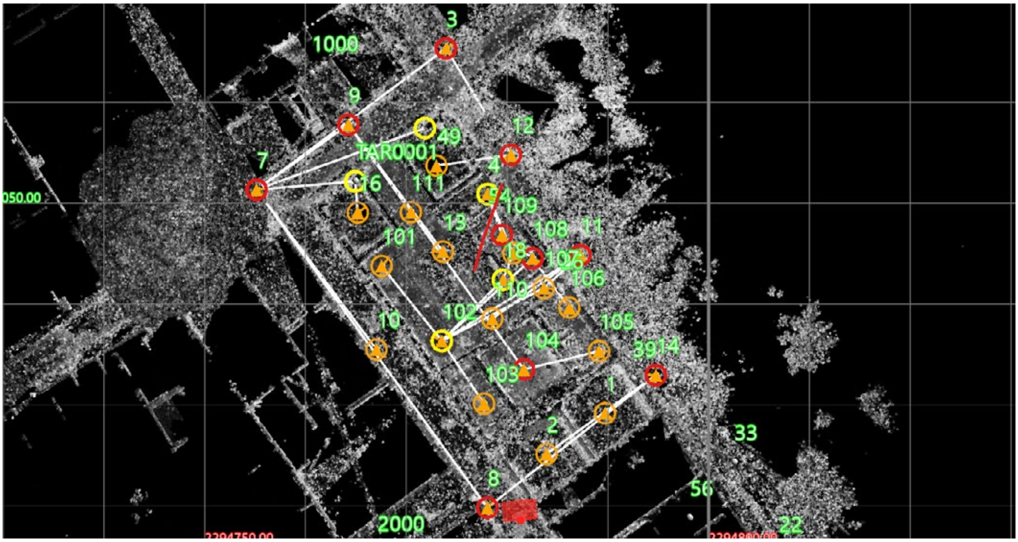


*Figure 6 - Scanning stations inside and outside the Caseggiato dei Lottatori.*

to the laser scanner. Although this method may result in slightly higher error than using a traverse, it allows faster surveying in the field.

Due to the complexity of the site, including its size, numerous obstacles, and small dimensions of certain spaces, we had to improve survey coverage of difficult areas by adding several minor scans. This required two days of TLS scanning. The first day was dedicated to the main scans, while the second day focused on more complex areas. In total, twenty-seven stations were established in and around the *Caseggiato* (Fig. 6). The scans were taken at a resolution of 3.1mm, at a distance of 10m, with a full-dome field of view (360° horizontal and 270° vertical). The resolution level was chosen based on the smallest element to be scanned, which in this case were the mosaic *tesserae* and the joints between them (Historic England 2018, 29-30).

Thanks to its active approach, TLS still has an advantage over photogrammetry in terms of accuracy. As Jim Chandler and Simon Buckley point out in a comparative study of the two techniques, "TLS offers advantages in terms of accuracy, repeatability and reliability, and can still be viewed as the 'gold standard' for 3D measurement" (Chandler, and Buckley 2016, 3). Many recent devices, including the model used in our study, incorporate HDR cameras to colourise the point cloud. However, the quality of these images is often average. To overcome this limitation, it is possible to merge the point cloud generated by a TLS with the texture produced by photogrammetry. This results in a significantly higher quality of the 3D model.

**UAS**

A DJI Mavic 3 device was used to acquire aerial photogrammetric data (Historic England 2017; Remondino et al. 2014; Bianco, Ciocca, and Marelli 2018) due to its affordability and ability to produce high-quality photos. The drone's weight of 895g, the 46-minute battery lifetime, the three-axis stabilised gimbal, and the high-quality 4/3 sensor camera with 20mpx and ND filter


*Figure 7 - Flights plan of the UAV survey.*

compatibility make it an ideal choice for photogrammetry. Additionally, a recent software update allows for semi-automated flight planning[1]. However, unlike other drones such as the DJI Matrice 300 or DJI Mavic 3 Enterprise RTK, this model does not have Real Time Kinematic (RTK) support for more accurate geolocation, which makes it essential to use GCPs distributed throughout the survey area to significantly reduce errors (Štroner et al. 2020; Forlani et al. 2018; Gerke and Przybilla 2016).

To reach the desired level of detail and quality, three flights were necessary to cover the entire area. The presence of obstacles such as vegetation and other buildings, as well as the size of certain rooms, made it impossible to obtain sufficient coverage using a conventional flight plan. Therefore, the following three flights were carried out (Fig. 7):

1. north-south and east-west grids at an altitude of 8m with a camera angle of approximately 45° to cover all the structures and their elevations;
2. north-south parallel lines, with a zenith viewing angle, to survey floors and wall bases;
3. a detailed survey of the external elevations and the smallest rooms, which required additional photos.

As a result, a total of 1116 images were taken to cover the entire area uniformly, for a total flight time of 75 minutes. For all three series, the camera had a fixed aperture of f/8 and an

[1] In comparison with other drones, this functionality is limited. The manufacturer only allows automated waypoint-based flight through their application. Tools such as WaypointMap (https://www.waypointmap.com/, last access on 12.07.2024) have been developed to overcome this limitation.


*Figure 8 - The different steps in data processing and merging: (1) Photogrammetry image alignment; (2) TLS dense cloud; (3) Merging of TLS and photogrammetric dense clouds; (4) 3D Model; (5) Orthophoto.*

ISO value of 100, while the shutter speed was variable, to ensure the best possible sharpness for all images. Thanks to these parameters and the flight altitude, a ground sample distance (GSD) of 2.8 mm per pixel was achieved.

**Data Processing**

The cloud points were firstly edited separately before being merged to create the final 3D model (Fig. 8). After transferring all the georeferenced scans from the TLS to the Magnet Collage software, the registration accuracy of each scan was checked using the Root Mean Square (RMS) value produced. To reduce the RMS value resulting from a significant vertical error, a cloud-to-cloud registration based on the Iterative Closest Point (ICP) algorithm was applied (Besl and McKay 1992; Rajendra et al. 2014). The lowest vertical error station was selected as the reference, resulting in an RMS resolution of 0.0162m. The 27 scans were exported in PLY format for cleaning operations using Cloud Compare software. The scans were manually cleaned to remove unwanted elements such as tripods and prisms placed on reference points, and they were merged into a point cloud containing over 427 million points. The number of points was reduced to 295 million points after cropping to the study area, refining the cleaning process by removing the last unnecessary elements such as surrounding vegetation, and applying the "duplicate point removal" and SOR (Statistical Outlier Removal) filters.

For the photogrammetric processing of the UAS photographs, Agisoft Metashape Pro software was used. This software can process various types of data, including aerial, satellite, multispectral, and thermal photographs, as well as TLS scans (since version 2.0) (Papoutsaki et al. 2023, 150). The images were aligned according to their GPS position recorded in their EXIF data, and a sparse point cloud of over 2 million tie points was generated, which were accurately positioned in the EPSG:3004 coordinate system using markers. A dense point cloud

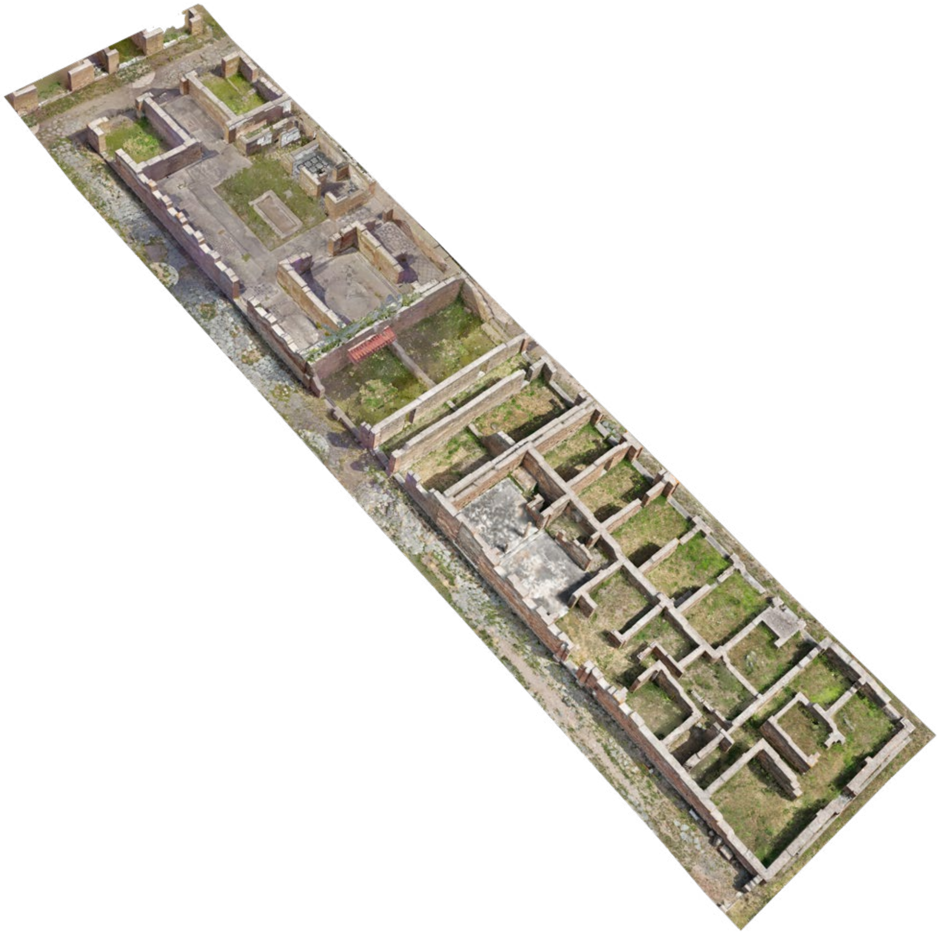

*Figure 9 - The final 3D model of block V, III in Ostia.*

of almost 76 million points was generated, which was then filtered and cleaned using Cloud Compare, resulting in 49 million points remaining.

The two cleaned point clouds from TLS and UAS were re-imported into Agisoft Metashape Pro and then merged to produce the 3D model (mesh) with a root mean square (RMS) error of 0.01m. The model was then textured using UAS photographs.

**Results**

The survey of block V, III in Ostia has resulted in a high-resolution, textured 3D model by combining TLS, UAS, and GNSS data (Fig. 9). It allows the export of detailed images and facilitates the acquisition of new data, particularly in terms of measurements. To analyse the various phases of the architectural complex and its modern restorations, which can


*Figure 10 - Orthophoto block V, III in Ostia.*

be distinguished using different materials, horizontal projections were also required. Agisoft Metashape was used to produce zenith orthophotographs (Fig. 10) and views of each external wall, correcting for any distortion caused by the photographic sensors. The high-quality and numerous photographs taken by the UAS from various angles enabled us to create high-definition orthophotographs. These images can be used in the future to produce plans of the different phases of the structures and their prospections.

**Data Archiving**

A fundamental step of the project was data archiving. Like any other form of data, the transfer and archiving of 3D models produced in archaeology must be considered. Currently, there are no European standards for the storage of this type of data, despite its widespread use in recent decades. This observation was already made in 2019 by the *consortium 3D SHS*, which includes TGIR Huma-Num, CINES and the Archéovision laboratory in Bordeaux: "dans le meilleur des cas, [les modèles 3D] sont sauvegardés sur les machines des chercheurs avec éventuellement un stockage supplémentaire, considéré comme plus sécurisé, sur un autre poste ou un autre support. À long terme, ces conditions ne sont pas satisfaisantes pour conserver ces données" (Dutailly et al. 2019, 29). Since the early 2000s, various international charters and recommendations have been promulgated to highlight the importance of protecting cultural and digital heritage, such as the UNESCO Charter on the Preservation of Digital Heritage[2] in 2003 (Denard 2012), the London Charter for the Computer-based Visualisation of Cultural Heritage[3] in 2009, and the Seville Principles[4] ratified by ICOMOS in 2017. The

[2] https://www.unesco.org/fr/legal-affairs/charter-preservation-digital-heritage, last access on 12.07.2024
[3] https://londoncharter.org/, last access on 12.07.2024
[4] https://icomos.es/wp-content/uploads/2020/06/Seville-Principles-IN-ES-FR.pdf, last access on 12.07.2024

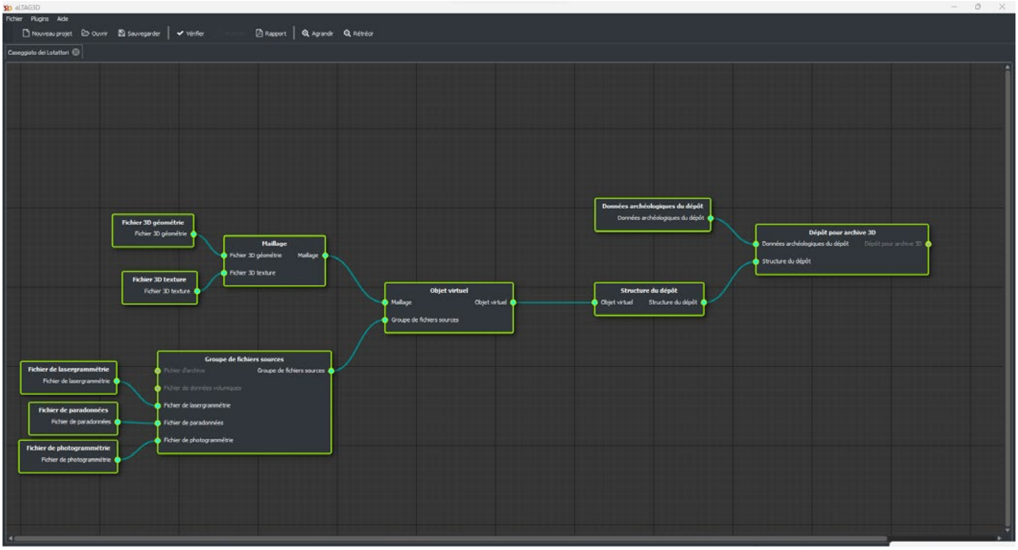


*Figure 11 - Screenshot of the project archive created with aLTAG3D software.*

latter, taking the London Charter as a reference, underlines eight fundamental principles for virtual archaeology, which include scientific transparency.

In recent years, two major research consortia have produced recommendations for archiving and documenting 3D models. The first consortium is the Archaeology Data Service (ADS), which has been providing advice on creating and managing digital data since 1996. In 2011, in collaboration with tDAR (the Digital Archaeological Record - Arizona State University), they published the third version of their *Guides to Good Practice*[5], which includes 3D data (McManamon et al. 2013). The text describes the metadata that should be included in the archive following the MIDAS standards (*A Manual and Data Standard for Monument Inventories*, The Forum on Information Standards in Heritage 2012). The metadata is divided into four main levels: Project-level, Resource-level, File-level, and administrative metadata. For 3D scans, additional data is provided for acquisition, registration, and mesh processing.

The *Consortium 3D SHS*, which has been renamed *Consortium 3DHN* since 2023, is the second main research institution to address the issue. Since the launch in 2014, its objectives have included drafting recommendations and guides for the use of 3D data in the human and social sciences, particularly in archaeology. In 2019, it published recommendations about "l'archivage pérenne des modèles numériques 3D pour les SHS" (Dutailly et al. 2019). Based on previous research, including that of ADS, the authors outline optimal techniques for archiving 3D models, from creating a management plan to writing metadata and using open file formats. The authors propose a more concise schema for metadata than the one by ADS, which allows a greater flexibility in project management. Additionally, they have developed a software, called *aLTAG3D*[6], which provides a visual interface for encoding metadata, automatically extracting

[5] https://archaeologydataservice.ac.uk/help-guidance/guides-to-good-practice/ (online version, last access on 12.07.2024).
[6] Open-source software available from: https://altag3d.huma-num.fr/ (last access on 12.07.2024).

certain information from files, and for creating the archive. These recommendations and this software were used to create a comprehensive archive of our project, ensuring that the files will be preserved for an extended period.

After creating the project in the aLTAG3D software, site and project information were encoded (Fig. 11). The source files, which include TLS scans in PLY format and photos taken by UAS in JPG format, were imported along with the relevant technical data. The paradata, which outlines the overall process, was also included in a pdf file. The latter contains the reports from Agisoft Metashape and Magnet Collage, along with a detailed explanation of the cleaning filters that were applied. The final 3D model and its associated texture file were then inserted into the software, which exported the final archive in ZIP format. The archive includes all the source and result files produced, as well as metadata (.xml) and paradata (.pdf). Multiple copies of this archive have been saved to ensure its preservation.

## Conclusion

The 3D model created for this project is an essential research tool for the future. It not only preserves a digital record of this architectural complex at a specific moment, which is essential for its proper conservation over time, but also provides a 3D scientific illustration for Martina Marano's publication and offers a collection of unpublished data for a better understanding of the phases of Ostia's Block V, III, from the Late-Republican period to Late Antiquity.

This case study illustrates the rapid implementation of a survey using TLS and UAS photogrammetry, which is nowadays possible thanks to a greater availability and easier utilisation of those high-performance tools and techniques. However, specific training is required, along with the ability to adapt to any situation, to find solutions to problems that arise during the survey. This was also true for this project, where the need for a high-resolution survey had to be balanced with time, logistical, and administrative constraints, as well as obstacles in the surrounding area and the limited size of certain rooms.

This case study allows us to identify the advantages and disadvantages of the two employed techniques. In terms of measurement accuracy, TLS still has a significant advantage (Chandler and Buckley 2016, 3). It is increasingly used in archaeology, despite its unattractive price. Using a topographic TLS is also advantageous in terms of processing, as the point clouds are directly georeferenced and require only minor cleaning and optimisation filters. On the other hand, UAS and photogrammetry are now widely used in archaeology thanks to their affordability and ease of use. The technique is also becoming more professional, with the introduction of protocols that make the survey more accurate and reproducible. As this case study shows, UAS photogrammetry also has an undeniable advantage when it comes to the speed of acquisition and the image quality. However, it requires longer processing times after the survey. Therefore, if the study's aim is to achieve a high accuracy and high-quality texture result, and if the resources (i.e. financial and time) allow it, the combination of the two techniques seems to offer a real added value.

Finally, this 3D survey could be at the centre of a future broader project to promote and communicate this important site at the heart of the Ostia Archaeological Park. In recent years, 3D models and reconstructions have proven useful for communicating new information to visitors (Gonizzi Barsanti et al. 2015; Loaiza Carvajal, Morita, and Bilmes 2020; Keumoe and Blot 2023; Wachowiak and Karas 2009). Furthermore, the increasing number of applications using virtual or augmented reality demonstrates the interest of these immersive solutions for a wide audience. While digital documentation cannot replace the archaeological object, it can provide complementary solutions for its preservation, promotion and study.

## Acknowledgements

We are grateful to the Archaeological Park of Ostia for permission to carry out our survey and to fly with the UAS. We would also like to thank Alessandro Novellini for his valuable assistance and for taking an active part in the survey. Finally, the financial support of the *Fonds National pour la Recherche Scientifique* (FNRS) made this study possible.

## Bibliography

Angelini, G. 2013. "Laser scanning e photo scanning. Tecniche di rilevamento per la documentazione 3D di beni architettonici ed archeologici." *Archeologia e Calcolatori* 24: 379-394.

Bakker, J. T. 1999. *The Mills-Bakeries of Ostia. Description and Interpretation.* Vol. 21. *Dutch Monographs on Ancient History and Archaeology*. Amsterdam: Brill.

Besl, P. J., and N. D. McKay. 1992. "A method for registration of 3-D shapes." *IEEE Transactions on Pattern Analysis and Machine Intelligence* 14 (2): 239-256. https://doi.org/10.1109/34.121791.

Bianco, S., G. Ciocca, and D. Marelli. 2018. "Evaluating the Performance of Structure from Motion Pipelines." *Journal of Imaging* 4 (8): 98.

Calza G., G. Becatti, I. Gismondi, G. De Angelis D'Ossat, and H. Bloch (ed.), 1953. *Topografia Generale, Scavi di Ostia 1*. Roma: La Libreria dello Stato.

Cavalieri, M., M. Marano, and J. Richard. Eds. Forthcoming. « Quaestio est appetitio cognitionis ». *Actualité de la recherche archéologique sur Ostie au cœur de l'Europe*, *Studia Academiae Belgicae*, 5.

Chandler, J., and S. Buckley. 2016. "Structure from motion (SFM) photogrammetry vs terrestrial laser scanning." In *The Geoscience Handbook 2016. AGI Data Sheets, Fifth Edition*, edited by M. B. Carpenter and C. M. Keane, Section 20.1. Alexandria: Loughborough University.

Chatzistamatis, S., P. Kalaitzis, K. Chaidas, C. Chatzitheodorou, E. E. Papadopoulou, G. Tataris, and N. Soulakellis. 2018. "Fusion of TLS and UAV Photogrammetry Data for Post-Earthquake 3D Modeling of a Cultural Heritage Church." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLII-3/W4: 143-150. https://doi.org/10.5194/isprs-archives-XLII-3-W4-143-2018.

Dawn, S., and P. Biswas. 2019. "Technologies and Methods for 3D Reconstruction in Archaeology". In *Advances in Signal Processing and Intelligent Recognition Systems. 4th International Symposium. SIRS 2018,* edited by S. M. Thampi, O. Marques, S. Krishnan, K.-C. Li, D. Ciuonzo, M.H. Kolekar, 443-453. Springer.

Denard, H. 2012. "A New Introduction to the London Charter." In *Paradata and Transparency in Virtual Heritage*, edited by A. Bentkowska-Kafel and H. Denard, 57-71. Londres: Routledge.

Descoeudres J.-P. (ed.) 2001. *Ostie - port et porte de la Rome antique*. Genève: Georg Editeur.

Dutailly, B., S. Eusèbe, V. Grimaud, N. Lefèvre, M. Quantin, and S. Tournon-Valiente. 2019. *L'archivage pérenne des modèles numériques 3D pour les SHS*. s.l. hal-02195914.

Ebolese, D., M. Lo Brutto, and G. Dardanelli. 2019. "3D Reconstruction of the Roman Domus in the Archaeological Site of Lylibaeum (Marsala, Italy)." *The International Archives of* *the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLII-2/W15: 437-442. https://doi.org/10.5194/isprs-archives-XLII-2-W15-437-2019.

Forlani, G., E. Dall'Asta, F. Diotri, U. M. d. Cella, R. Roncella, and M. Santise. 2018. "Quality Assessment of DSMs Produced from UAV Flights Georeferenced with On-Board RTK Positioning." *Remote Sensing* 10 (2): 311. https://doi.org/10.3390/rs10020311.

Gerke, M., and H.-J. Przybilla. 2016. "Accuracy Analysis of Photogrammetric UAV Image Blocks: Influence of Onboard RTKGNSS and Cross Flight Patterns." *Photogrammetrie – Fernerkundung – Geoinformation* 2016 (1): 17-30. https://doi.org/10.1127/pfg/2016/0284.

Glogowski, H. 2023. *"Another Block in the Wall". Nouvelles perspectives sur l'enceinte tardo-républicaine d'Ostie: reconstruction archéologique de l'édifice et réflexion sur son rôle dans le développement des quartiers adjacents*, Doctoral thesis.

Gonizzi Barsanti, S., G. Caruso, L. L. Micoli, M. Covarrubias Rodriguez, and G. Guidi. 2015. "3D Visualization of Cultural Heritage Artefacts with Virtual Reality devices." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XL-5/W7: 165-172. https://doi.org/10.5194/isprsarchives-XL-5-W7-165-2015.

Historic England. 2017. *Photogrammetric Applications for Cultural Heritage*. Swindon: Historic England.

Historic England. 2018. *3D Laser Scanning for Heritage. Advice and Guidance on the Use of Laser Scanning in Archaeology and Architecture. 3rd Edition*. Swindon: Historic England.

Jo, Y. H., and S. Hong. 2019. "Three-Dimensional Digital Documentation of Cultural Heritage Site Based on the Convergence of Terrestrial Laser Scanning and Unmanned Aerial Vehicle Photogrammetry." *ISPRS International Journal of Geo-Information* 8 (2): 53-66.

Keumoe, G. D., and C. Blot. 2023. "Transformer les pratiques muséales au Cameroun grâce à la visualisation 3D." *Humanités numériques* 7. https://doi.org/10.4000/revuehn.3315. http://journals.openedition.org/revuehn/3315.

Kompoti, A., A. Kazolias, M. Kylafi, V. Panagiotidis, and N. Zacharias. 2023. "Terrestrial Laser Scanning Coupled with UAVs Technologies: The Case of Old Navarino Castle in Pylos, Greece." Transdisciplinary Multispectral Modeling and Cooperation for the Preservation of Cultural. Third International Conference, TMM_CH 2023, Cham, 20-23 mars 2023. https://doi.org/10.1007/978-3-031-42300-0_11

Loaiza Carvajal, D. A., M. M. Morita, and G. M. Bilmes. 2020. "Virtual museums. Captured reality and 3D modeling." *Journal of Cultural Heritage* 45: 234-239. https://doi.org/10.1016/j.culher.2020.04.013.

Marano, M. 2016-2017. "Il cd. Caseggiato dei Lottatori e l'isolato V, III di Ostia: analisi delle trasformazioni edilizie." PhD thesis, Università degli Studi di Roma "Tor Vergata".

Marano M. 2018. "Ostia, isolato V, III: analisi preliminare delle trasformazioni edilizie", in *Ostia Antica. Nouvelles études et recherches sur les quartiers occidentaux de la cité, Actes du colloque international, Bruxelles-Roma* edited by C. De Ruyt, Th. Morard, and F. Van Haeperen, pp. 45-51. Brussels: Belgisch Historisch Instituut te Rome.

McManamon, B. A., F. P. K. Niven, ADS, and tDAR. 2013. *Caring for digital data in archaeology: a guide to good practice*. Oxford: Oxbow Books.

Papoutsaki, A., V. V. Panagiotidis, A. Kompoti, A. Kazolias, and N. Zacharias. 2023. "The Digitization of Klissova Islet and the Church of Agia Triada in Mesologgi." Transdisciplinary Multispectral Modeling and Cooperation for the Preservation of Cultural Heritage. Second International Conference, TMM_CH 2021, Cham, 13-15 decembre 2021. https://doi.org/10.1007/978-3-031-42300-0_11

Rajendra, Y. D., S. C. Mehrotra, K. V. Kale, R. R. Manza, R. K. Dhumal, A. D. Nagne, and A. D. Vibhute. 2014. "Evaluation of Partially Overlapping 3D Point Cloud's Registration by using ICP variant and CloudCompare." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XL-8: 891-897. https://doi.org/10.5194/isprsarchives-XL-8-891-2014.

Remondino, F., M. G. Spera, E. Nocerino, F. Menna, and F. Nex. 2014. "State of the art in high density image matching." *The Photogrammetric Record* 29 (146): 144-166. https://doi.org/10.1111/phor.12063.

Štroner, M., R. Urban, T. Reindl, J. Seidl, and J. Brouček. 2020. "Evaluation of the Georeferencing Accuracy of a Photogrammetric Model Using a Quadrocopter with Onboard GNSS RTK." *Sensors* 20 (8): 2318.

The Forum on Information Standards in Heritage. 2012. *The UK Historic Environment Data Standard. Version 1.1.* s.l.

Tomassini, P. 2022. Ostie*, fenêtres sur cour. Le* Caseggiato delle taberne finestrate*: reconstruire cinq siècles de vie ostienne,* Leuven-Paris-Bristol: Peeters. BABESCH, Suppl. 44

Vyverman, S. Ongoing. *The Big Block Theory: Archaeological, Diachronic and Topographical Study of a City Block of the Site of Ostia Antica: the Insula Consisting of the* Caseggiato delle Trifore *and the Adjacent Building*. Ongoing doctoral thesis.

Wachowiak, M. J., and B. V. Karas. 2009. "3d Scanning and Replication for Museum and Cultural Heritage Applications.' *Journal of the American Institute for Conservation* 48 (2): 141-158. https://doi.org/10.1179/019713609804516992.

# Reviews

# Tuna Kalayci, Karsten Lambers and Victor Klinkenberg (eds), *Digital Archaeology: Promises and Impasses*, [Analecta Praehistorica Leidensia 51], Sidestone Press, Leiden, 2023 | Book Review

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Kalayci, T., Lambers, K. and Klinkenberg, V. (eds.), *Digital Archaeology: Promises and Impasses*, [Analecta Praehistorica Leidensia 51], Sidestone Press, Leiden, 2023.

Digital archaeology is now a well-established field of archaeology but is proving to be as promising as it is complex, due to its constant evolution. It is on this dichotomy that the discussion of the volume "Digital Archaeology: Promises and Impasses", published in 2023 by Sidestone Press as part of the series Analecta Praehistorica Leidensia (APL), is based. The authors, mainly (but not exclusively) from the Faculty of Archaeology at Leiden University, provide an in-depth analysis of the challenges and opportunities associated with the use of digital technologies in archaeology. What stands out in this volume, edited by Tuna Kalyci, Karsten Lambers and Victor Klinkenberg, is a collection of essays that explore the application of digital technologies in archaeological research and cultural heritage management. By focusing on the challenges and "unfulfilled promises" of digital archaeology, the authors help to promote the responsible use of technologies and encourage further developments in the field. The book provides an opportunity to critically examine the current state of the art of Digital Archaeology, highlighting not only the successes of this field but also its limitations.

"Digital Archaeology Promises and Impasses" begins with an introduction by Karsten Lammers, in which she reflects on the meaning of digital archaeology itself by introducing the book. She also gives space to present data on the interest in digital archaeology among students at the Faculty of Archaeology at Leiden University, and the career prospects it can offer them. From the beginning, the editor emphasises the strength of this publication, namely that all the work is the result of the direct experience of the authors. Therefore, there is nothing empirical about the topics covered. It is important to stress this premise, because it actually strengthens the aim of the book: to take a critical look at the positive, the negative and the dubious aspects that currently surround digital archaeology. The book is then divided into seven chapters, each dealing with a different topic related to digital approaches and methodologies in archaeology. The topics range from the collection of archaeological data to its processing, analysis, re-use and dissemination, including the very young field of archaeogaming. All authors reflect on the strengths as well as the more problematic or dubious aspects of the digital approaches they deal with, providing a clear picture of the state of the art as well as their experience with the particular topic, method or analysis.

In keeping with the title of the book the opening essay, written by Tuna Kalaycı and Piraye Hacıgüzeller, provocatively begins by saying "We are all digital archaeologists". This incipit, which is a quote from a 2012 article by Morgan and Eve (Morgan and Eve 2012), serves as an introduction to the topic of the paper. In fact, it critically analyses the development of digital archaeology over time, highlighting both its potential and its challenges. Digital, the authors argue, is transforming and influencing both the understanding of archaeologists' work as well as the collaboration between them. While optimistic about the future application of digital methods and technologies (old and new) to archaeological research, the authors also question their uncritical adoption in the field, from the use of Big Data to Artificial Intelligence (AI). The paper attempts to take stock of whether these practices can and/or do contribute to a more inclusive and collaborative archaeology and, above all, which player benefit most from such innovations. In the second paper, the discussion shifts to a topic closely related to the management of digital archaeological data in the Netherlands. Milco Wansleeben, Walter Laan and Ronald Visser reflect on the need for a standard protocol for the management of these data, focusing on the case study of the so-called SIKB0102 protocol. SIKB0102, a standardised XML data exchange format for the interim storage of data on objects deposited in Dutch archaeological repository, was first introduced in the Netherlands in 2011. In this chapter, the authors attempt to trace the history of the launch of this format, trying to understand the nature of the problems associated with it, possible solutions, and possible developments to make it as accessible as possible. In line with this, the topic of archaeological data management is taken up again by Tymon de Haas and Martijn van Leuseno. They highlight the exponential growth of digital archaeological data over time and the challenges associated with its management and analysis in the third paper of the book. The authors emphasise the need to standardise the documentation of archaeological data. This will make it more accessible to a wider audience. However, they also highlight the problematic issue of gaps in the publication and archiving of survey data in the field of archaeology. They conclude with proposals to improve the situation in the medium term, such as the adoption of semantic modelling and LOD, and the improvement of training in archaeological documentation and archiving. The focus then shifts from data acquisition, management and storage to data analysis in the fourth paper in the book. Indeed, Jason E. Laffoon and Till F. Sonnemann discuss the topic of data analysis by addressing the management of isotopic data, which are useful for building predictive models (isoscapes) to trace geographical origins in archaeology. Through a case study of the existing strontium and oxygen isoscapes for the Circum-Caribbean, the authors address the issue of the reliability of such isoscapes. They emphasise that there is a need for much more systematic analysis of individuals of known origin than has been done to date to prove their reliability in the field of archaeology, and particularly in the study of human mobility and migration. The topic of data analysis is taken up again in the book's fifth paper, in which, Sarah Klassen, Tommaso Pappagallo and Damian Evans discuss deep learning applied to 2D and 3D aerial remote sensing data to identify archaeological evidence from the Khmer Lidar Archaeological Consortium (KALC) and Cambodian Archaeological Lidar Initiative (CALI) processes. The authors discuss the challenges and opportunities it offers, keeping in mind that the goal is to facilitate the archaeologist's task in trying to identify possible new archaeological sites. In the sixth paper, Iza Romanowska and Fulco Scherjon take up the topic of simulation and its introduction into the field of archaeology for the virtual reconstruction of now-lost landscapes or archaeological evidence. They take a close look at the current state of the art in the field and try to answer the question of whether or not the expectations associated with the world of simulation have achieved the goals that were announced in previous years. The seventh chapter by Aris Politopoulos and Angus Mol deals with a fairly young discipline in the field of archaeology, i.e. archaeogaming, highlighting both its shortcomings and the impacts it has had in these early years of development. At the end of the book, the editors have invited Rachel Opitz to provide an outstanding review of all the chapters. Opitz's reflection provides an umbrella view of the themes and issues addressed within the book, as well as the questions and answers posed and given by the authors to each of the issues addressed.

What distinguishes Digital Archaeology Promises and Impasses is undoubtedly the effort of the editors and the authors themselves to bring together all their experiences with digital archaeology, without focusing exclusively on the positive aspects or successes of their work. The constructive criticism of each topic covered and the questions posed (sometimes deliberately left with a question mark) are proof that the purpose of the volume has been fully achieved. It provides a timely and clear picture of the 'promises' and 'impasses' that currently characterise digital archaeology.

## Bibliography

Morgan, C., and S. Eve. 2012. "DIY and Digital Archaeology: What Are You Doing to Participate?" *World Archaeology* 44 (4): 521-37. DOI: 10.1080/00438243.2012.741810.

# Lorenzo Mancini, *Edilizia di culto presso gli* ethne *dell'Epiro. Architettura e paesaggi del sacro alla periferia nord-occidentale della Grecia*, Quasar, Roma 2021| Book review

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Lorenzo Mancini's latest work offers a comprehensive study of the architecture of sacred buildings in the region of ancient Epirus, which corresponds to the area between present-day southern Albania and north-western Greece. As the A. specifies in the introduction (pp. 22-23), the title is indicative of the chronological period examined which coincides with the presence of *ethne* (tribal groups often reunited in federal political structures) and, therefore, spans from the end of the Classical period to Octavian's victory at Actium, fought at the southern borders of Epirus.

Although the focus of the volume is on the architectural and monumental aspects of Epirote sanctuaries and cult sites, with a special attention towards the architectural decoration, the A. demonstrates his deep and wide-ranging knowledge of these topics, discussing a large number of archaeological, epigraphic, literary and iconographic evidence, supported by a solid and extensive bibliography. The familiarity with the material is evident and confirmed by Mancini's academic background, comprising many years of fieldwork with the Archaeological joint Mission at *Phoinike* of the University of Bologna and of the Archaeological Institute of Tirana, directed by S. De Maria and Sh. Gjongecaj and from 2017 by G. Lepore and B. Muka. In fact, this volume is preceded by Mancini's PhD dissertation at University of Bologna, focused on sacred architecture in the "indigenous" sites of Epirus, and by various in-depth articles on some aspects of Epirote sacred landscapes and public architecture (Mancini 2013; Mancini 2017; De Maria, Mancini 2018; Mancini 2019; Mancini 2020).

The book is organised by regional areas, according to the traditional division of Epirus into Molossia, central-southern Epirus (corresponding to Thesprotia, Cassopea and Ambrakia and Corcyra's territories), and Chaonia. Within these three sections, a concise historical background is provided for each region and its related ethnic groups, delving into their institutional development and mythical-religious imagery. Furthermore, a synthesis of the *pantheon* of deities and of some minor sites of worship are given for each tribe, based on various types of evidence which, although sometimes fail to lead to conclusive interpretations, are still discussed in-depth. Subsequently, within the aforementioned regional division, sites with monumental evidence of buildings identified as part of a cult place are dealt with in dedicated chapters. These chapters are structured in the form of catalogue voices, which include a topographical framework, a brief history of previous studies with bibliography, an analysis of the archaeological evidence and hypotheses regarding chronology, reconstruction and functional interpretation.

In the first section, much space is given to the analysis of the oracular sanctuary of Zeus at Dodona with its *naiskoi* and their debated interpretation (chs. I.3.1-I.3.6). The length of these chapters confirms the overwhelming amount of evidence compared to other sites in Epirus, which has sometimes had the unfortunate result of monopolising the debate about Epirote religion (Piccinini 2012). Through a first-hand re-analysis of the evidence on the field, together with new graphic documentation, the A. successfully proposes reasonable hypotheses regarding the identification of the titular deities of these small temple-like buildings and to question their function, despite the fact that some scholars still refer to the well-established, but outdated, interpretation proposed by D. Evangelidis and S.I. Dakaris (Evangelidis, Dakaris 1959; Dakaris 1971).

Considering the function of these cult buildings, usually identified as *naiskoi*, the A. finds evidence for a wider range of potential uses, discussing them in more detail in chapter IV.3. He examines previous interpretations as temples (Dakaris 1971), temple-*thesauroi* – stressing the hypothetical correlations between architecture and ethnic groups (Quantin 2008, 20-29; Piccinini 2016, 264-265) – or as polyfunctional rooms used for reunions or banquets (Emmerling 2012, 201-210). Even if the data is insufficient to get to determining results, the latter use is investigated in relation to *Naiskos Γ* by the A., who presents some convincing evidence that ritual feasting could have taken place in this building, perhaps by élites representative of tribal organization or an amphictyonic association (pp. 493-494). It would have surely been intriguing to hear the A.'s opinion on the recent volume on Dodona by D. Chapinal-Heras in which is also present a discussion of these buildings and their function as treasuries, archive rooms or dining places and an attractive but insufficiently documented proposal of attribution to the three main *ethne* of Epirus (Chapinal-Heras 2021, 71-72). Unfortunately, the two volumes were published more or less contemporaneously.

In the second section, the discussion of the construction of identity through a shared *pantheon* is particularly noteworthy. In the case of Thesprotia and central-southern Epirus, it translates into the acquisition of underworld imagery and deities (chs. II.1.4-II.1.6). At the centre of the debate is the *Nekyomanteion* sanctuary and especially the structure near the village of Mesopotamos, which has traditionally been identified as the oracular site cited by Homer in the Odyssey. Nevertheless, following the intuition of D. Baatz, an increasing number of scholars, including the A., now refute this hypothesis in favour of an interpretation of the building as functional to the process of production and storage of agrarian resources (pp. 252-253). Although there is limited evidence to support the existence of a sanctuary of the dead, the A. does not shy away from a careful analysis of the evidence related to chthonic cults, in particular numismatic and coroplastic finds, emphasising the risks of automatically identifying the recipient of worship based on iconography or architectural models, as female protomes or *oikos* buildings are often correlated to *Kore-Persephone* without substantial data. Nevertheless, underworld nuances are cautiously referred by the A. to some evidence from the Acropolis A of Dymokastro (ch. II.4.1), in particular some thirty fragments of a life-size statue recognised as a Ludovisi-type Hermes (possibly a cult statue); a fragment of an animal which is speculatively viewed as a three-headed Cerberus; the residential-like plan of the *Oikos N* which is a frequently recurring layout in "chthonic" sanctuaries.

In the third part, dedicated to the region of Chaonia, the A. tackles the question of the emergence of the sanctuary of Asklepios at Butrint, which stands out as the only cult place in the region whose material and monumental evidence are sufficiently know for both the Hellenistic and Roman period. In the absence of stratigraphical data, the traditional dating of the first phase of the sanctuary to the late 4th or early 3rd century BCE relied on the chronology of some movable finds (Melfi 2012, 24-25) and on the *terminus ante quem* given by the dedicatory inscription of the theatre (232 – 163 BCE). The A., recalling a recent study by him, N. Aleotti and A. Gamberini (Aleotti, Gamberini, Mancini 2020), confutes this dating in favour of a new chronology of the material to the 2nd century BCE. Together with the careful analysis of the archaeological remains of the sanctuary buildings, supplied with a new plan of the temple of Asklepios and its mosaic pavements (p. 447), the A. proposes to postdate the establishment of the sanctuary during the late 3rd century (p. 420), even in the chronic uncertainty of stratigraphic data. Another issue is represented by the function of the so-called "shrine of Asklepios", a small quadrangular building divided in two rooms, which Ugolini classified as *pronaos* and *naos*. Although it has been convincingly identified by M. Melfi as a *thesauros* where the sanctuary's offerings and valuables were stored (Melfi 2007), this interpretation can only apply to the last roman Imperial phase because the archaeological data is insufficient to reconstruct the Hellenistic aspect of the building, as the A. himself has to begrudgingly admit (p. 442).

Lastly, a substantial section serves as conclusion of the work. It consists of seven chapters where the A. provides a synthesis of the major themes of his work in chronological order, demonstrating how difficult it is to recognise elements in the architecture of sacred structures which are specific to the Epirote building culture. This is mainly due to the scarcity of evidence and its diverse nature which do not allow to reach conclusive explanations, with the risk of frustrating the reader. Nevertheless, the A. successfully meets the challenge of highlighting both the connection between Epirote architecture and the contemporary Mediterranean *koine* and its original and lively aspects developed in a much wider context of self-representation during the Hellenistic period. Some cautious cues are given towards the political and social history of the region which will be hopefully examined in depth in future studies. Moreover, the volume publishes new and detailed graphic documentation, which is the precious result of the A.'s experience on the field, and a rich catalogue of architectural elements for which the A. proposes an indispensable chronological serialization which will be helpful, together with the volumes on civic buildings in Epirus and architectural decoration in Chaonia (Rinaldi 2020; Podini 2014), to anyone dealing with Epirus' public architecture. In the light of his value of reference work for both scholars and students, an index of places and names at the end could have been an appreciated supplement.

In short, the volume is a significant addition to the scholarship of sacred architecture in Epirus and, generally, of the political, social and identity aspects related to religious evidence. Moreover, the numerous prompts, albeit cautious, towards the political and social history of the region, such as the considerations about a "Ionian-Adriatic koine" for architectural decorations or about the influence of Rome in the maintenance and transformation of sacred complexes (pp. 516-518), open the path for further discussion. More in-depth investigation of the many aspects implied by the study of "sacred landscapes" may combine the archaeological analysis with an anthropological view of the landscape and its perception in order to come closer to an exhaustive picture of the Epirote religion and cult places and their relation with the social, economic and political reality. This could mean to take a further step towards comprehending the reasons behind the preference for some deities, the spatial distribution of sanctuaries, the diffusion and use of some mythical narratives and the cultural interactions between ethnic and political groups. In doing so, Mancini's volume represents an extremely useful reference work and a solid foundation for any scholar interested in approaching these topics in Epirus.

**Bibliography**

Aleotti N., Gamberini A., Mancini L. 2020. 'Sacred places, territorial economy and cultural identity in northern Epirus (Chaonia)', in *Boundaries Archaeology: Economy, Sacred Places, Cultural Influences in the Ionian and Adriatic Areas*, edited by E. Giorgi, G. Lepore, A. Gamberini, 45-63. Heidelberg: Propylaeum.

Chapinal-Heras D. 2021. *Experiencing Dodona: the development of the Epirote Sanctuary from Archaic to Hellenistic times*. Berlin-Boston: De Gruyter.

Dakaris S.I. 1971. *Archaeological guide to Dodona*. Ioannina: Cultural Society "The Ancient Dodona".

De Maria S., Mancini L. 2018. 'Territori e paesaggi sacri nella Caonia ellenistica e romana', in *Politics, Territory and Identity in Ancient Epirus*, edited by A.J. Dominguez, 193-246. Pisa: Edizioni ETS.

Emmerling T.E. 2012. *Studien zu Datierung, Gestalt und Funktion der ‚Kultbauten' im Zeus-Heiligtum von Dodona.* Hamburg: Verlag Dr. Kovač.

Evangelides D., Dakaris S.I. 1959. 'Το ιερόν της Δωδώνης Α. Ιερά Οικία' in *Αρχαιολογική Εφημερίς*, 1–194.

Mancini L. 2013. 'Templi, *thesauroi*, "*temples-trésors*". Note sull'edilizia templare non periptera nei santuari dell'Epiro ellenistico' in *Ocnus* 21, 75-99.

Mancini L. 2017. 'ΘΕΣΠΡΩΤΙΚΑ ΙΕΡΑ. Il contributo del paesaggio sacro alla conoscenza di un *ethnos* epirota', in *Annuario della Scuola archeologica di Atene e delle missioni italiane in Oriente* 95, 205-225.

Mancini L. 2019. 'L'architettura templare nei santuari dell'Epiro', in Dodonaios *L'oracolo di Zeus e la Magna Grecia. Catalogo della mostra, Museo Archeologico Nazionale di Reggio Calabria, (8 marzo-9 giugno 2019)*, edited by C. Malacrino, K. Soueref, L. Vecchio, 181-188. Reggio Calabria: Kore.

Mancini L. 2020. 'Il 'rovescio' del Continente. Paesaggi inferi d'Epiro tra fonti letterarie, miti contemporanei e realia', in Acheruntica. *La discesa agli Inferi dall'antichità classica alla cultura contemporanea*, edited by R.M. Danese, A. Santucci, A. Torino, 31-66. Urbino: Argalìa Editore.

Melfi M. 2007. 'The Sanctuary of Asclepius', in *Roman Butrint. An Assessment* edited by I.L. Hansen, R. Hodges, 17-32. Oxford: Oxbow Books.

Melfi M. 2012. 'Butrinto: da santuario di Asclepio a centro federale', in *I processi formativi ed evolutivi della città in area adriatica,* edited by G. de Marinis, G.M. Fabrini, G. Paci, R. Perna, M. Silvestrini, 23-30. Oxford: Archaeopress.

Piccinini J. 2012. 'Rethinking Epirote Religion. A Survey of Recent Scholarship on Epirote Cults and Sanctuaries', in *Annuario della Scuola archeologica di Atene e delle missioni italiane in Oriente* 90, 318-326.

Piccinini J. 2016. 'Renaissance or decline? The shrine of Dodona in the Hellenistic period', in *Hellenistic sanctuaries. Between Greece and Rome*, edited by M. Melfi, O. Bobou, 152-169. Oxford: Oxford University Press

Podini M. 2014. *La decorazione architettonica d'età ellenistica e romana nell'Epiro del nord*, Bologna: Bononia University Press.
Quantin F. 2008. 'Recherches sur l'histoire et l'archéologie du sanctuaire de Dodone. Les oikoi, Zeus Naios et les Naia' in *Kernos* 21, 9-48.
Rinaldi E. 2020. Agorai *ed edilizia pubblica civile nell'Epiro di età ellenistica*, Bologna: Bononia University Press.