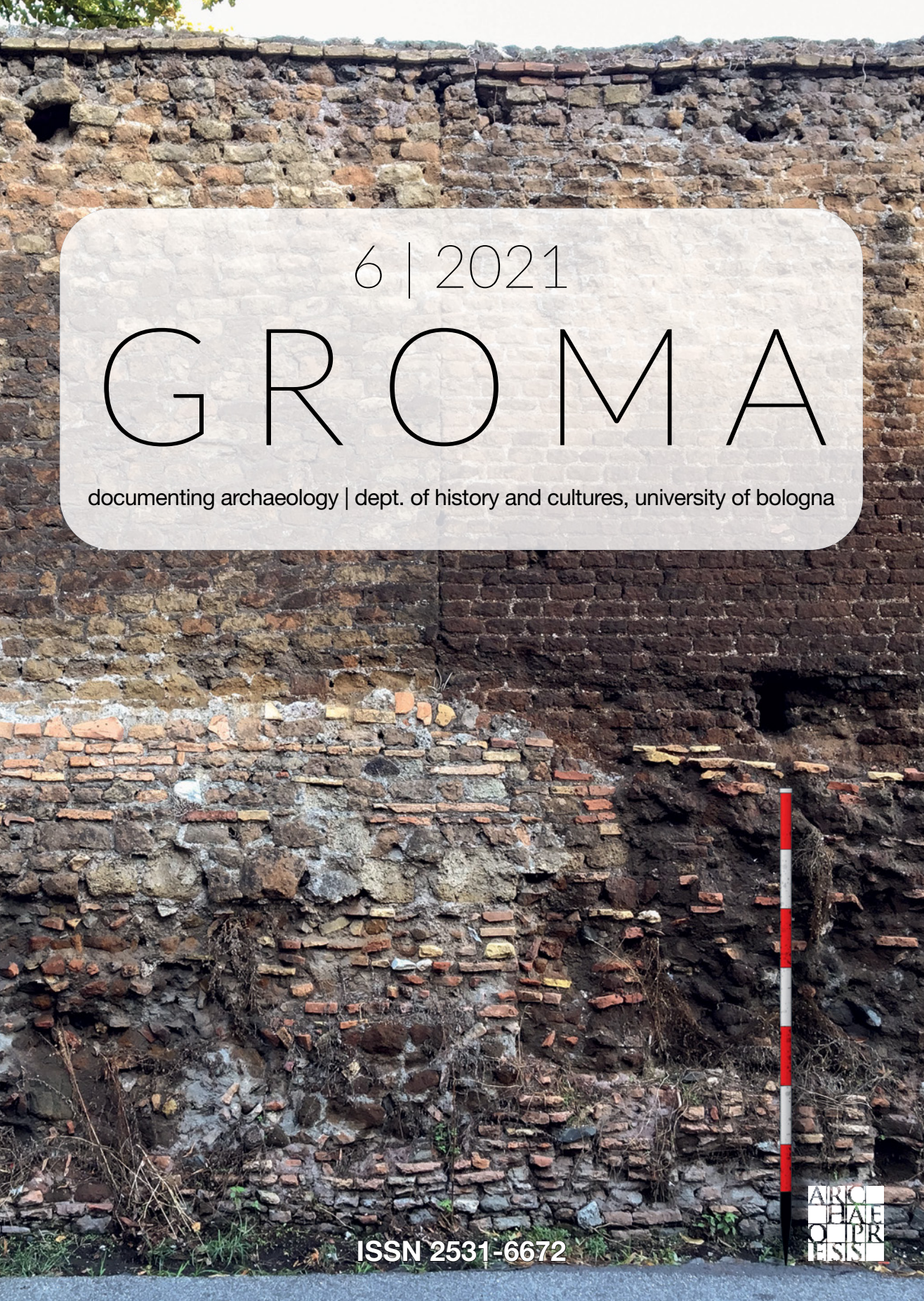

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Articles

Traces around a capital: the hinterland of Ravenna through remote sensing

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Abstract

Remote sensing has been a fundamental tool in reconstructing the urban landscape of the abandoned Late Antique city of Classe, near Ravenna (Italy). However, much of Classe urban plan is not yet known, while the vast area north of Ravenna has been generally ignored for the presence of thick alluvial deposits. The number of freely available aerial and satellite images has increased exponentially in the past decade, yet no study has exploited these sources. The features mapped by analysing these sources allowed us to identify new structures in Classe and shed new light on water management and land-use practices around Ravenna.

Keywords

Remote sensing, landscape archaeology, satellite imagery, longue durée, Ravenna

Introduction

Aerial archaeology started as a new methodology in the late 19th century when photos were taken mainly to document excavated sites. The full potential of aerial photography for archaeological explorations was already evident in the first half of the following century (Piccarreta and Ceraudo 2000, 73–84; Musson 2013, 17–26). In the last decades, more and more archaeological features have been successfully mapped in a wide range of landscapes and sites, also facilitated by technological innovations such as satellite imagery (Fowler 2010) and, more recently, drone applications (Campana 2017; Adamopoulos and Rinaudo 2020).

One of the Italian sites where aerial archaeology has played a crucial role is the abandoned city of Classe, near Ravenna (Fig. 1), where it helped shed light on the topography of both urban and suburban areas, and determined the identification of numerous buildings and infrastructures (i.e., streets, canals, bridges). The historical sources are not clear about the emergence of this centre, but decades of archaeological research have shown how a suburban area with scattered rural villas and necropoleis (Manzelli 2000) turned into a city equipped with walls and numerous basilicas (Augenti 2011). This drastic change happened from the 5th century CE, with the new role of Ravenna as the capital of the Western Roman Empire (*Ravenna Da Capitale Imperiale a Capitale Esarcale* 2005) and with the emergence of Classe as one of the most important ports in the Mediterranean (Augenti 2019).

Much knowledge about this city and its hinterland derives from aerial archaeology, with the first applications already in the 1950s-60s (*Convegno per lo Studio della Zona Archeologica di*

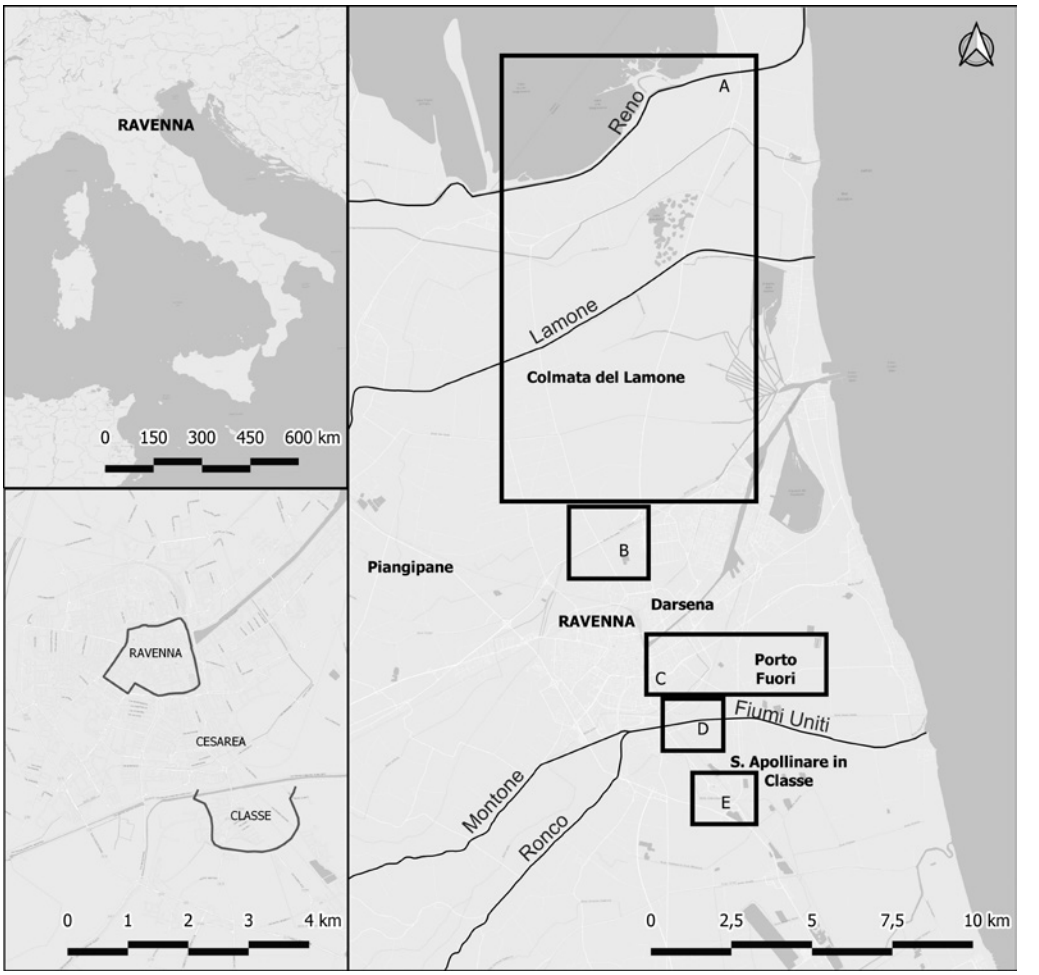

Figure 1. Positioning of Ravenna within the Italian Peninsula (top-left inset), Ravenna-Cesarea-Classe urban system (bottom-left inset), and the location of Ravenna and the five areas discussed in detail with rivers and main towns: A: the area of the Colmata and Po di Primaro river; B: the area of the northern suburb of Ravenna; C: the area of the southern suburb of Ravenna; D: the urban area of Classe; E: the surroundings of Classe (basemap Esri). Author M. Abballe.

Classe a Mezzo dell'Aerofotografia 1962), then further complemented in the first decade of the 21st century (Boschi 2008). These studies were also assisted by the analysis of satellite data and large-scale geophysical prospection (Boschi 2012b). In the meantime, several structures and buildings were excavated, including part of the Late Antique/Early medieval harbour infrastructures (Augenti and Cirelli 2012) and main religious complexes such as the monastery of San Severo (Augenti, Christie, and Laszlovszky 2017) and the basilica Petriana (Augenti, Boschi, and Cirelli 2010).

Despite all these investigations, much of the urban plan within the city walls is not yet known. Understanding the evolution of the extra-urban landscape also remains complex due to the

environmental transformations that have characterised the area, such as coastal progradation, (artificial) river avulsions, and wetland reclamations.

Despite the successes achieved through aerial archaeology at Classe, no studies have exploited the new and free to use aerial and satellite images that have been made available during the past decade (Scardozzi 2016, 217). These new data may potentially help to fill in the empty areas within the city walls where buildings have not yet been found. These numerous but still largely unexplored sources had already been identified as potentially fundamental to integrating our knowledge of the hinterland of Ravenna (Abballe 2021). Together with historical images, these large data sets have already proven essential to map new fluvial traces in the Romagna plain, from protohistoric palaeochannels near Imola (Bologna) and Forlì (Forlì-Cesena) (Abballe and Cavalazzi 2021), and medieval flood events around Massa Lombarda (Ravenna) and Villafranca di Forlì (Forlì-Cesena) (Abballe 2022).

In addition, we wanted to assess whether this approach could also work in the *Colmata del Lamone* area, a vast area north of the Ravenna that has been generally ignored for the presence of thick alluvial layers connected with the 19th-20th centuries massive land reclamation project (Nardi 1987). Here, the analysis of aerial and satellite photos aimed at identifying possible natural and/or anthropogenic traces predating the land reclamation programme, that might still be outcropping in geomorphological windows, namely areas not buried by later alluvial deposits. Specifically, the study of the coastal area near Ravenna also links with the Dante Pinewoods project promoted between 2019 and 2021 to investigate the landscape, climate, and environment in the coastland of Ravenna, with a specific focus on the pinewoods standing in the area from the Middle Ages onwards (Bortoluzzi and Cavalazzi 2022).

With these objectives in mind, this paper will discuss the new evidence mapped around Ravenna, especially in the poorly known area north of the city. Moreover, we will also present some novel evidence within and near the abandoned town of Classe, to the south of Ravenna, which sheds light on a large and articulated building near the so-called basilica Petriana.

M.A.

Methodology

The primary research consisted of systematically analysing all aerial photos and satellite images freely available online to identify crop and soil marks possibly related to buried natural landforms, such as palaeochannels and crevasse splays, and/or anthropogenic features like channels, canals, and buildings.[1] This work has been facilitated by many freely available digital sources offered by national and regional governmental bodies and private companies (Fig. 2).

Notable is also the advanced state of digitalisation of topographical and geographical data provided by the Emilia-Romagna region through their Moka, a Content Management System for GIS data accessible online. Thanks to this platform, we were able to analyse two of the oldest cartographic sources covering the whole Ravenna province (and beyond), such as the *Carta storica regionale o Carta Topografica Austriaca* from 1853 and the *IGM Primo Impianto* from 1877-95. These two sources also offer a reasonable resolution for the identification of the

[1] For the methodology used, see Ceraudo 2013, 28–29; Musson 2013, 64–66; Verhoeven et al. 2013.

Source	Year	Type	Sensor
Volo Istituto Geografico Militare Italiano (IGMI)	1931-1937	Aerial	B/W
Foto Royal Air Force (RAF)	1943-1944	Aerial	B/W
Istituto Geografico Militare Italiano (IGMI), Volo GAI (Gruppo Aeronautico Italiano)	1954-1955	Aerial	B/W
Ministero dell'Ambiente e della Tutela del Territorio e del Mare (MATTM)	1988–1989 1994–1996 2000 2006–2007 2012	Aerial	B/W (first 2 series) RGB (last 3 series)
Agenzia per le Erogazioni in Agricoltura (AGEA)	2008, 2011	Aerial	RGB NIR
Google Earth Pro	2003 - 2020	Satellite	RGB
Microsoft Bing	2009 - 2020	Satellite	RGB
Esri World Imagery	2011 - 2018	Satellite	RGB
Consorzio telerilevamento agricoltura (TeA)	2014 2017	Aerial	RGB
Yandex	2021	Satellite	RGB

Figure 2. List of aerial and satellite images used for this research. Author M. Abballe.

agrarian subdivisions existing at the time (second half of the 19th century), thus offering a first *terminus ante quem* for the dating of some of the evidence identified.

Furthermore, the hinterland of Ravenna has been documented in historical maps since the 15th century. The most relevant sources are available in the local archives, such as the *Archivio di Stato* or the *Archivio Storico Comunale*. In particular, maps dated after the 17th century helped in interpreting some of the traces detected, especially the infrastructural ones, which are usually depicted in the cartography of the time.

M.A.

New data from aerial and satellite imagery

Intense urbanisation characterises the territory immediately around Ravenna so that rural areas are not frequent. Furthermore, massive reclamation works carried out in modern times (deeply) buried the palaeolandscapes both north of the urban centre and south of Classe (Fabbri 1987). These reasons led previous studies to ignore these areas, but novel data have emerged during our research, which we will summarise in the upcoming sections.

The southern suburb of Ravenna

The first area where several new features emerged is located between Ravenna and the Fiumi Uniti river, artificially created in the 18th century (Fig. 1.C) (Bellardi 1741). Most of them

Figure 3. Southern suburb of Ravenna, area north of Fiumi Uniti and near Via dei Poggi: A: site seen on Yandex imagery 2021; B: same site seen on Google Earth 2021; C: possible structural anomalies highlighted: square-shaped structural anomaly (no. 1); circular feature (no. 2); field divisions (no. 3). Author M. Cavalazzi.

became visible in Yandex imagery from 2021 and Google Earth imagery from September 2021 (Fig. 3), where we can recognise a 3 m wide positive crop mark northeast of Via dei Poggi. In particular, in the Google Earth imagery the more luxuriant vegetative growth defines a possible squared feature,[2] approximately 30 m per side (Fig. 3.C, no. 1). A smaller rectangular feature seems to connect to the southern side of the squared anomaly, again visible as a positive crop mark about 1.7-1.8 m thick, for a total perimeter of 12x5 m. In addition, a circular negative anomaly is visible just a few metres to the south, with a diameter of 5 m, plus a negative edge of circa 2-3 m that may refer to the same feature (Fig. 3.C, no. 2).

Numerous positive anomalies are also recognisable throughout the field, about 2 metres wide and parallel to each other, with a southwest/northeast orientation (Fig. 3.C, no. 3). These intersect almost orthogonally with at least three larger positive crop marks, between 2 and 3 m wide, also parallel to each other but oriented northwest/southeast. The first can be interpreted as agricultural channels due to their regularity, while the second set of evidence has a less precise shape. They may result from a difference in the local geology, corresponding to the presence of swales within a beach ridge, since these depressions favour water stagnation and, thus, vegetation growth.

Moreover, several other marks can be seen in the same imagery moving east towards Porto Fuori, both negative and positive (Fig. 4). We want to draw attention to five of these. The first is a very large feature located between Via del Grano and Via Argine Sinistro Fiumi Uniti (Fig. 4.A). It is recognisable as a negative soil mark in the eastern fields and as a complex anomaly in the western field. This second evidence is characterised by a darker (positive) mark on the south border, circa 5 m wide, while the remaining anomalies alternate between more luxuriant parts with less luxuriant ones. In total, this feature seems to be 60 m wide and at least 600 m long. Southwest, we can also see another feature that had already been mapped and interpreted as a chunk of the Panfilio canal (Boschi 2012b, id. 211), an artificial channel

[2] Only three sides are visible while the fourth roughly coincides with Via dei Poggi.

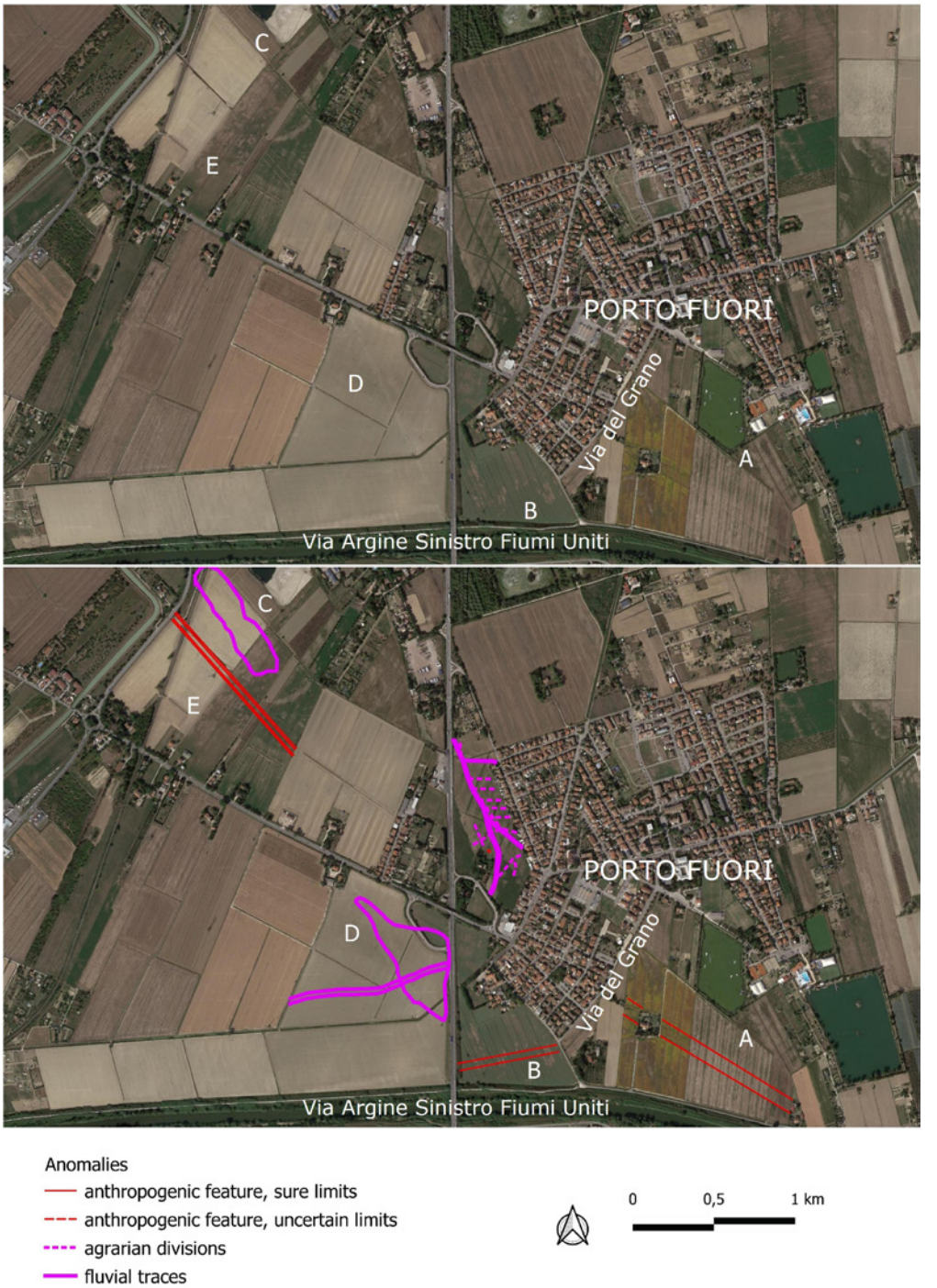

Figure 4. Southern suburb of Ravenna, surroundings of Porto Fuori: A: canal south of Porto Fuori; B: Panfilo canal; C-D: fluvial traces associated with the Badoreno; E: newly mapped canal (Google Earth 9/2021). Author M. Abballe.

created around 1650 to connect Ravenna with the no longer existing Candiano harbour (Fig. 4.B) (Boschi 2012b, 228).

Furthermore, according to written sources, the more ancient Badoreno channel was supposed to reach Porto Fuori, a waterway existing at least from the 6th century that connected Ravenna to the Po river to the north and the Adriatic sea towards the south (Novara 1994, 13–20; Gelichi 1991, 154). Several features have already been mapped west/northwest of Porto Fuori (Boschi 2012b, 250, tav. 1), including two interpreted as potential remains of the Badareno (Fig. 4.C-D) (Boschi 2012b, id. 67 and 202). All these features have been linked to natural hydrography, but in the same Google image, we can clearly see an artificial channel circa 20 m wide with embankments of about 2/3 m, visible as negative crop marks (Fig. 4.E). The same channel can be better seen in a MATTM aerial image of 6 August 2005, with the possible embankments highlighted as positive anomalies. In total, it can be followed for about 1 km, ideally connecting the modern Darsena to Porto Fuori.[3]

M.A., M.C.

The northern suburb of Ravenna

Moving northwards of Ravenna, the first set of novel evidence we present is located near Via S. Alberto, just on the city's outskirts (Fig. 1.B). Many positive crop marks are visible in the same Google Imagery from September 2021 (Fig. 5). Most of them are circa 2 m wide and cluster near the crossroads between Via S. Alberto and Via Bisanzio. They may be interpreted as channels, and they define several parcels much smaller in size and with an utterly different orientation than the current ones (Fig. 5.A). Some of the marks appear to be double, both in the fields south of the crossroad and about 600 m further north, where we can see similar features likely connected. These may be correlated to a larger feature to the west, about 15 m wide, recognisable in Esri images from both 18/08/2020 and 27/04/2022. Its sinuous shape could indicate a natural palaeochannel, from which the canals of the fields could potentially draw water.

A little further south, we can also partially reconstruct the course of an almost certainly artificial canal circa 10 m wide (Fig. 5.B). The central one of the three identified chunks, mapped in Google imagery, appears as a negative soil mark, while negative crop marks correspond to the western chunk visible in MATTM images from 2000 and 2006. In the former, a potential third chunk is visible near the Mausoleum of Theodoric, with a north/south direction (Fig. 5).

M.A.

Area of the Colmata and the Po of Primaro

Further north, dozens of km of canals have been mapped in the *Colmata del Lamone* area (Fig. 1.A),[4] which can be traced back to the various phases of this extensive reclamation programme

[3] The features visible in this aerial image match perfectly with those of a Quickbird satellite image discussed in Boschi 2012b, 102, fig. 3.1.3.1, suggesting they were both shot in the same period.
[4] The geological map of Ravenna edited by Domenico Preti (2002) served as basis for their mapping.

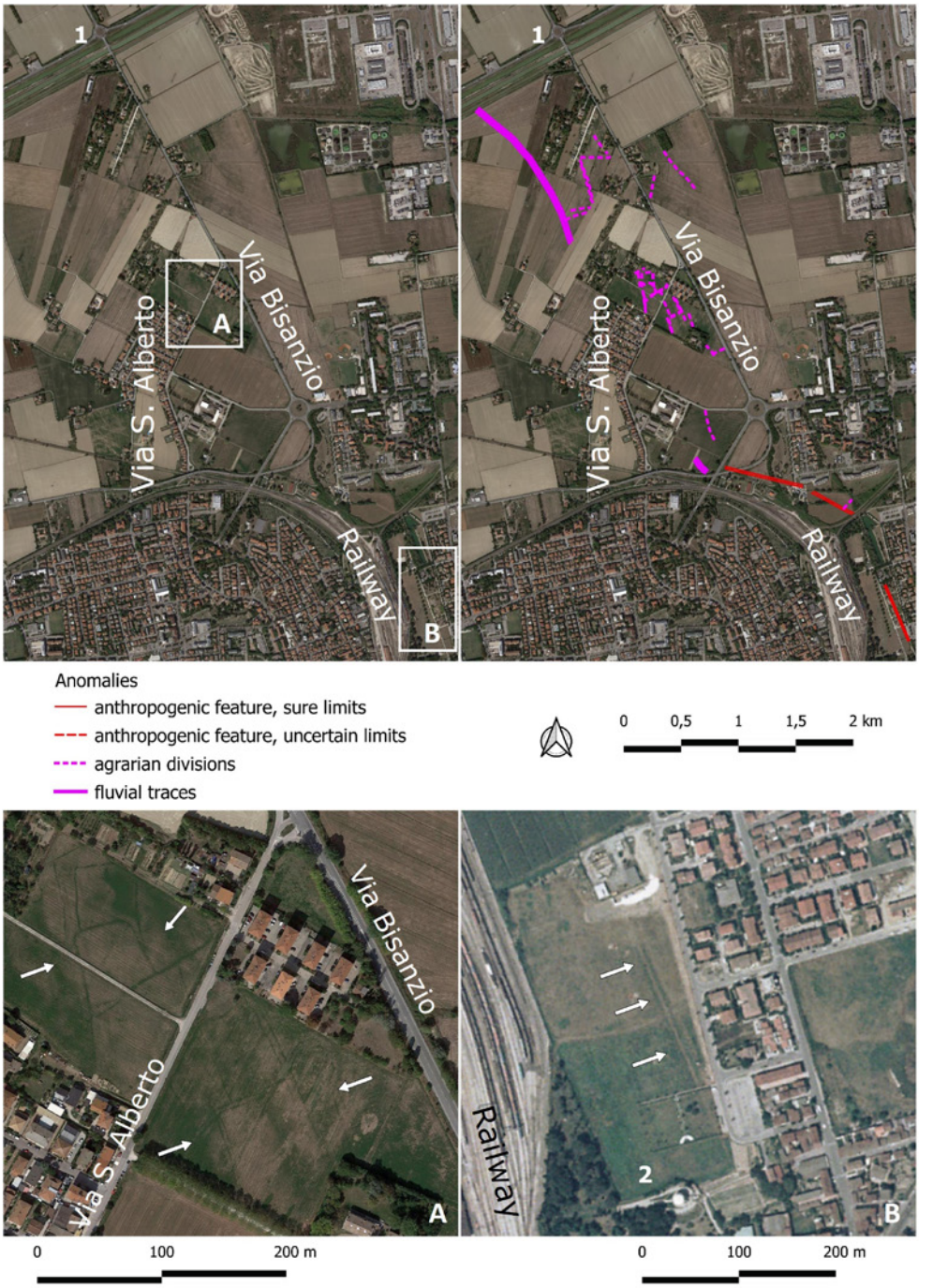

Figure 5. Northern suburb of Ravenna: all newly mapped fluvial and anthropogenic traces (Google Earth 9/2021) with no. 1 indicating the only known archaeological site in the area, dating to the Roman period; A. possible post-Roman field system (Google Earth 9/2021); B: palaeochannel northwest of the Mausoleum of Theodoric, indicated by no. 2 (MATTM 2000). Author M. Abballe.

promoted between the 19th and 20th centuries. However, several traces seem unrelated to this programme and, they may refer to more ancient features.

In the area that goes from the Reno river towards south, a special focus was put on the surroundings of Mandriole (Fig. 6, no. 1), where chunks of a large palaeochannel connected to the medieval *Po di Primaro* can be observed (Abballe 2021). These are particularly visible in Google Earth imagery (3/2011 and 9/2021, Fig. 6, letter A) and IGMI aerial photos from 1954 (Fig. 6, letter B). The medieval monastery of S. Adalberto in Pereo was located upon this fluvial ridge (Fig. 6, no. 2) (Novara 1994).

South of the Canale Destra Reno, within the *Colmata* area, the imagery shows a network of embankments, channels and roads: they are visible on Google Earth imagery (3/2020; 4/2020; 4/2018; 3/2015; 3/2011) and aerial photographs (IGMI-Volo GAI 1954) as soil and crop marks, both positive and negative, depending on field-use or cultivation status (Fig. 7.A).

Further south, in the area between the river Lamone and the hamlet of San Romualdo (Fig. 7.H, no. 10), the number of anomalies increases. In particular, the oldest aerial photos, such as the IGMI-Volo GAI (1954) and RAF (1944) are the most significant. We will focus here mainly on two features that can be observed in these images (Fig. 7.D). The first is a sinuous positive anomaly, approximately 650 m long, that may refer to a large fluvial meander (Fig. 7.D, no. 2). It is visible in the IGMI 1954 flight west of S. Pietro in Armentario site (Fig. 7.D, no. 3)[5] and north of S. Romualdo (Fig. 7.H, no. 10). The second is a positive anomaly, probably the trace of a buried canal, approximately 20 m large and 2 km long, oriented north-south, visible in the flights IGMI-Volo GAI 1954 and RAF 1944, and Google Earth images from April 2020 and July 2017 (Fig. 7.D, no. 4 and Fig. 7.F, no. 8).

Moving east, the flights IGMI-Volo GAI 1954 and RAF 1944 show several interesting features near the archaeological site of S. Maria in Palazzolo (Fig. 7.E, no. 6) (Augenti, Ficara, and Ravaioli 2012, 271–72, id. 274), a monastery founded in the 9th century on the site previously occupied by a rural church and a palace (Bermond Montanari 1983; Pasquali 1983), which *Agnellus* attributes to Theodoric, king of the Ostrogoths (*Liber Pontificalis Ravennatis* A, 303). The first is a sinuous trace near the dune ridges southwest of the site, approximately 1.1 km long, which appears both as negative soil and crop marks (Fig. 7.E, no. 7). The second is a network of agrarian divisions, still clearly visible, in the area east of Palazzolo (Fig. 7.F, no. 9). The third, in this same area, is a negative anomaly, approximately 500 m long, a few metres large and with an irregular path (Fig. 7.E, no. 5). Finally, tens of small circular anomalies are arranged regularly in parallel rows (Fig. 7.B-C).

Moreover, moving towards Ravenna (Fig. 7.G), it is possible to detect several positive and negative anomalies in Google Earth images from 2021. These rectilinear features are perpendicular to the nearby beach ridge, which is a prosecution of the same identified near Classe and generally dated to Late Antiquity (Abballe 2021, 39).

M.C.

[5] This church may have been erected already in the 4th century, and only abandoned around in the 15th century, but few reliable data actually exist; see Novara 1994, 18–21, n. 5.

Figure 6. The area of the Po of Primaro near the hamlet of Mandriole (no. 1), seen through Google Earth 3/2011 (letter A) and IGMI-Volo GAI 1954 images (letter B); no. 2 corresponds to the site of the monastery of S. Adalberto in Pereo. Author M. Cavalazzi.

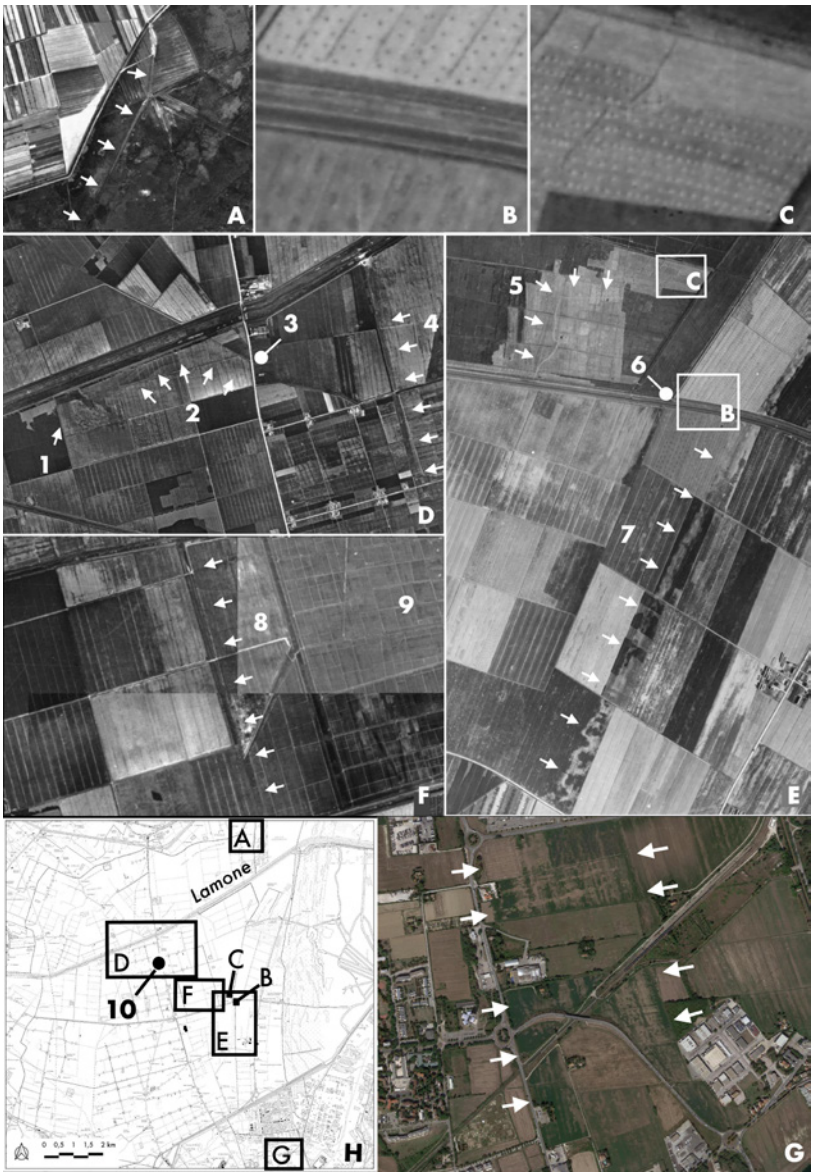

Figure 7. Area of the Colmata: A: IGMI-Volo GAI 1954 with traces of embankments and channels south of Canale in Destra Reno, while the arrows highlight the Padoreno channel, according to the historical maps; B-C: Volo RAF 1954 over the area of Palazzolo with traces of pinewood; D: IGMI-Volo GAI 1954 with a crevasse splay (no. 1) south of the river Lamone, probably related to the Colmata process and larger fluvial trace (no. 2), near the site of S. Pietro in Armentario (no. 3) – located according to the historical map (Archivio Storico Comunale di Ravenna, CCX, 66) – and the Padoreno canal (no. 4); E: Volo RAF 1954 with the trace of a path/trial (no. 5), the site of Palazzolo (no. 6) and a swale (no. 7); F: IGMI-Volo GAI 1954 with the Padoreno canal (no. 8) and traces of rice paddles (no. 9); G: Google Earth 2021 with agrarian divisions on the dune ridges; H: position of each inset with IGM 1:25.000 basemap and location of S. Romualdo hamlet (no. 10). Author M. Cavalazzi.

The urban area of Classe

As already mentioned, the site of Classe has been investigated extensively and with various methods. The availability of new aerial and satellite images can fill the gap of many 'empty' areas within the urban walls (Fig. 1, D). Among these, the Google Earth images of September 2021 have been the most fruitful (Figg. 8-9).

Most of the new evidences are clustered around the site of the so-called basilica Petriana (Fig. 8, no. 3), a palaeo-Christian church investigated by excavation and geophysical investigation (Abballe 2021, 39). The basilica itself was already visible in several aerial and satellite images (Boschi 2012b, 205, fig. 6.2.2.1). Still, we can see the building north of it, previously known only thanks to magnetometry (Boschi 2012a, 224, fig. 5.), for the first time through remote sensing. The plan of the basilica matches perfectly with the previous reconstruction, while we can also see for the first time an unknown part of the northern building, namely its northern corner (Fig. 8, no. 2), which was not visible in the geophysical results. This difference could indicate a distinct state of preservation of the structures. Unfortunately, the entire eastern half of this rectangular building is not visible in the recent satellite images, concealed by a change of use of the field.

However, the most interesting data concerns a building located southeast of the Petriana, already identified through geophysics but whose plan remained unclear (Boschi 2012a, 224, fig. 5.). Numerous negative crop marks define part of a central plan building, composed of several apses and octagonal rooms connected to a central room (Fig. 8, no. 4). Moreover, a structure with a Latin cross planimetry is also clearly visible at the southwest corner. The central room is circa 22-25 m large, while the whole building is at least 65-70 metres long.

A positive crop mark can be noted close to it, in northern direction, already identified as the harbour-canal of Classe (Fig. 8, no. 1) (Boschi 2012b, 223). The basilica and the nearby buildings seem to be aligned to this channel.

Finally, the same imagery also sheds more light on the urban and extra-urban areas, east of the basilica Petriana (Fig. 9). The 2021 imagery shows a negative anomaly, corresponding to the already mapped urban wall circuit (Fig. 9, no. 1), which was partially excavated (Lepore and Montevecchi 2009). Furthermore, rectangular and linear traces are visible just inside the walls, appearing as negative vegetation marks and suggesting the possible presence of additional archaeological remains also next to the city walls (Fig. 9, no. 2). Around 85 m further east, a negative crop mark can be recognised, mostly likely a palaeochannel oriented approximately north-south, almost parallel to the city walls circuit (Fig. 9, no. 3).

Further eastwards, other channels and a series of positive crop marks oriented west/east, circa 2 m wide and parallel to each other are visible (Fig. 9, no. 4). They are perpendicular to the Late Antique beach ridge (Abballe 2021, 39), whose swales are clearly visible as positive crop marks. Approximately in the middle of the series of channels, probably related to agricultural activities, a more clearly defined (primarily positive) feature is visible, having the same orientation as the smaller channels. This larger evidence may have a continuation

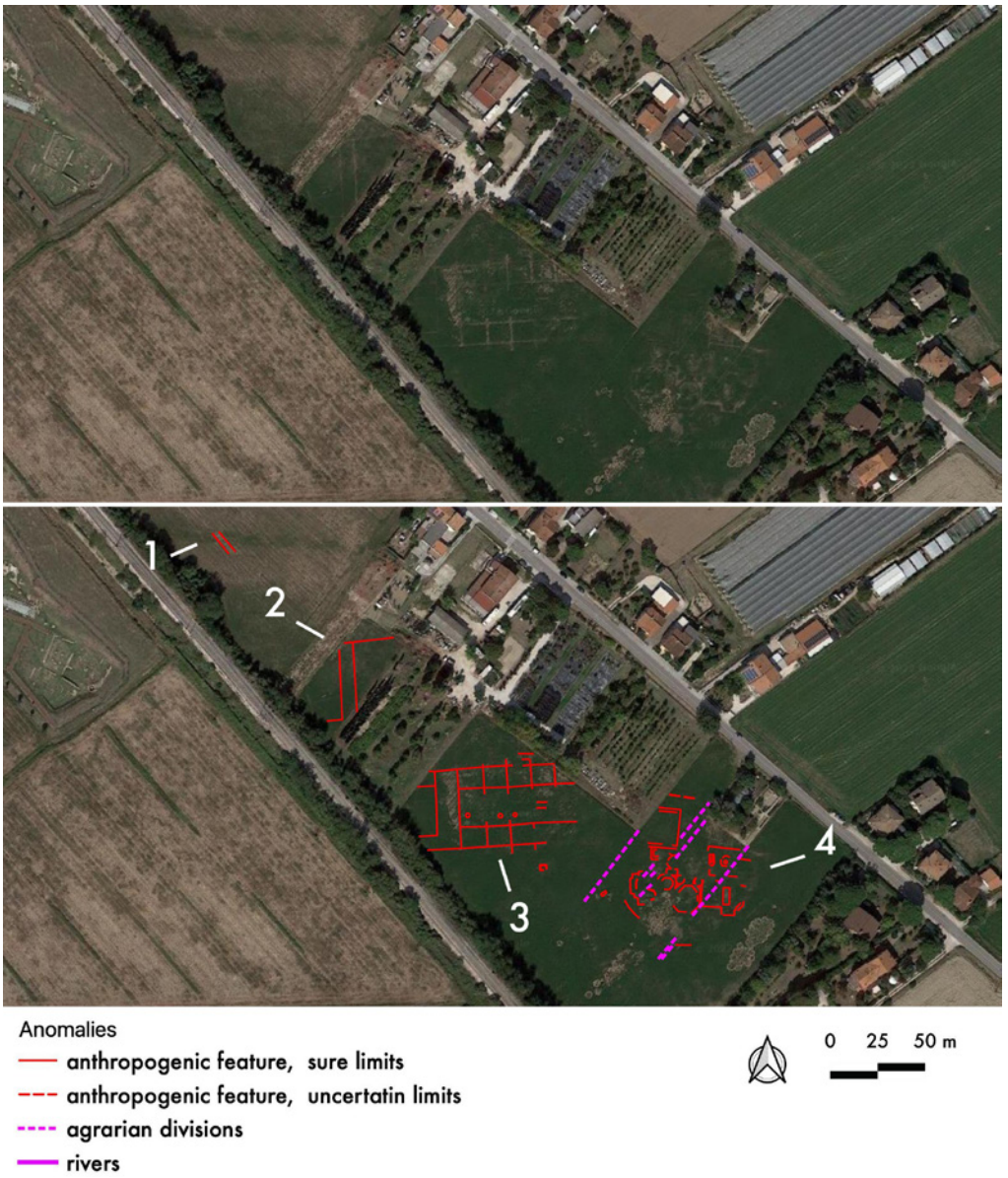

Figure 8. Area of Classe seen on Google Earth 2021 with anomalies described in the text: the harbour-canal of Classe (no. 1), the building north of the Petriana (no. 2), the basilica Petriana (no. 3), and the building with a central octagonal room south of the basilica (no. 4). Author M. Cavalazzi.

about 20 m further south, defining a possible channel about 35 m wide in total (Fig. 9, no. 5).[6] Currently, we have not been able to find existing data to propose a dating (and function) for this large double feature, so targeted investigations will be needed.

M.C.

[6] This more recent imagery integrates satellite (Boschi 2012b, 218, fig. 6.3.1.7) and MATTM aerial images from 2005.

Figure 9. The area of Classe seen on Google Earth 2021 with anomalies in the area of city walls (no. 1), remains of buildings (no. 2), palaeochannels (nos. 3 and 5) and field system (no. 4). Author M. Cavalazzi.

The southern hinterland of Classe

Several dozens of already known natural and anthropogenic features south of Classe (Fig. 1.E) (Boschi 2012b, 252–56, tavv. 3-7), where confirmed through our re-analysis. New features were particularly evident in an Esri image from August 2018, and they cluster in a modern parcel south of the Classe junction along the SS16 Via Classicana (Fig. 10).

The main feature is a negative crop mark about 630 m long and 5 m wide, characterised by darker edges, namely positive crop marks (Fig. 10.A). This feature is mostly straight, with a northwest/southeast direction, but it clearly has a sinuous path in the southern part. The meandering of the southern section seems to contradict the previous interpretation as a road axis (Boschi 2012b, id. 131), when the dark outer edges were interpreted as lateral channels. Thus, we propose to interpret these features as a large swale with two more possible parallel ones, one on each side. Their presence is perfectly compatible with the beach ridge already mapped (Boschi 2012b, id. 217), responsible for the general vegetation growth difficulty. However, there are numerous positive crop marks, primarily perpendicular to both ridge and

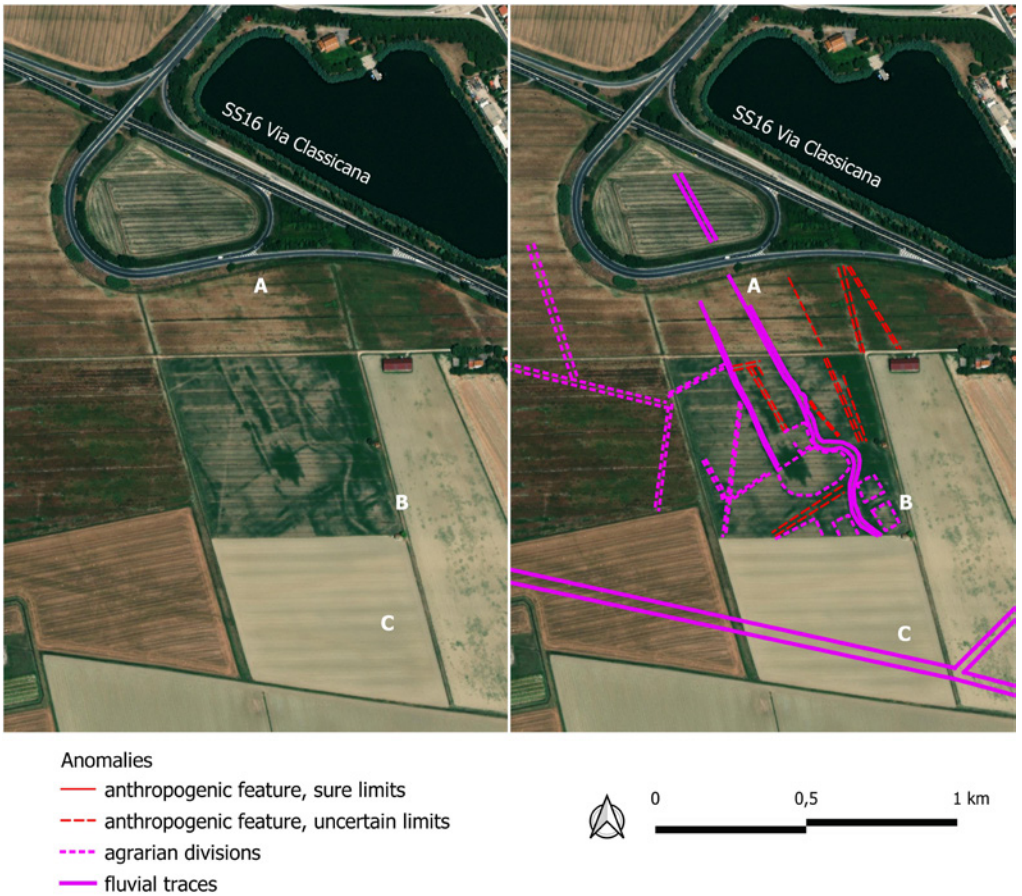

Figure 10. Area south of Classe with both natural and anthropogenic traces (Esri 2018): A: large swale; B: small quadrangular parcels; C: already known large palaeochannel of a rectified river. Author M. Abballe.

swales, perfectly compatible for orientation with the channels already mapped immediately to the west (Boschi 2012b, id. 130). This correspondence is further confirmed by the presence of quadrangular areas, of about 25-30 m per side, identified in the southeast corner of the field and also recognised about 500 m further west (Fig. 10.B). Thus, the presence of these small square plots seems to characterise this field, differentiating it from those nearby where only parallel channels were mapped (Boschi 2012b, 253, tav. 4).

M.A.

Discussion

The suburbs of Ravenna and Classe

The interpretation of all river evidence, probable artificial channels and possible agricultural subdivisions mapped both north and south of Ravenna is by no means a simple task. This difficulty is due both to the geomorphological transformations that have affected the area, which have never been studied in detail and to the small number of known archaeological sites outside the urban areas (CPA-RA). We will focus on three locations where the intersection of previous (geo)archaeological data and the analysis of historical cartography allows us to narrow down the chronological framework for the creation of the features mapped by remote sensing.

From the north, the first area is located between Via S. Alberto and Via Bisanzio, just outside Ravenna (Fig. 5.A). The system of fields identified here does not appear in the aerial photographs nor in the 19th-century maps analysed, suggesting an earlier date. Moreover, the only certain archaeological data in the vicinity suggests that the Roman level is at a depth of about 2.5 m (CPA-RA, SA001). Therefore, targeted investigations will be needed to understand whether we are dealing with a peculiar medieval or early modern parcelling and if it was associated with specific land use.

The second area is located near the Mausoleum of Theodoric (Fig. 5, no. 2) and concerns the identification of a possible canal that appears to run not too far from it, in a north/south direction (Fig. 5.B). Written sources indicate that the Badareno ran near this site before reaching Porto Fuori, southeast of Ravenna (Fabbri 1991, 18). Traces of this canal may also have been found during the park's landscaping (Venturini 2003), which led to the discovery of a ship dating to the 5th century (Maioli and Medas 2010). It is difficult to say whether the mapped feature is really the trace of this vital waterway and, if so, whether it belongs to the first phase of activation/creation during Late Antiquity/Early Middle Ages, or to later resettlements that may have been necessary after the *Colmata* reclamation (see section 4.3).

Finally, the third area is the southernmost one, south of the Basilica of Sant'Apollinare in Classe (Fig. 1.E). As mentioned above, numerous natural and anthropogenic evidence have been mapped in a field south of the Via Adriatica (Fig. 10). Among these, the most enigmatic ones are certainly the small quadrangular squares that emerged both in this field and previously mapped further west. These do not appear in the aerial photographs, and it is evident from the 19th-century cartography that the area was occupied at the end of the century by enormous paddy fields, identified as 'Risaia Munghina' in the IGM *Primo Impianto* (Pancino 2000). These

small squares could correspond to internal subdivisions of the rice fields, whose traces have now almost completely disappeared due to the change in land use.

M.A.

Classe

The main question raised from our discoveries in the site of Classe relates to the interpretation of the complex building located southeast of the basilica Petriana (Fig. 11) (Augenti 2012, 55; Boschi 2012a; 2012b, 201–3). Assuming that the identification of the structures excavated between 2004 and 2008 with the basilica Petriana is correct, as no epigraphs or similar clear evidence have emerged to confirm the dedication of the building, we may tentatively recognise this large building with the baptistry of the Petriana, mentioned in the medieval sources. Agnellus describes this baptistry as 'wonderful in size, with doubled walls' – probably an *ambulacrum* (Testi Rasponi 1924, 2, 3:148, n. 2) – 'and high walls, built with mathematical art' (*Liber Pontificalis Ravennatis* A, 312; *Liber Pontificalis Ravennatis* B, 161). He also adds that two *monasteria,* St. Matthew and St. James, were joined to the sides of the baptistry (*Liber Pontificalis Ravennatis A*, 336; *Liber Pontificalis Ravennatis B*, 203). The Latin cross-shaped building can be one of them. However, Agnellus's words seem to go against this hypothesis since, according to him, the baptistry was squared-shaped (*tetragonus*) and not octagonal (*Liber Pontificalis Ravennatis A*, 325; *Liber Pontificalis Ravennatis B*, 183: Agnellus specifies that the baptistry included a *pars virorum* and a *pars mulierum*), as frequently happened in the Ravenna area.[7]

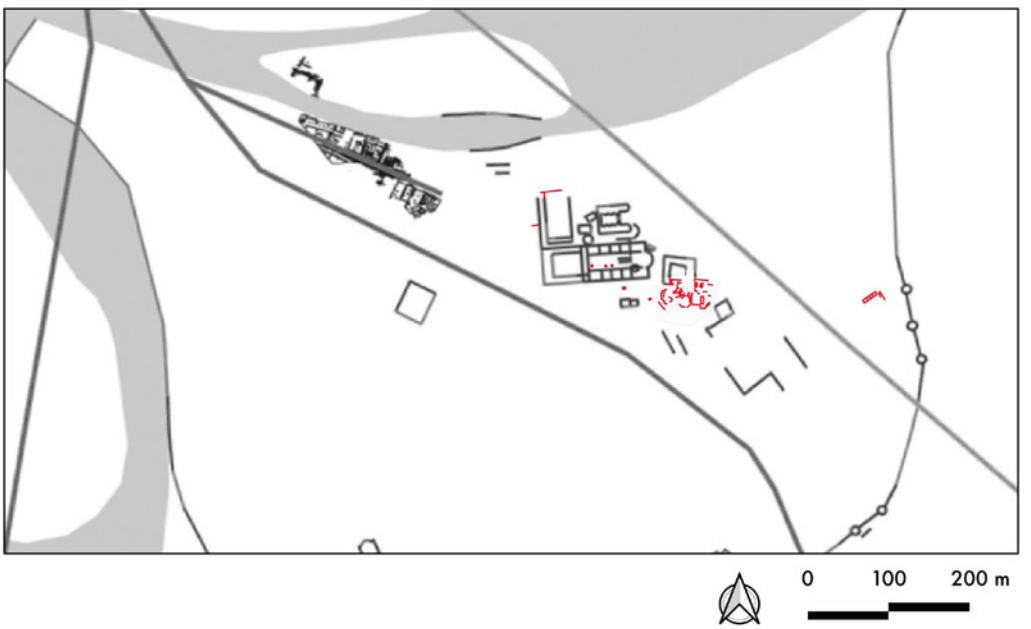

Figure 11. Map of the monuments of Classe with the structures, previously unknown, identified thanks to the aerial and satellite imagery in red. Author M. Cavalazzi.

[7] See *Liber Pontificalis Ravennatis B*, 323–4, where Deborah Mauskopf Deliyannis underlines that squared baptistries are quite common in Africa, according also to Deichman 1976, 352.

Indeed, most of the shapes recognised in the satellite image seem to be octagonal. Anyway, Agnellus may simply refer to the exterior plan of the building at ground level, as pointed out by Testi Rasponi (Testi Rasponi 1924, 2, 3:148, n. 2). If this were the case, the building would have appeared partially as a square, similar to the still-existing Neonian or Arian baptisteries (the latter, less clearly) in Ravenna.[8]

If these traces within the walls certainly refer to buildings, additional structural remains may be located immediately north of the Fiumi Uniti river (Fig. 3). We saw how positive crop marks define a rectangular enclosure, associated with a circular anomaly with a diameter of circa 8 m. At the moment, they seem not to be related to the many natural and agricultural traces seen in the parcel, and we cannot exclude that they refer to buried structures. No archaeological remains are known for this parcel, which is located between the settlements of Classe and Cesarea (Fig. 1). However, the area seems to be important, since medieval and modern cartography places the *via Romana* here, a road connecting Ravenna to Classe and the nearby pinewood (Boschi 2012b, 50–51, 243, 248). Furthermore, previous studies located the *monasterium* of the saints *Johannis* and *Stephani ad Titum* or *ad Pinum* in this area, which according to the written sources existed between the 6th and 11th centuries.[9] So far, it is impossible to associate with certainty the marks identified to this church, but this can be a starting point to address further investigations.

M.C.

Ravenna northern wetlands

The most interesting features located north of Ravenna tell us about the long-term interaction between humans and water in a very hostile landscape.

The main evidence of the area can be strongly related to the Padoreno channel (Figg. 7.A and 12, no. 3). This infrastructure was part of the network of canals that linked Ravenna and its harbours to the Po river during the Middle Ages (Novara 1994, 13–20; Gelichi 1991, 154). Still, the Padoreno may have been created during Late Antiquity to replace the *Fossa Augusta*, an artificial canal connecting Ravenna to the Po river.[10] The preliminary interpretation of these traces with this important channel is possible thanks to abundant historical cartography, which depicts it from the 16th century onwards. However, we must underline that the earlier maps, such as the so-called Ginanni map (Ginanni 1774) or the map of the Bonifica Gregoriana (1585, Carrari 2009, fig. 34) draw the Badareno channel in an approximate way, without any real topographical precision, as commonly happens in such cartographic representation. Still, the anomalies detected find a sufficiently accurate reference in the more recent cartography, such as the *Carta storica regionale* or *Carta Topografica Austriaca* (1853) and the IGM *Primo Impianto* (1877-95), although the Lamone flood in 1839 and the following land reclamation process of the *Colmata* might have slightly change the Badoreno route.

[8] Bovini 1964, 52, 190; Farioli Campanati 1983, 47; the ground levels of the Arian and the Neonian Baptistries are now buried underground; the Arian baptistry was characterised also by an *ambulacrum* with a polygonal plan, now disappeared. For full bibliography about the Neonian baptistry and the references to other square baptistries in northern and central Italy see: Muscolino, Ranaldi, and Tedeschi 2011, 11–28.

[9] Berti Ceroni and Smurra 2005, 114–15, n. 87, about the *monasterium* see also Farioli Campanati 1983, 51.

[10] The *Fossa Augusta* may have been filled up by alluvial deposits by the 3rd century CE, together with the Roman harbour of Ravenna (Bortoluzzi and Cavalazzi 2022).

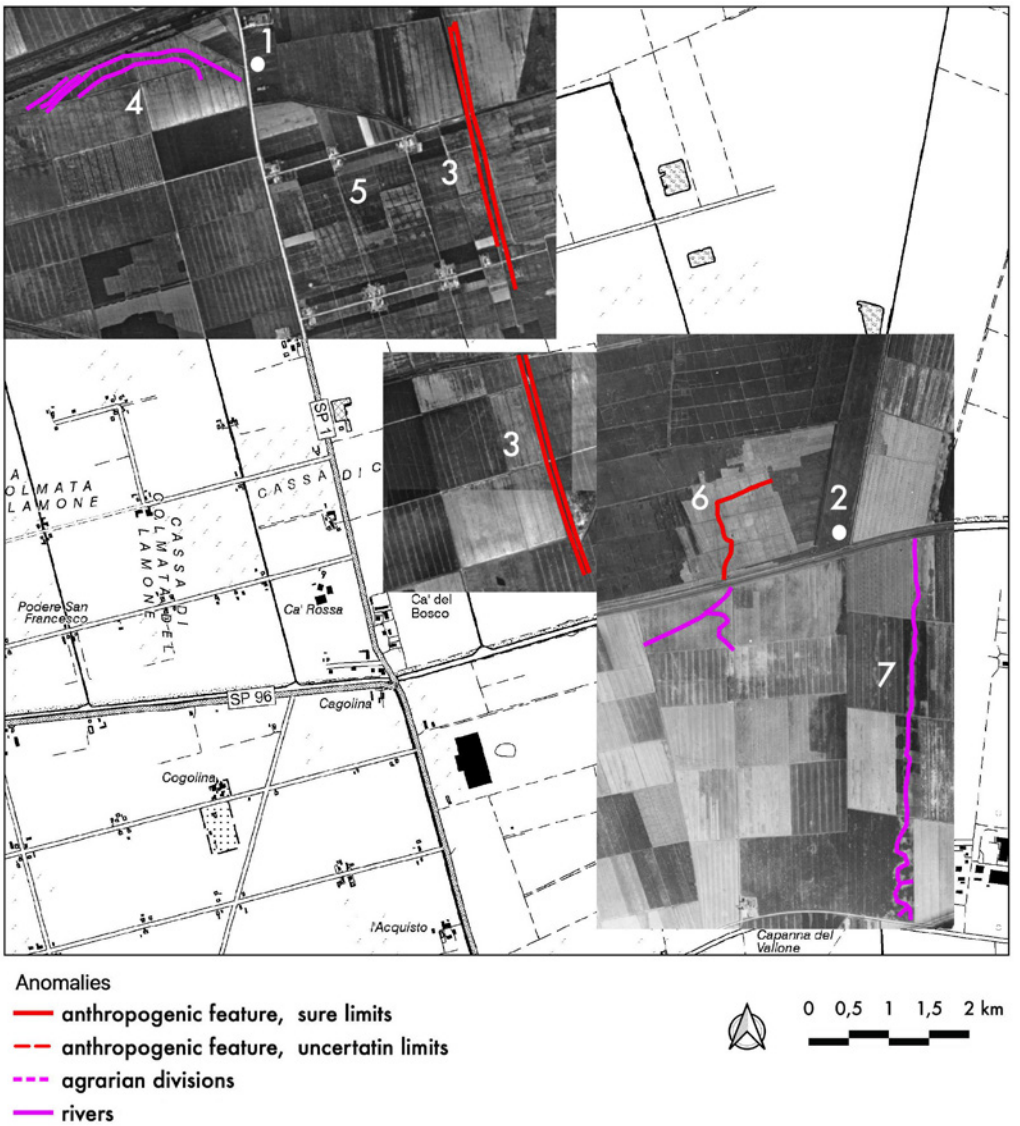

Figure 12. Highlighting of main anomalies near the area of S. Pietro in Armentario (no. 1) and the area of Palazzolo (no. 2): the Padoreno channel (no. 3); fluvial meander (no. 4); rice paddies (no. 5); trail path (no. 6); swale (no. 7). Author M. Cavalazzi.

In addition to this, a large meander (Fig. 12, no. 4) in the area of S. Romualdo seems relevant since it is located immediately west of the site of the church of S. Pietro in Armentario (Novara 1994, 18–21, n. 5) (Fig. 12, no. 1). Only further investigations may clarify if this feature relates to the Colmata process or the premodern activities of the Lamone river. So far, we can underline the proximity between this feature and the presence of a large channel cutting through the Iron Age/Roman period beach ridge, identified in the regional geological cartography (Preti 2002, Foglio 223, *Tetto delle sabbie litorali del Subsintema di Ravenna*). In this cartography, this channel was mapped up to the area of Piangipane, and further southwest towards Russi. Thus,

we can relate it to the premodern course of the Lamone, attested exactly in this area, at least from the Early Middle Ages (Abballe 2021, 42–43).

Rich in traces is also the sector of the hinterland of Ravenna between Palazzolo and the Ravenna suburb. This area was historically included in the island of Palazzolo monastery. Here, a series of anomalies are linked to the agricultural exploitation of the area: first, the grid of squares is a trace of the paddies for the rice cultivation, carried out probably during the Colmata period around the end of the 19th century (Fig. 12 no. 5); second, the regular pattern of small circular anomalies is probably a trace of the cultivated pinewood of Palazzolo (Fig. 7.B-C); finally, an irregular negative anomaly seems interpretable as a trail (Figg. 7, no. 5 and Fig. 12, no. 6). Slightly east of the Palazzolo site, where the Late Antique and medieval shoreline was, the irregular anomaly oriented north-south is probably the trace of a swale (Fig. 12, no. 7).

Finally, we detected the evidence of the beach ridges as well as a probably premodern agrarian division northeast of Ravenna (Fig. 7.G). The parcels typology looks similar to those detected in the area of Classe, on the Late Antique shoreline (Boschi 2012b, 144, id. 74).

M.C.

Conclusion

Around ten years ago, Federica Boschi pointed out the necessity to promote frequent and repeated reconnaissance flights around Classe. She judged this approach as the only way to overcome the challenges brought by the local geomorphological complexity and better understand the landscape around this prominent archaeological site, as well as Ravenna itself (Boschi 2012b, 62; Cavalazzi 2020). Indeed, she applied to the Ravenna area a definition already used for some British regions, that is 'difficult and clay soil landscapes' (Mills 2007).

Unfortunately, this call went unheard, but our research has demonstrated the value of this approach leading to new knowledge in the extremely dynamic landscape around Ravenna. We used sources not meant for archaeological research, which were often taken also in not ideal periods (i.e., not during the summer season). Still, their large number allowed us to obtain meaningful data on water management and land-use practices, as well as possible structures within the abandoned town of Classe.

However, it is evident that we will need more systematic and multidisciplinary research to truly unlock the multilayered landscape around Ravenna, shaped by rivers and sea but on which we can recognise numerous anthropogenic traces. To reveal and understand all these traces, we will need extensive surveys (Campana 2019), combined with remote sensing, geophysics, and geoarchaeological investigations. The latter must be aimed both at the dating of the various natural and artificial palaeochannels, as done in the similar port city of Portus, near Rome (Salomon et al. 2020), and at systematically reconstructing the reclamation processes documented in both written sources and historical cartography, as done inland of Ravenna (Abballe 2022; Abballe, Cavalazzi, and Fiorotto 2022).

This need becomes more urgent looking at the profound changes affecting the Ravenna coastland, with landforms transformed or even erased by agricultural activities (Boschi 2012b, 27; Berti Ceroni and Smurra 2005, 23), increasing urbanisation pressure and a landscape

equilibrium threatened by both human activities and climate change. In this situation, more systematic and multidisciplinary research will collect new and precious data before they are lost forever. Moreover, they will provide the local communities of the hinterland of Ravenna with the historical and cultural instruments to face the challenges of this century in terms of climate change and landscape management, urgencies that are growing day by day.

M.A., M.C

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New considerations on the acropolis of Butrint during the Archaic age

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Abstract

The paper discusses the current state of research in relation to the archaic phases of Butrint (Southern Albania), one of the few sites of ancient Epirus with important archaeological evidence dating back to the Archaic period. The international archaeological missions that have investigated the acropolis of the site over the last century have brought to light few but clear traces of frequentation of the area. Pottery, an ash altar and roof tiles suggest that this was probably a cult place: the proximity and control of Corcyra over the mainland makes it plausible that the island had a role in shaping its appearance, however its features are still debated. The recent excavations and topographical surveys of the University of Bologna offer the opportunity for a new analysis of the historical and archaeological context in which Archaic Butrint is framed, as well as, at the same time, put forward open research questions that will need to be developed by future excavation campaigns.

Introduction

Butrint, ancient *Buthrotum* or *Bouthrotos*, represents a remarkable site in the context of ancient Epirus, located between northern Greece and southern Albania. Defined *polis* by Hecateus (*FGrHist* I, 106) as early as in the 6th century BCE and part of the historical region of Chaonia, Butrint developed on the terminal part of the Ksamili peninsula, surrounded by the Butrint Lake and the Vivari channel, which separates the promontory from the overlooking Vrina Plain. The centre was born in a favourable position for an easy access to the hinterland, rich in natural resources, for the connections with cities placed further north and for the control of routes and commercial traffic towards Greece and the Adriatic and Ionian coasts. Those few Greek sources that dealt with the region considered Epirus as semi-barbarian because of the social and economic organization of its population. Strabo (7.7.1-9) recalled, quoting the work of Theopompus of Chios, that there were several tribal groups (*ethne*), combined in *koina*, after which three regions were named. The leading ones were the Molossians, the most powerful koinon at the time of Theopompus, followed by Thesprotians and Chaones, who instead he believed to have held power before the Molossians (Hammond 1967; Sakellariou 1997). The *koina* were established on an ethnic basis and on warrior-pastoral communities settled in unfortified villages scattered all over the territory (*kata komas*), whose subsistence was based on a mixed agropastoral economy, comprising forms of intensive cultivation and husbandry of herds and cattle (Douzougli, Papadopoulos 2010, 9-14; Papayiannis 2017). It is nowadays difficult to reconstruct the history of Epirus, in particular during its first phases. That is where Butrint plays a fundamental role: its seamless occupation from the 8th century BCE until the 16th century CE makes it a privileged centre for the study of the Archaic history of the surrounding territory, albeit accepting the limits implied in this very uniqueness.

Archaic Butrint between history and archaeological research

Most of the information related to Archaic Butrint and Archaic Epirus comes from contacts with the Southern Greek world. Greek colonisation of the Epirote coasts began early: the Corinthians settled in the area at least from the half of the 8th century BCE, founding Corcyra in 733 BCE (Th. 1.25.3; 1.38.1). The island did not wait too long before assuming an independent role from the *metropolis*, creating its own commercial empire and expanding its control over the *peraia*, the facing mainland. They probably controlled the area of the Kestrine region, extending from Lygia, near the promontory of Leucimme, to Butrint, closing the canal of Corcyra in the North (Carusi 2011). It was supervised by fortifications built along the coast, among which there were probably the so-called Dema Wall (Giorgi, Bogdani 2012, 81-82, 248-249), Butrint itself, and Kalivo (Crowson 2020a; 2020b; Bogdani 2020) on the opposite side of the Vrina Plain.[1] The island had an economic and strategic role because its revenues came from trade, as well as from livestock, fishing, and salt production, which doubled thanks to the control of both banks of the canal, and which led to several contrasts with Corinth (Intrieri 2010; Carusi 2011; Psoma 2015) (Fig. 1 and 2).

Butrint was part of the *peraia* of Corcyra and so the city probably stayed under the control of the island at least until the 5th century BCE (Intrieri 2018). Despite the relevance of the Corcyrean presence on its territory, the status of Butrint as proper Greek colony is still to be confirmed. The first ceramic finds testify to a small settlement located on the acropolis between the late Bronze age and early Iron age, whose production is much closer to the indigenous Epirote world than to the colonial one, and similar to what is found in neighbouring sites, such as Kalivo and Çuka e Ajtoit.[2] The Archaic settlement in Butrint developed on the acropolis as well, on a terrace made with large irregular boulders dated between the 8th and 6th century BCE based on the proto-Corinthian and Corinthian pottery found in the Archaic walls, one of the few and best-preserved testimonies of the first settlement of Butrint.[3] L. M. Ugolini divided the Archaic wall in three different sections. First, the 'Pelasgian' one, the earliest segment on the southern side of the acropolis. Then, a second wall in 'Primitive polygonal' masonry, built immediately afterwards, expanding the terrace westward and occupying the southernmost side of this portion of the acropolis. Lastly, a third one, longer than the previous two, defined as 'large boulder polygonal' with an angular section. The dating of the acropolis walls has been debated for a long time. At the time of the discovery, Ugolini proposed a 6th century BCE chronology for their construction. He had also noticed how the construction technique, which uses blocks of local limestone, provided a single curtain, about 2 meters thick, with a kind of internal filling made of boulders to help in the construction of the rows (Ugolini 1942, 26-28, 39-44). Ugolini's proposal was revised by N. Ceka, who assigned the name of 'Butrint 1' to this circuit, dating it to the 7th century BCE (Ceka 1976). The excavations conducted by A. Nanaj from 1982 to 1986, followed by the Greek-Albanian Mission co-directed with C. Hadzis from 1989 to 1995 in the eastern stretch of the Archaic wall, the one considered to be the most ancient, had initially supported Ceka's hypothesis, but later moved the dating to the *terminus post quem* of 500 BCE based on the Corinthian and Attic pottery found during excavations (Arafat, Morgan 1995; Hadzis 1998). The research by the Butrint Foundation in

[1] In this so-called 'Butrint system', probably Karalibeu could be considered as a complementary site to the Dema Wall (Bogdani 2020, 40-46).
[2] Ugolini 1937, 67, 115; Hodges 2006, 54-77; Lima 2013, 49-63; Hodges 2013, 9, 10, 18.
[3] Hernandez 2017b, 245-250; Benfatti *et al.* 2020, 183-186; Giorgi, Lepore 2020, 163-174; Giorgi 2022.

Figure 1. Corcyra and the Epirote coast (Carusi 2011)

2006 confirmed the dating between the 7th and 6th century BCE, given the abundant presence of Corinthian pottery in site (Greenslade *et al.* 2013, 49.51; Hodges 2013). In recent years, the excavations of the Italian and Albanian archaeological project led by the University of Bologna and the Albanian Institute of Archaeology inside the filling of the westernmost section of the Archaic walls could once again underline the fully Archaic timeframe for their construction (Giorgi 2022; Giorgi, Muka 2023). It is still a matter of debate whether the construction of these Archaic walls can be linked to the Corcyrean presence in the area, since these have many

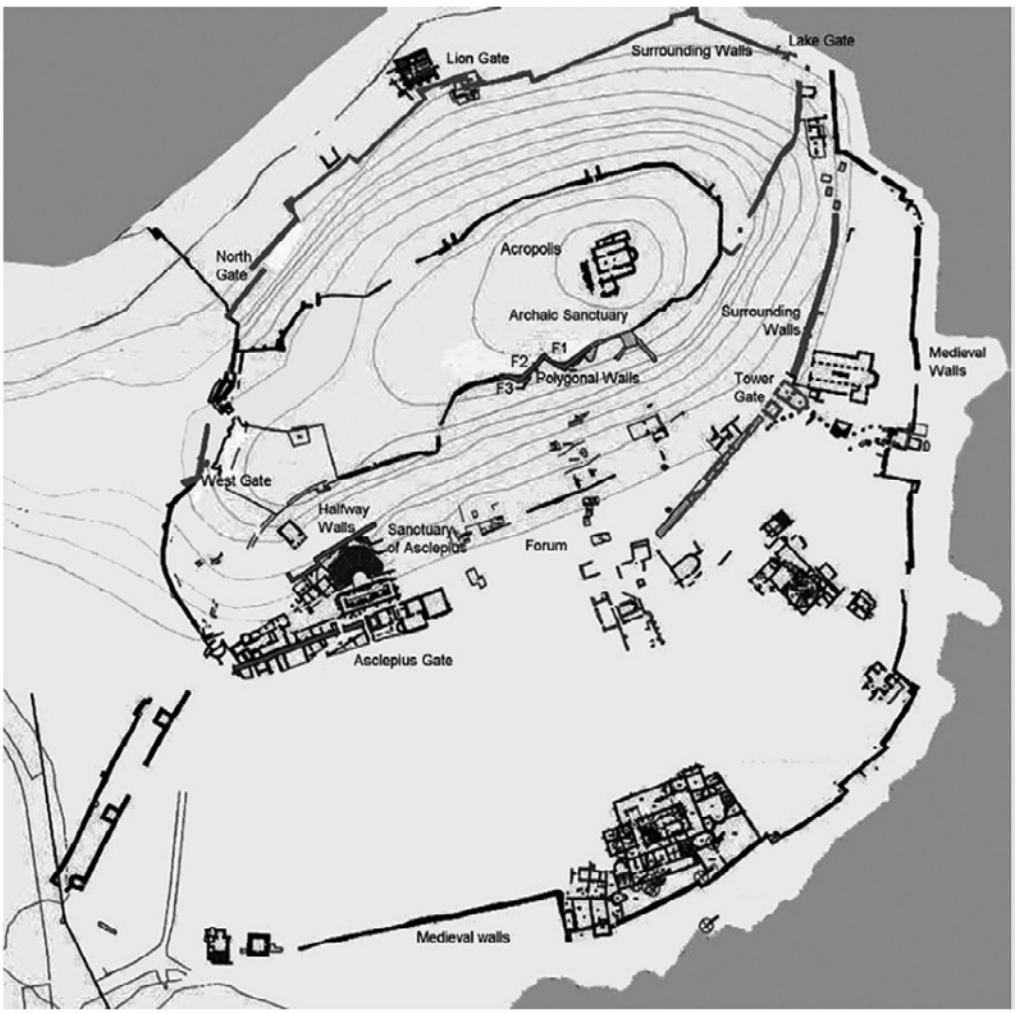

Figure 2. Plan of the city of Butrint (Giorgi, Lepore 2020)

features in common with other sites of colonial origin, such as Apollonia, whose Archaic walls are dated to the third quarter of the 7th century BCE, or Ambracia (Dimo *et al.* 2007, 166-171; Ceka 2010, 649-650). The absence of other similar wall sections on the rest of the acropolis of Butrint has led to the hypothesis that this might be a retaining wall rather than a defensive one, later incorporated into the Medieval circuit built in the 10th and 11th century. However, it is also possible to accept that it served both functions, considering that the city has gone through numerous phases of construction and destruction, which could have widely changed the appearance of the acropolis (Ceka 2008, 22-24; Giorgi, Lepore 2020, 171-172).

Other findings testify that the acropolis was frequented throughout the Archaic period. Among these, there is the so-called *bothros* found by D. Mustilli during his survey of the hill between 1938 and 1939 in the section between the Venetian Castle and the Acropolis Basilica. It was associated with proto-Corinthian and Attic pottery and numerous fragments of Corinthian

pottery with coloured bands, which led Mustilli to date the first occupation of the acropolis to the 7th century BCE.[4] Between 1982 and 1994, the campaigns directed by A. Nanaj and C. Hadzis near the inner side of the acropolis walls brought to light, albeit out of context, fragments of imported Archaic pottery, mainly Corinthian, dated between the 7th and 6th century BCE, but also Attic (5th-4th century BCE), Laconic and Orientalizing-period inspired pottery. Other relevant findings are the remains of yellow-fabric roof tiles of Corinthian production, inscribed sling shots, and a hearth used for at least one century as an altar, thus interpreted due to the presence of burned seashells and bones found on a bed of compact ashes[5] (Fig. 3). The same types of pottery were discovered in secondary deposition during the analysis of the deposits of the lower part of the city, once submerged by the waters of the lake, and which became accessible between the 4th and 3rd century BCE, leading to the expansion of the wall circuit at the base of the acropolis as well (Hodges 2013, 7-10; Aleotti 2015; Hernandez 2017b, 220-230).

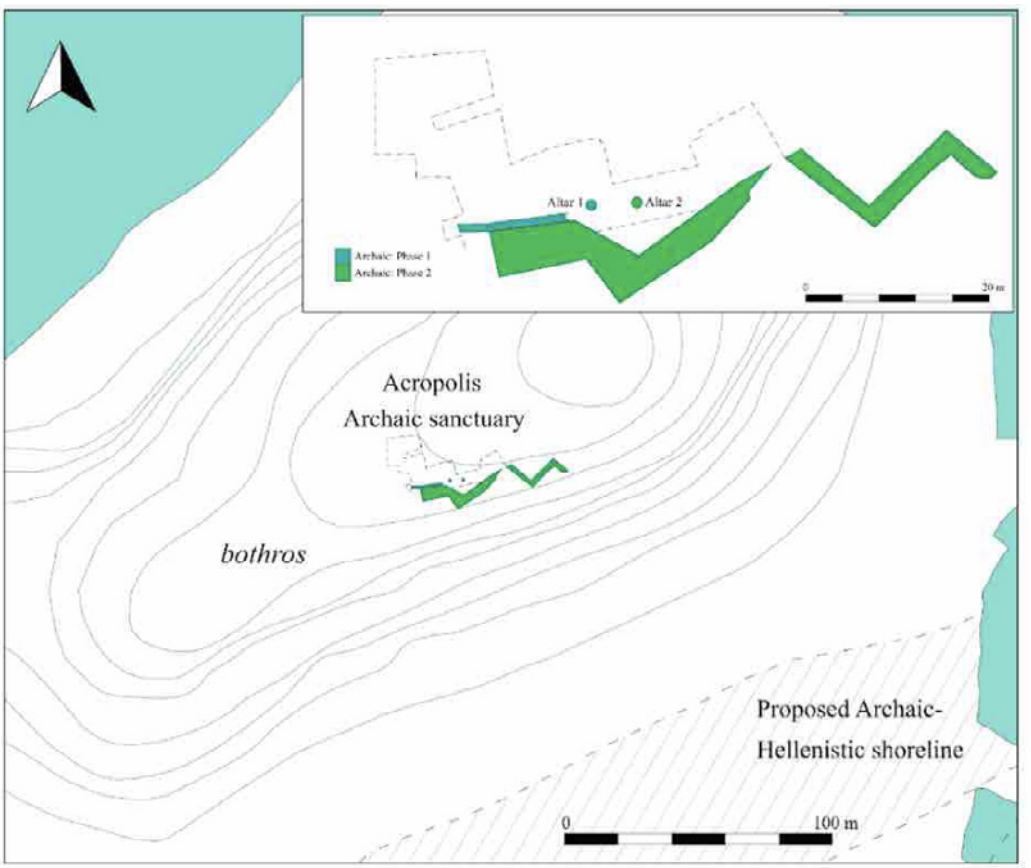

Figure 3. Location of the ash altar (Greenslade et al 2013)

[4] Ugolini 1937; Mustilli 1941, 686-688; Ugolini 1942. During the 2021 campaign, the team of the Italian and Albania Archaeological Mission in Butrint (Butrint Project) was able to locate what Mustilli believed to be the stone block closing the *bothros*, thus narrowing the area of the Acropolis where it could have possibly been originally found. There are still numerous open questions about the real nature of the so-called *bothros* identified by Mustilli, whether it was the result of sacred and ritual actions, or a secondary deposition gathered over time due to the long attendance of the place.

[5] Nanaj 1985; 1986; 1988; 1995; Hadzis 1998; Arafat, Morgan 1995; Greenslade et al. 2013, 47-52; Giorgi 2022.

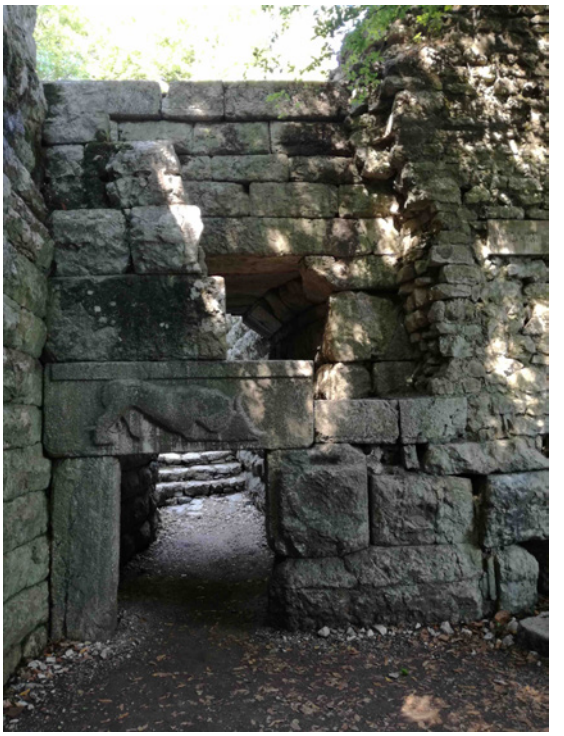

Figure 4. The Lion Gate (photo by the Author)

Nevertheless, these data cannot be used to put forward a concrete proposal for outlining the shape of the Protohistoric or Archaic city of Butrint, since no precise evidence has been recovered neither about the settlement nor about the necropolis related to these phases. According to K. Arafat and C. Morgan, the lack of other relevant findings reveals that Butrint was no other than a seasonal shelter during the initial phases of its life (Arafat, Morgan 1995, 31). On the other hand, it is plausible to think that, thanks to Corcyra's contribution, Butrint had quickly become an emporium and a cultural center of some importance, fundamental to ensure control of the other part of the strait, both for military and commercial reasons. After Hecateus, not only no other source will refer to Butrint as *polis*, but there is not any other exhaustive information on this site, even though it must have had a relevant role in the area. A more recent hypothesis proposed by D. Hernandez tries to reconstruct the appearance of Butrint during the Archaic age suggesting the existence of a temple on the top of the acropolis hill. D. Hernandez interprets the wall circuit on the acropolis as a *temenos* in defence of a sanctuary dedicated to Athena *Polias*, which would have been placed below the current Late Antique Basilica (Hernandez 2017b; Giorgi 2022). L. M. Ugolini had already supposed the presence of a temple on the acropolis on the basis of the frieze of the Lion Gate, depicting a lion biting a bull, which he considered to be Archaic (Ugolini 1942, 56-65) (fig. 4). D. Mustilli had found a ceramic fragment with the letters ΑΘΑ engraved on it in the so-called *bothros* during the 1938-1939 campaign. These findings were attributed to a cult dedicated to *Athena*, as well as few clay sculptures, an antefix decorated with palmettes and a female clay mask, all found around the *bothros* (Mustilli 1941, 686-688). D. Hernandez supports his reconstruction by recalling the relations between Athens and Corcyra, as well as an oracular lamella from Dodona, dated around the end of the 4rd century BCE by most scholars, mentioning the request of ἁ πόλις ἁ τῶν Χαόνων to Zeus *Naios* to know where to move and rebuild the temple of Athena Polias, which he believes has the city of Butrint as requester.[6] Another important part of this reconstruction is the similarity observed between the Lion Gate lintel in Butrint and the epistyle of the 6th century temple of Kardaki (park of Palaeopolis - Mon Repos in Corfu), whose construction meets the standards of the Ionian Sea Style (Fig. 5 and 6). Given the similarities

[6] Lhote 2006, 59-61, 11; Quantin and Quantin 2007, 177 with references for previous debates on the chronology of this oracular lamella; Hernandez 2017b, 242-244. It is important to underline that the problem concerning the chronology of this lamella is still open: while most scholars believe it to be dated around 330-320 BC, there are some discordant opinions, such as the one recently expressed by Meyer 2013, 20, n. 33, according to whom the lamella can be dated around the second half of the 3rd century BC.

Figure 5. The Kardaki Temple (photo by the Author)

Figure 6. The lintel of the Kardaki Temple (photo by the Author)

between the lintel of the Kardaki temple and the Lion Gate lintel, D. Hernandez deduces that the Butrint temple was built according to the characteristics and proportions of the Ionian Sea Style. The lintel depicting the lion and the bull would have been part of the frieze, therefore representing that union between Doric and Ionic elements which is one of the main features of the Ionian Sea Style. D. Hernandez proposes the reconstruction of the Archaic temple in Butrint as a Doric, peripteral, and hexastyle temple with 11 or 13 columns along its side, 21-26 x 11 metres long, built at the end of the 6th century BCE. Moreover, he supports his thesis with the discovery of several rock cuttings in the bedrock right under the Late Antique Basilica. He interprets these signs as revealing of the position and orientation of the Archaic temple, which he believes were the same of the later shrine and temple of Asclepius, as well as the Roman centuriation and settlement on the Vrina Plain.

New reading of the evidence on the acropolis

Although the presence of a cult place on the acropolis of Butrint during the Archaic age can be considered likely given the site topography and its role in the maritime trade of the Adriatic Sea, the reconstruction and position of this temple entail several questions of uncertain resolution.

D. Hernandez's proposal of the dedication of the temple to Athena could be taken in consideration, given the already mentioned inscribed fragment and the figurines found by Mustilli. Admitting that these could really be related to the cult of *Athena*, it is important to note that the goddess is attested and worshipped in Epirus and in other Corinthian colonies, like Ambracia, Apollonia and Epidamnus, already in the Archaic period. However, as P. Cabanes and S. De Maria and L. Mancini point out, these elements are not enough to conclude that the goddess was actually worshipped in Butrint as well (Cabanes 2007, n.189; De Maria, Mancini 2018; Aleotti et al 2020, 45-46).[7] Besides, the oracular lamella from Dodona quoted by Hernandez still raises numerous questions, like those linked to the so-called '*temples voyageurs*' of which this lamella brings an example. As carefully pointed out by S. and F. Quantin, the use of the verb ἀνχωρίζω (more precisely meaning 'withdraw', deriving from the military world) suggests that the *naos* was not intended to be moved over long distances, but on short ones, and that the choice of the formula ἀνχωρίξαντας ποεῖν implies that the real interest of the Chaones lied not in the replacement of the temple but in its reconstruction (Quantin, Quantin 2007, 177-182). A second point regards the identity of the *polis* asking to replace and rebuild the temple. This is interpreted not only as the actual city of the Chaones, but also their State, and Phoinike is the only centre which could fit the description, being apparently a relevant city for the *koinon* at the end of the 4th century BCE as the inclusion of the city in the list of the *theorodoki* of Argos shows. It is true that the cult of Athena has not been attested in Phoinike so far, however the latest excavations on the hill have shown a wide renovation of the city-centre in the 3rd century BCE, which could then justify the need to move and rebuild the temple (De Maria, Mancini 2018, 214-220; Rinaldi 2020, 26-46).

[7] Although this is an old theory that has not been further explored in later works, it is still worth recalling the opinion of other scholars, such as R. Hodges and I.L. Hansen, recently discussed again in De Maria, Mancini 2018, who believe that the temple on the Acropolis could have been dedicated to Zeus *Soter*, taking as evidence the later presence of his name in the manumission inscriptions found near the Theatre and the iconography on the first minting of the city. Hansen 2009, 10-11; Hodges 2013, 10. On the coinage, see Adby 2012.

Even so, this reconstruction becomes doubtful when the architectural aspect of the religious landscape of the region is taken into consideration. When considering the other Archaic temples in the area, the examples that come to mind are first and foremost the well-known monumental buildings in Corcyra, among which there is the already mentioned Kardaki temple. Their extraordinary shapes and dimensions are direct testimonies of Corcyra's wealth and power. Therefore, they do not find a direct comparison even with religious buildings discovered in other sites belonging to the Corinthian and Corcyrean area of influence along the coast of Epirus.[8] Few structures have been recognised as temples within the urban area or in the surroundings of these cities. Among them, it is worth mentioning the 7th century BCE building in Mastilitsa in Thesprotia (Tzortzatou, Fatsiou 2009, 24), and the late-Archaic Apollo temple in Ambracia (Tzouvara-Souli 2001, 233-235; Fantasia 2017, 6). From their remains it is visible that these temples had already undergone a process of monumentalization, however smaller than the Corcyrean ones.

On this subject, it is interesting to report the studies of L. Mancini, who has demonstrated, even though focusing mostly on Hellenistic building, that temples in indigenous Epirus tend to have smaller dimension (Mancini 2013; 2015; 2016). For what concerns Chaonia, these buildings can usually be found in the forms of prostyle or *in antis naiskoi*, without any trace of *peristasis*, as a consequence of their late development during the 4th century BCE.[9] Examples of this are visible, first of all, in Dodona, one of the most renowned oracular sanctuaries in the Greek world, whose main temple was an *oikos* building surrounded by bronze *lebetes* beside the sacred oak, and where the reconstruction of the so-called temples dedicated to Dione, Heracles, Themis and Aphrodite all led to small structures, in some cases prostyle tetrastyle and in others just with two columns *in antis* (Dakaris 2003, Mancini 2015, 62-138; Piccinini 2017). This peculiarity is also present in Butrint, where both the shrine and the temple of Asclepius are quite small buildings. Discovered by L. M. Ugolini in 1929, the sanctuary of Asclepius was the centre of the Hellenistic city, keeping its privileged position also after the Roman conquest, when it was enlarged and underwent a general process of monumentalization. The structures visible today are the reconstruction of the Roman period, however they preserve the same layout and internal divisions of the first buildings, as well as the small dimensions and the floor made of limestone slabs. The shrine is formed by two communicating rooms, an antechamber and another rear room slightly raised above the floor. It was in this room that the votive stipe, fundamental for dating the whole complex, was found.[10] It seems that before the Roman intervention the shrine had also two columns in front of the entrance. The temple, instead, which is located on the upper terrace, was probably a prostyle tetrastyle temple. Even

[8] There are also other examples of Archaic temples in the nearby Illyria, such as in Bonjakët (Davis *et al.* 2010) and the peripteral temple of Shtyllas (Quantin 1999), both in the territory of Apollonia. There are also the temples in Spitalla e Capo Palla (Pojani 2010) in the territory of Epidamnus. The first wave of Corinthian colonisers had moved away from the mother city before it completed the process of elaborating its own specific architectural language, and before many of the cults found in Corinth (as they are known for the Classical and Hellenistic ages) assumed definite architectural forms such as to be brought into the colonies and immediately recognisable as Corinthians. This also explains why it is difficult to find parallels in the urban arrangement between the colonies and Corinth (Hadzis 1997; Williams 1997, 40-41; Antonetti 2011, 54; Quantin 2011).

[9] In Mancini 2015, 380-381, it is underlined how temples in Thesprotia are usually built in the *oikos* form, while in Molossia prostyle and tetrastyle temples are far more common.

[10] The construction of the sanctuary of Asclepius is dated at the end of the 4th century BC (Melfi 2007), however recently others (De Maria, Mancini 2018, 210-214, and Aleotti *et al.* 2020) have expressed new considerations on the subject. Their new analysis of the pottery and ritual objects found in the favissa has highlighted that these findings can be dated mostly to the 2nd century BCE, thus re-opening the discussion on the arrival of the cult of Asclepius in Butrint and the beginning of his worship in the city.

though little can be said about its elevation since it is badly preserved, four assizes of the back wall of the cell are still visible, reaching the height of 1.52 m. Moreover, on the floor of the cell is possible to recognize two different phases of floor preparation: the Hellenist mosaic, with a tessellated emblem depicting a coiled snake, the discovery of which confirmed the dedication of the building to Asclepius, and the Roman one, depicting white and black geometric motifs (Melfi 2007; Mancini 2015, 304-326).

This brief digression on the Butrint religious landscape of the Hellenistic Age leaves room for new considerations. The physical proximity and the influence of Corcyra on Butrint could easily support the idea that its ruling class could have built here a peristyle temple similar to the ones found on the island or in other Corinthian-Corcyrean colonies in order to stress their control over the peninsula. Given these premises, the solution to the questions regarding the appearance of the Butrint Archaic temple probably lies on considerations about the degree of Corcyra's influence and the status of Butrint in relation to it. In other words, the presence of a peristyle temple in Butrint could be legitimate, given that the city was considered part of Corcyra's *peraia*, which was a direct prosecution and extension of the island on the mainland. However, this cannot be taken for granted for several reasons, starting with the fact that the independence of the local Epirote tribes and the ways they interacted and influenced the Corcyreans with their own culture, society and politics is still to be determined for this time period. Moreover, the complete absence of findings related to the building is equally relevant and poses a series of questions regarding its actual monumentalization or whether it could have been more similar to the structures assembled with clay and straw common throughout Epirus.[11] The lintel of the Lion Gate is only by convention and tradition considered part of an ancient temple, however it is not possible to demonstrate anything other than its rearrangement on the gate where it is located today. Ugolini had already expressed his doubts about its origins, stating that the iconography of the lion biting the bull has a certain rigidity in the forms and a conventional approach in the execution that could be linked to a craftsmanship of Archaic inspiration, rather than a production dated directly to the 6th century BCE (Ugolini 1942, 63). The architrave has been seen by Hernandez as a symbol of the relationship between Corcyra and Athens, however the image of the lion biting a prey (especially a bull) is actually very common and widespread throughout the Archaic age, therefore not necessarily implying a direct inspiration from the Athenian Acropolis. Examples of this iconographic motif within the Archaic age production can be found on Proto-Corinthian, Corinthian, Boeotian and Attic black-figure pottery starting from the 7th century BCE (Hofsten 2007, 13-18). Consequently, the inspiration for the Lion Gate subject may as well have come from many different cities of the Greek world that came in contact with Butrint thanks to the trade routes crossing the channel.

A final issue is represented by the position of the temple of Athena Polias. Scholars who have dealt with the subject, starting from L. M. Ugolini, believe in the existence of a temple on the acropolis of Butrint during the Archaic age, since the pottery findings claim as undeniable that the area was visited for religious purposes. However, they have not always agreed on its location. On the one hand, there is the opinion of those, such as D. Hernandez, who locate it on the top of the hill, below the Late Antique Basilica, because they believe the rocky outcrop

[11] The Acropolis, the Museum, and the area of the Sanctuary of Asclepius have been searched for possible remains and re-employments of columns, capitals, blocks or decorations belonging to the Archaic temple both during the 2018 and 2021 campaigns of the Butrint Project, however the research has been unsuccessful so far.

has been worked to house the foundations of the temple (see also Martin 2004, 81). Speaking of which, it must be considered that the acropolis has been one of the most frequented parts of the city. It was subject to several phases of reconstruction in ancient times, and it was also deeply involved in archaeological excavations, so it is an area of the city that has widely changed over time. The Basilica was restored several times, and between the 14th and 15th century CE a Venetian fort was built om top of it, which makes it even more difficult to state which actions visible on the bedrock could belong to the Archaic period and which not. On the other hand, however, many scholars believe that the temple is located on the central terrace of the acropolis, near the area excavated first by the Albanian Mission in 1980s and then by the Greek-Albanian Mission in 1990s (Greenslade *et al*. 2013, 50; Hodges 2013, 10). This last theory is supported by more concrete evidence such as the remains of the Archaic walls, which may also have delimited the *temenos* of the cult place, and the findings, including the altar and the Corinthian roof tiles. The results obtained from the excavations of the Late Antique Basilica by the Butrint Foundation are quite relevant on this matter. The 2008 investigations had suggested the presence of a previous building, described as temple dedicated to Zeus *Soter*, on which the basilica would have been built (report of the Butrint Foundation 2009, 10). However, the results of the 2009 excavation campaign declared that, apart from some fragments of archaic pottery, no remains of buildings prior to the Basilica were found, although their existence is believed to be possible (report of the Butrint Foundation 2010, 11). Consequently, it seems more plausible that the temple was located on the lower terrace, given the greater number of findings supporting this hypothesis.

The archaeological remains on the Acropolis: a review

In 2018 the team of the Archaeological Mission of the University of Bologna and the Archaeological Institute of Tirana in Butrint (Butrint Project) decided to focus part of their efforts on the study of the acropolis of Butrint and unveil the traces located by D. Hernandez in order to better understand the stratigraphy of the upper plateau of the hill (Fig. 7).[12] The first set of these rock cuttings is located in the left aisle of the Acropolis Basilica, close to the apse, where Hernandez recognises cuttings that would allow to reconstruct the size of the blocks forming the walls of the Archaic building, oriented NW-SE, and which would represent the east side of the temple (Fig. 8). A second similar and parallel set of cuttings is located southwest, in the central nave, close to the narthex, which would be the west side of the temple (Fig. 9). Finally, a third set of rock cuttings, parallel to the previous two, is located outside the area of the basilica, not far from it, on the top of a large boulder, which could have been part of the *temenos* of the temple, or the foundation for its crepidoma (Fig. 10). There are two other evidences identified by Hernandez, although less relevant for the purpose of reconstruction: a small room on the north side of the basilica, connected to the left aisle, with a rocky surface which he interprets as part of the temple or *temenos* (Fig. 11); and a cavity carved into the bedrock, perhaps used for drainage, on the side of the right aisle. The

[12] The Butrint Project (https://site.unibo.it/butrint/en) is an Albanian-Italian research project by the Department of History and Cultures of the University of Bologna and the Albanian Institute of Archaeology in agreement with the Albanian Ministry of Culture and Butrint National Park and with the support of the Italian Ministry of Foreign Affairs and the University of Bologna. The project was established in 2015 with the aim of conducting degradation mapping and topographic survey with laser scanning technology of the sanctuary of Asclepius and the wall circuit. Starting in 2018, these activities have been joined by the stratigraphic excavation of some sections of the Hellenistic wall circuit and later in 2019 of the Acropolis area. Giorgi, Muka 2015; Muka, Giorgi 2017, 2018; Benfatti *et al.* 2020; Giorgi, Lepore 2020; Giorgi 2022; Giorgi, Muka 2023.

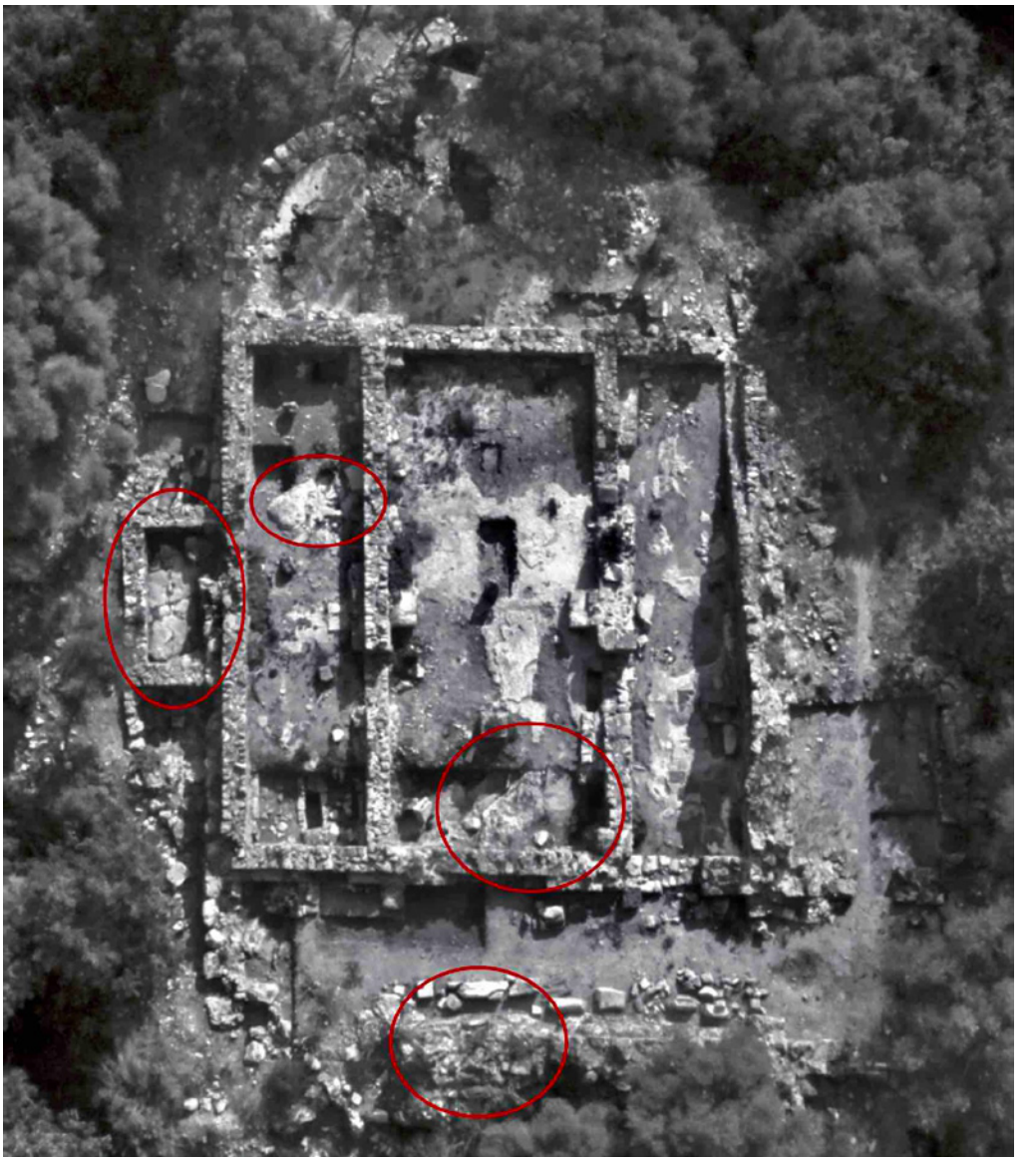

Figure 7. Acropolis Basilica plan with the area interested by the 2018 topographic survey of the Butrint Project (Greenslade et al. 2013, modified by the Author)

area investigated was restricted to the first three set of evidence identified by Hernandez, which means that only the bedrock already involved in the excavation campaign conducted here in 2009 was exposed, without involving neither other areas of the Basilica nor the whole extension of the bedrock on the summit of the acropolis.

The data were collected mostly manually on site, and compared, at a later time, with the data acquired using the Laser Scanning technique. Since the very beginning in 2015, the Butrint Project focused its efforts on the topographic survey and documentation of the remains of the city with a Leica P30

Figure 8. Cuttings on the left side of the Acropolis Basilica (photo by the Author)

Figure 9. The area interpreted as west side of the temple by D. Hernandez (photo by the Author)

Figure 10. The so-called temenos/krepidoma (photo by the Author)

Laser Scanner, an environmental time-of-flight scanner particularly recommended in the architectural documentation of cultural heritage.

After cleaning the area, it became evident that part of the bedrock had been subject to human action, as it can easily be seen both on the flattened surface of the cuttings within the Basilica area, in the side room, and on the three parallel cuts on the boulder just outside the Basilica, which are too sharp to be the product of natural erosion. Nevertheless, at the present state of knowledge, there are no means of assigning a precise chronology to them. It is not possible to define their eventual purpose or to date them to a specific human

Figure 11. The room on the north side of the Acropolis Basilica (photo by the Author)

intervention, that is the levelling of the hill for the construction of the Archaic temple, the construction of the Late Antique Basilica or the construction of the Venetian fort. Consequently, this uncertainty can be extended to the rock cuttings identified by Hernandez. Even deciding to set aside the different orientation of the cuts of the so-called east and west sides and the ones of the lateral room and on the boulder — which would pose some complication in the reconstruction of the sacred area already by themselves — there is still the obstacle of their different heights. The presence of a significant difference in height between the parts involved had emerged already on site during the cleaning operations preceding the topographical survey, and it was confirmed during the re-elaboration of the data obtained from the Laser Scanner point clouds. The difference is particularly evident between the highest of the cuts on *temenos*/*krepidoma* boulder and the set of cuttings of the so-called east wall (difference of 0.50 m), as well as between the latter and the cuttings of the so-called west wall (difference of 0.70 m). A similar situation is also present between the room on the side of the Basilica and the so-called east side, in fact the surface of the latter is 1.02 m higher than the floor of the room. It is not clear how this difference in altitude could be fitting into the construction of a temple, since it would have implied the presence of a base of some kind, whose remains are not visible as well. These considerations highlight how it is not possible to directly relate the actions seen on the bedrock to the construction of the Archaic temple, while they can be equally linked to the phases of the Late Antique Basilica or the Venetian fort.

Also in 2018, the Butrint Project team decided to survey and measure the remains of the Kardaki temple as well. According to Hernandez's reconstruction, the Butrint temple would have been built in its likeness, however this statement is only based on the resemblance of the architraves of the two temples. Comparing the dimension of the blocks forming the *krepidoma* in Kardaki and the trace of the block that Hernandez believes to have located on the Late Antique Basilica bedrock in Butrint would still not be enough for a solid reconstruction, since the dimension (both length and width) of the former change along the entire perimeter. As already mentioned, the Kardaki temple falls under the architectural type of the Ionian Sea Style: Corcyra's temples, in particular the *Artemision*, are considered one of its finest examples, so it comes as no surprise that Kardaki too could be described as such. After all, the simple succession on its famous architrave of the *astragalus*, a wider and convex band and, finally, another narrow and slightly protruding band, approximately the same height as the *astragalus* at the top, is considered a perfect expression of the attention reserved to the horizontal decoration of the trabeation in this style, which, however, does not have illustrated scenes on the architrave (Dinsmoor 1973, 169) (fig. 6). At the present state, the presence in Butrint of the Ionian Sea Style cannot be confirmed. The Lion Gate lintel could belong to it, even though as an exception because of the presence of the eponymous scene. It seems so far that the Ionian Sea Style was identified only in the Peloponnese, on Corcyra, and in the Achaian colonies of Magna Graecia, while there is no evidence of it in Epirus and, more generally speaking, along the Ionian coasts (Barletta 1990, 45).

Given the importance of the Acropolis for understanding the first moments of life of the city, between 2019 and 2022 the Butrint Project has worked on a new series of excavations on its southern plateau near the Archaic walls, between the Venetian Castle and the Late Antique Basilica.[13] The 2019 campaign brought to light much of the Roman-Imperial and Medieval

[13] These excavations focused on an area that had already been partially investigated by the archaeological mission led by A. Nanaj first and then together with C. Hadzis in the 1980s and 1990s, followed by the Butrint Foundation in 2006 and 2009. Cfr. Greenslade, Leppard, Logue 2013 for history and results of previous excavations on the Acropolis.

contexts with large quantities of Archaic pottery in secondary deposition, which nonetheless confirmed once again the frequentation of the area during the Archaic age. The 2021 campaign focused attentively on the area right next to the westernmost section of the Archaic wall, where intact and sealed Archaic stratigraphies and fine pottery were found within the filling of the Archaic wall. This direct connection between the stratigraphies of the Archaic wall and Archaic materials in a closed context confirmed that this section of the Archaic wall can be assigned to a timeframe starting from the beginning of the 6th century BCE. In addition, shapes and types of pottery found inside the *emplekton* gave a confirmation of the presence of a sacred area on the Acropolis of Butrint during the Archaic age, although its appearance is still to be determined.

Discussion: questions for an open problem

Data collected so far help us define what Butrint could have looked like before the Hellenistic growth. After the appearance between the end of the Bronze Age and the beginning of the Iron Age of what K. Arafat and C. Morgan describe as a small seasonal shelter, during the Archaic age Butrint entered the Corcyrean *peraia*. The absence of other references in historiographical sources beyond the mention of Hecateus of Miletus underlines that although the city was possibly born as an indigenous settlement, during the Archaic age Corcyra's control was extended over the mainland, including Butrint as well. The city could leverage on its favourable geographical position, which was an excellent access point for trade with the hinterland and the exploitation of its resources. The commercial importance of Butrint is reflected by the archaeological research; in fact numerous fragments of Archaic pottery of various shapes and origins were found during the excavations on the acropolis: amphorae, cups, fragments of *lekythoi*, *hydriai* and craters, in addition to both local and Corinthian pottery used for cooking (Nanaj 1986; 1988; 1995; Aleotti 2015; Hernandez 2017a, 220-230). Archaeological finds also provide evidence for the presence of a sacred area on the Acropolis, which could justify Butrint as an 'emporic' sanctuary in this phase, fuelled by the commercial appeal of Corcyra, as well as the rest of the Epirote coast. At the present state of studies, however, there is not much information, neither from an architectural nor from a socio-cultural and political point of view, that could help to easily trace the appearance of the Archaic temple on the acropolis. Determining whether it was a peristyle or a smaller temple is just one of the questions arising during the analysis of this open problem and of all the (meagre) sources regarding Archaic Butrint. It is likely that the temple was located on the central terrace of the acropolis, as it is suggested by findings. Although much is still left to say about the appearance of the acropolis itself, the 2021 campaign of the Italian and Albanian Butrint Project on the Acropolis has brought to light further evidence related to the occupation of the hill during the Archaic age. The hope is that future studies and excavation campaigns will provide more data in order to answer the questions regarding the dedicatory deity, the development and dynamics of the cult place and the settlement, the influence of both Corcyra and Epirote *ethne* on Butrint, as well as the causes that led to the disappearance of any reference to this sacred area, which would probably also help explaining the gaps in evidence dating between the half of the 5th century BCE and the beginning of the Hellenistic age. After almost one century from its discovery, numerous excavation campaigns and research projects, Butrint displays once again its potential for the study of the history of both the ancient city and, on a wider view, Epirus itself.

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Rocca Savelli (Aventine Hill). Contribution to the knowledge on defence systems for family goods in Rome during the late Middle Ages

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Abstract

This paper concerns the results of the archaeological investigations at the Savelli fortress on the Aventine Hill in Rome. This fortification surrounds a well-known park of the city: the Giardino degli Aranci. The research has been addressed to improve the knowledge on a topic of great historical interest: the architectural typologies developed by Roman aristocratic families in order to defend their properties. Locating Rocca Savelli within a specific architectural typology is problematic, due to the lack of research on this site. The research team of the Department of History and Cultures of the University of Bologna has surveyed the remains, studied their building features and documented stratigraphic data. This paper summarises the preliminary results of such research effort. The structures still conserved above the ground level can be dated back to the second half of the 13th century and are the output of craftsmen specialised in building with local tuff. The fortification was most likely built by the Savelli family in order to defend its dwelling on the Aventine Hill. The next step of the research will be addressed to in-depth analyses of data collected during the fieldwork. The aim is to better specify the original features of the structure and its later modifications. At a later stage, it will be possible to understand the economic, cultural and ideological background of the people connected to the fortification (patrons, builders and inhabitants). Ultimately, the project will include geophysical prospections and small excavations across the park to investigate the presence of further structures conserved below the present ground level.

Keywords

topographic survey, architectural archaeology, fortifications, towers, tuff coursed rubblework.

Introduction

From the 11th century, a strong demographic increase brought to a denser urban tissue. This originated in a wide architectural renewal involving infrastructures (town walls, roads, etc.) and buildings: from churches and monasteries to the palaces of religious and civil powers, to private buildings, fortresses and towers (Augenti 2020, 29-36).

In this period, the wealthiest families in Rome controlled entire sectors of the city through a system of fortifications and towers. Based on various needs, different architectural solutions were put in place. Towers were chosen when it was necessary to control a single road or a series of strategic points in a wider area. For example, the Frangipane family controlled the Palatine Hill through such system (Augenti 2020, 28, 33; Carocci 2010; Di Carpegna Falconieri 1994; Hubert 1990).

Closed defensive systems, composed of regularly disposed towers connected by walls and battlements, are more complex. An example of this is the fortification built by the Caetani

family on the Appia Road, next to the Mausoleum of Cecilia Metella. The structure built by the Savellis on the Aventine Hill may have been similar, although some questions must yet be clarified: did the size of the fortification change through time? Was it built in order to protect a group of previous buildings? Or was the area empty, allowing the establishing of a complex settlement, whose only remains are represented by the defensive system? And yet, were the structures inside the fortification built at a later moment? Such questions have oriented this study, although it is obvious that fully understanding this typology of fortifications will require a wider dataset of sites.[1] In the following sections, the paper provides a summary of what is known on the history of this settlement, particularly focusing on the results of architectural-archaeological investigation.

Regarding the medieval period, the first document mentioning the structure may date back to the 10th century, with the mention of an '*antiquo palacio*' (ancient palace) which hosted Otto III (Bruno 2013, 389). The emperor needed a stronghold to directly control Rome (and the Church): a symbol of legitimate and universal dominion. However, several scholars have argued that the Palatino Hill is more plausible as the imperial seat in the city. The debate is still open, since no extensive excavation has ever been organised at the Savelli Park. At the same time, no remain of the Ottonian dwelling has been identified on the Palatine at present.[2]

Through the late medieval written evidence, it is possible to achieve a clearer image. Documents signed by Cencio Savelli (elected pope in 1216 as Honorius III) in 1216-1217 suggest the presence of a family dwelling on the Aventine Hill (Krautheimer 1981, 394, 461). The documentation does not provide any detail on the structure or its spatial relationship with the most important monument in the area: the Basilica of Saint Sabina. On 5th June 1222, Cencio Savelli assigned this church and other surrounding buildings to the Order of the Preachers (later known as the Dominican Order). These friars added the bell tower and the cloister (Docci, Chiavoni 2017, 72-73; Krautheimer, Corbett, Frankl 1970, 72-98; Acampora 2017, 186-188).

The most useful document for this research dates back to the second half of the 13th century. On 24th February 1279, Cardinal Giacomo Savelli wrote down his will: among the list of his properties, the document mentions a fortification on the Aventine Hill called '*munitionem montis qui supra Marmoratam*' (Reg. Hon. IV, 580). Marmorata is an early medieval place name. It initially indicated the left bank of the Tiber, west from the Aventine. Later, it was used to indicate the entire valley between the Aventine and the Mount Testaccio (Maischberger 1996, 223). Therefore, a fortification owned by the Savellis on the Aventine Hill was present in 1279 (Delogu 1983, 711; Krautheimer 1981, 461). Besides the fortress, the family owned houses and towers, although some of them were ruins:

[1] The architectural-archaeological survey was carried out on September 2016 by the Department of History, Culture and Civilisations (archaeological section) of the University of Bologna. Organiser: Enrico Giorgi, data collection and elaboration: Andrea Fiorini, Michele Massoni, Michele Silani.

[2] Augenti 1996, 74-75; Santangeli Valenzani 2001, 163-168; Sereni 2017, 192-193. However, the human presence in the area of Rocca Savelli in the early Middle Ages is testified by the ceramic finds brought to light during the 1991-1992 and 2006 excavations by the local Soprintendenza (Ciarocchi, Ricci 2017, 177, 179).

> *'domos, turres seu ruinas turrium quas habemus ab ecclesia Sancte Marie de Grandellis supra versus Marmoratam et in Marmorata et munitionem montis qui supra Marmoratam [est], sive fuerint patrimoniales sive fuerint per nos acquisite; alias vero domos et turres seu ruinas turrium quas habemus a dicta ecclesia Sancte Marie citra versus Ripam in tota regione Ripe et monitionem (sic) Montis Fabiorum seu de Sasso domine Mabilie sorori nostre' (Reg. Hon. IV, 580).*

These properties covered a relatively wide area, bordered by the Theatre of Marcellus on north ('monitionem Montis Fabiorum') and the following sites, on south: the 'regione Ripe', the church of Saint Mary de Gradellis (once located at the bottom of the hill, along its northern ramparts, close to the left bank of the Tiber) and the Marmorata.

The last information taken into account here is from the chronicles of Tolomeo from Lucca: in 1284, Jacopo Savelli promoted several restorations on the Aventine and he founded a considerable structure ('*palatium papale'= papal palace*) next to Saint Sabina. Once elected pope as Honorius IV (1285), he moved there:

> *'Anno Domini MCCLXXXIIII° [...] Iacobus de Sabello [...] Hic montem Aventinum edifitiis restaurat; fecit enim palatium papale apud Sanctam Sabinam, ibidemque moratur quamdiu vixit, et multa alia hedificia' (MGH, Tholomei, 204).*

About the analysis of the surviving structures, Donatella Fiorani, Daniela Esposito and Roberto Marta have particularly examined their masonry techniques, although neglecting stratigraphic evidence. Their results can be summarised as follows: in order to build the fortification, the Savellis made use of a particular kind of tuff called lionato: a name related to its yellowish-reddish colour. This material was quarried in small rectangular blocks with sub-regular thickness. Before being assembled in the masonry, such building elements were carefully selected in order to give the fabric a homogenous appearance, both in terms of colour and layout. Coursed rubblework techniques (locally known as 'tecnica a tufelli') date back to the 13th century, when this kind of masonry was widely used in Rome. It was common during the Roman period, but it was reintroduced in the late 12th century. During the 13th century, blocks became increasingly regular. However, this process reversed during the 14th-early 15th century, when blocks also tended to be bigger (Fiorani 1996, 154, n. 57; Esposito 1998, 23-24, 74-75, 153-156, 311; Marta 1989, 44-46).

Methodology

The data utilised in this study have been acquired applying the main methodological foundations of the architectural archaeology: analyses of masonry techniques, stratigraphic relationships between different building components, comprehension of building phases, in-depth analyses of building materials (Boato 2008; Brogiolo, Cagnana 2012; Francovich, Parenti 1988). The archaeological investigation has been based on 3D surveys of the architectural remains. After a first topographic approach with Total Station, the survey has been carried out through a Laser Scanner, following procedures already applied in other projects of the University of Bologna (Toniolo, Bergami, Silani 2019; Fiorini 2018; 2019). The topographic documentation of the Savelli Fortress has also required detailed photogrammetric surveys of all the frontages of the structure.

Results

Rocca Savelli is an architectural complex featured by a squared shape (ca. 98x100 m). It is composed of six building compounds (from now on, 'BC'), 38 frontages and 11 architectural elements (Fig. 1). BC1 is a gate tower projecting from the walls and belonging to the so-called '*a gola aperta*' typology (a kind of tower open on the inside). BC2 and 4 are towers located at the corners of the fortification, which have been consistently modified through time. BC5 is a significantly bigger structure placed in the middle of the north-west side of the fortification. The overall surface of this building (now reused as a terrace) is more than 100 m2. It most likely represented the main tower of the fortress, which allowed the visual control of a vast landscape,

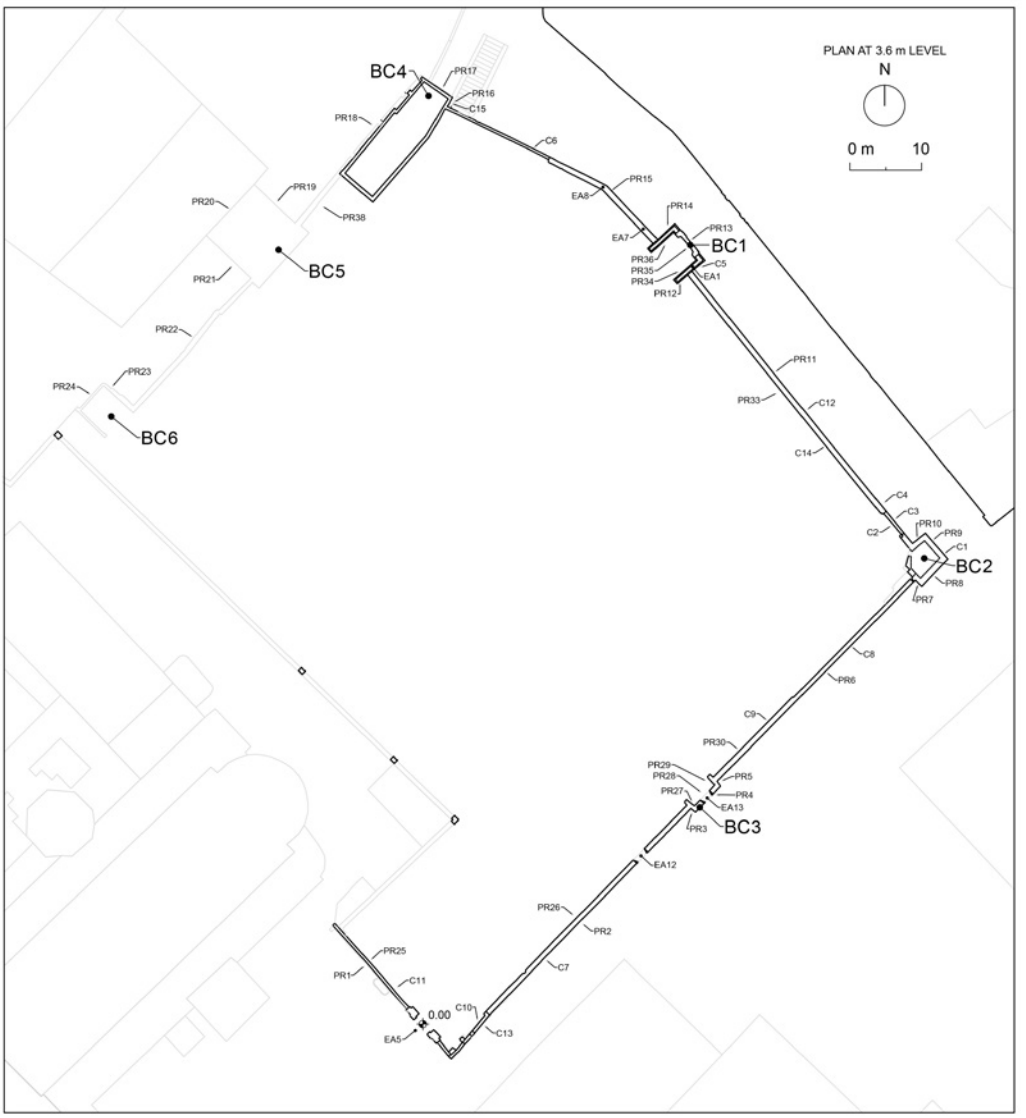

Figure 1. Plan of the architectural complex and its building compounds.

comprising a portion of the Tiber. BC5 is mirrored by BC3 on the opposite side of the site: a small tower placed in the middle of the walls. Ultimately, the remains of another tower can be identified on the north-west corner of the fortification (BC6). Nowadays, the structure has been reused as a terrace. The area surrounded by such defensive system covers about 7,000 m2.

The most ancient structures are located in the southern corner of the fortress (Fig. 1). These remains are composed of a brief portion of masonry in roughly refined tuff blocks, with no refining of the external surface. These building components are small and laid in horizontal rows. The thickness of the mortar joints varies across the masonry (Type B2). In Rome and its surroundings, these techniques (so-called '*a bozzette tufacee*') introduced the arrival of 'regular' coursed rubblework in the 13th century. The walls in small blocks of tuff (Phase 2) are stratigraphically later than this early structure. Therefore, it is possible to propose for Type B2 a chronology around the first half of the 13th century. Regarding the function of these structures, it is possible to suggest two hypotheses to be verified through further archaeological investigations (GPR and excavations among them): they may either be the perimeter of a pre-existing fortification or a part of a residential complex. Furthermore, the presence of buildings next to the church of Saint Sabina would not contrast with written evidence (Fig. 2. Krautheimer 1981, 394, 461).

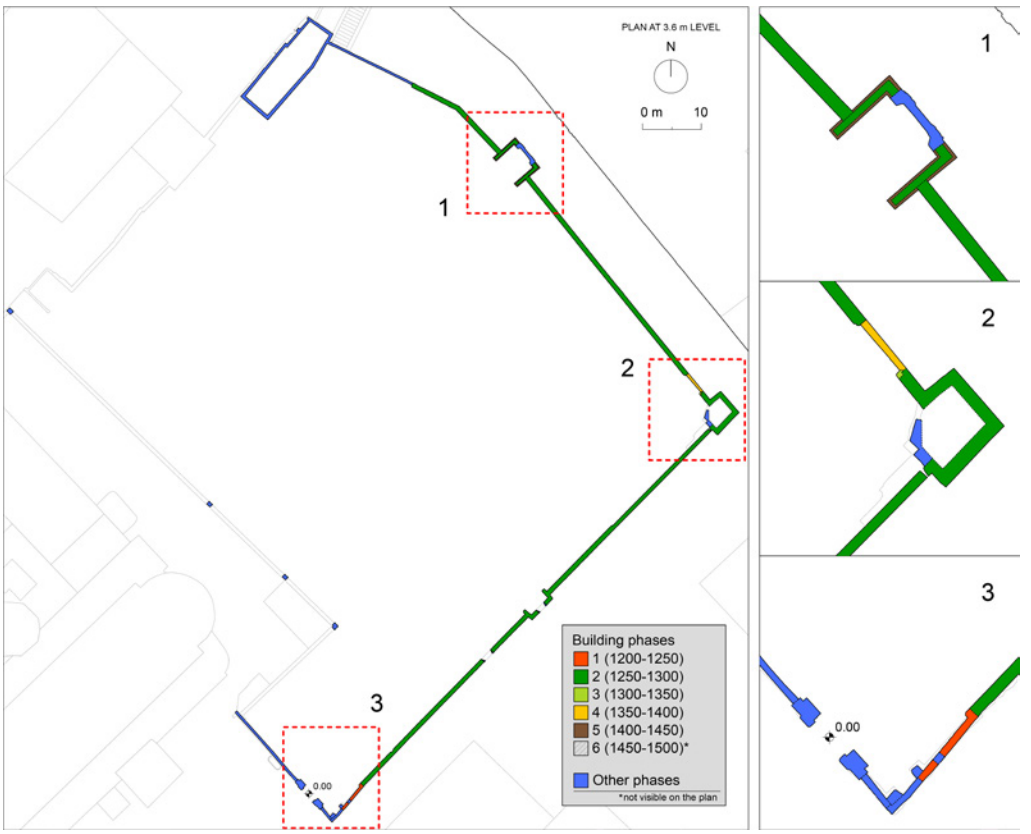

Figure 2. Plan of the architectural complex and its building phases.

Figure 3. South-east frontage (PR2) - detail: connection between the walls in small blocks (right) and the earlier structure in roughly refined rubble (left).

As mentioned above, the southern portion of the walls of the second phase is supported by the remains of the first one. This later structure was built with a more complex technique, assembled by specialised builders. It can be unambiguously compared with 13th century structures (Fiorani 1996, 154, n. 57; Esposito 1998, 23-24, 74-75, 153-156, 311; Marta 1989, 44-46.). Building elements had been accurately refined, in terms of both shape and surface. Such small blocks are laid in horizontal rows, leaving thin mortar joints (Type A1) (Fig. 3).

The presence of small sub-regular blocks instead of more irregular rubble is indicative of the high socio-economic level of the patron (Bianchi 1995). This is confirmed by the first mention of a fortress owned by the Savellis on the Aventine Hill (1279). Based on these data, the second half of the 13th century is the most suitable chronology for the foundation of the fortress (Fig. 4).

By analysing stratigraphic evidence and architectural features, it has been possible to reconstruct the sequence of the building activities related to the second building phase. The patrons' aim was probably overseeing a strategic point of the city and protecting their properties: the buildings within the walls, next to the apse of Saint Sabina. Indeed, the inner surface of the fortification is perfectly plane and was most likely artificially regularised. Patrons

Figure 4. South-east frontage (PR2). detail and main masonry types. The most ancient structures are indicated through the codes 'B2' (Phase 1, first half of the 13th century) and A1 (Phase 2, second half of the 13th century).

also decided to have the fortification built with stones. The stone supply came from nearby quarries. The area where the fortress was built is mainly composed of gravels, sands and clays, therefore it must be excluded as the quarrying place. However, a vast area stretching north-east and south-east from the fortress seems well-suited as a possible tuff quarry, as documented by geological maps (Fig. 5).[3]

Figure 5. Distribution of lithic tuff around the archaeological site (figure elaborated from the Geological Map of the Metropolitan City of Rome).

Consequently, utilising tuff as a building material may depend on the proximity to its quarries. At the same time, a part of the building materials of the structure may have been reused from previous buildings.[4] After having found the stone deposits, stonemasons must have quarried blocks out through axes or saws. Specialised stonecutters later refined blocks in order to eliminate irregularities. There are no traces related to the refining technique usually known as *anathyrosis* (in Italian, '*nastrino*'= ribbon), which is typical of specialised stonecutters. However, the considerable regularity of the building components must be related to the sapient refining of highly specialised craftsmen (Fiorini 2019).

Blocks do not seem to have been further refined on the side related to the surface of the wall. The tool utilised in shaping blocks was probably some kind of stonemason's hammer, which left traces. This part of the refining process may have been performed either in the quarry or at the building place. In the first case, the operative chain was more efficient: building materials reached the building place when they were ready to be assembled in the masonry. Transport should not have been particularly difficult, since tuff is a relatively light material compared to other kinds of stone. At the same time, the area was plane and did not require pack animals. Most likely, oxen were used to drag building materials, loaded on wagons (Fiorani 1996, 87; Esposito 1998, 74).

About the openings of phase 2, just a few ones have not been altered by deteriorations or later modifications. Among these architectural elements, some small windows are worthy of mention since well connected to the masonry (therefore contemporary with the fortress).

[3] https://g3w-suite.cittametropolitanaroma.it/it/map/carta-geologica-litologica/ (accessed: 10/04/2021).
[4] When observed from close distance, building components do not seem to show traces of previous mortar, as normally expected for reused materials.

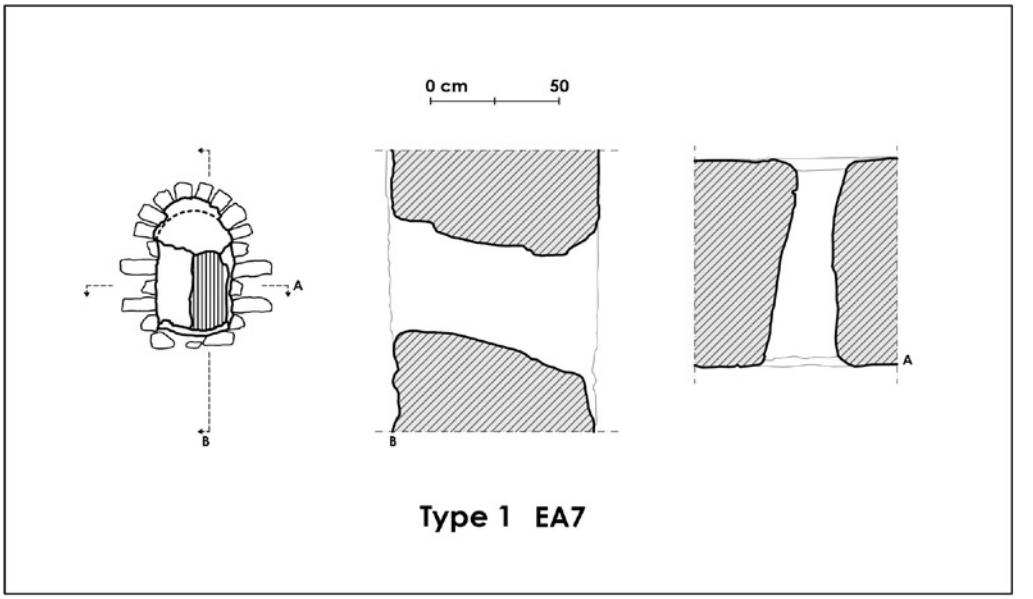

Figure 6. Opening from the second half of the 13th century (Phase 2).

These small openings were probably used to oversee the north-east moat (nowadays, Clivo di Rocca Savella) and the nearby road alongside the south-east frontage (Via di Santa Sabina). The architectural element 7 (from now on, 'EA') belongs to this typology (Fig. 6).[5]

It is possible to notice several 14th century restorations (Phases 3-4), when the scarps of the BC1 gate tower were partially coated with bricks (Phase 5) (Fig. 7).

The second half of the 15th century represented a crucial moment of the building history of the fortress (Phase 6). After some restorations, investments kept maintaining the structural efficiency of the fortification, also by strengthening the defensive systems. In this period, the fortress was provided with a multitude of gun slits (Type 1 and 2). Indeed, these architectural elements had been built piercing the 13th century walls (Phase 2). The EA8 belongs to the first typology,[6] while EA1 can be associated to the second one (Fig. 8).[7] This functional component can be compared to other architectural elements from the 15th-16th century.

By analysing the medieval gun slits, it is possible to clarify the function of some openings of the fortress. The first type is featured by a 'manoeuvring chamber' that narrows down to a width of 6-7 cm. Consequently, the opening was able to host weapons of no more than

[5] The EA7 opening is characterised by the following features. Inner frontage: rectangular opening covered by a lowered arch composed of eight building elements. These blocks have been carefully refined and cannot be differentiated from the other elements composing the two jambs. Inside: the opening is inwardly splayed. External frontage: vertical, rectangular opening.

[6] EA8 shows the following features. Inner frontage: rectangular. Inside: trapezoidal, inwardly splayed. External frontage: rectangular opening.

[7] EA1 shows traces of a lock on the outside and is composed of a single stone element.

60mm calibre (the inner diameter of the barrel). Considering the height of the opening from the ground, the most suitable choice was a sort of small portable cannon, used between the 15th and the first quarter of the 16th centuries. It had a long barrel and it was provided with an element (*crocco)* or a bracket used to dock the cannon to the wall (Fig. 9).

All the gates surveyed around the fortress were built later than phase 2, since they required piercing the walls. These elements show architectural and building features clearly linked to the modern period. The monumental gate (EA5) comes from Villa Balestra (16th century) and was reassembled in Rocca Savelli in 1937. A photograph from the 1920s shows the absence of this architectural element along the walls (Fig. 10).

Figure 7. The gate tower (BC1), along the north-east side of the fortress.

Another modern opening (EA6, Type 1) can be found on the south-west frontage and belongs to a well-known typology in 17th century Italy. In Rome, an example of this very common type conserved at 31 Via dei Chiavari is particularly interesting. It was a gate (nowadays reused as a window), composed of jambs and arch in Peperino tuff, while the keystone and the capitals are made with travertine. This architectural element dates back to the first half of the 17th century, since an epigraph located on the capitals mentions Stefano Zanetti (the owner). He inherited the building from his uncle Antonio in December 1623 (Fig. 11. Bianchi 1998, 320-323).

The chrono-typological repertoire of masonry techniques is composed of three main categories: masonry in building components refined with a chisel (A); masonry in roughly refined building components (B); masonry in coarse or barely refined building components (C).

Two further categories are related to brickwork (D) or masonry in mixed materials (E) (Fig. 12). Each category groups together a series of masonry techniques, with differences in terms of refining, size of the building components and layout (Tab. 1).

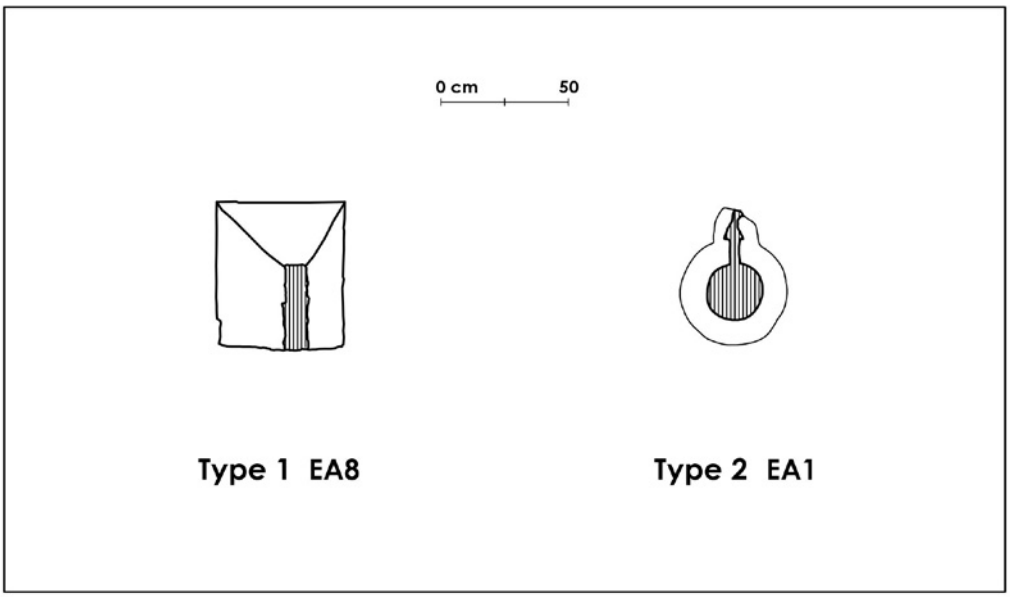

Figure 8. Openings from the second half of the 15th century (Phase 6).

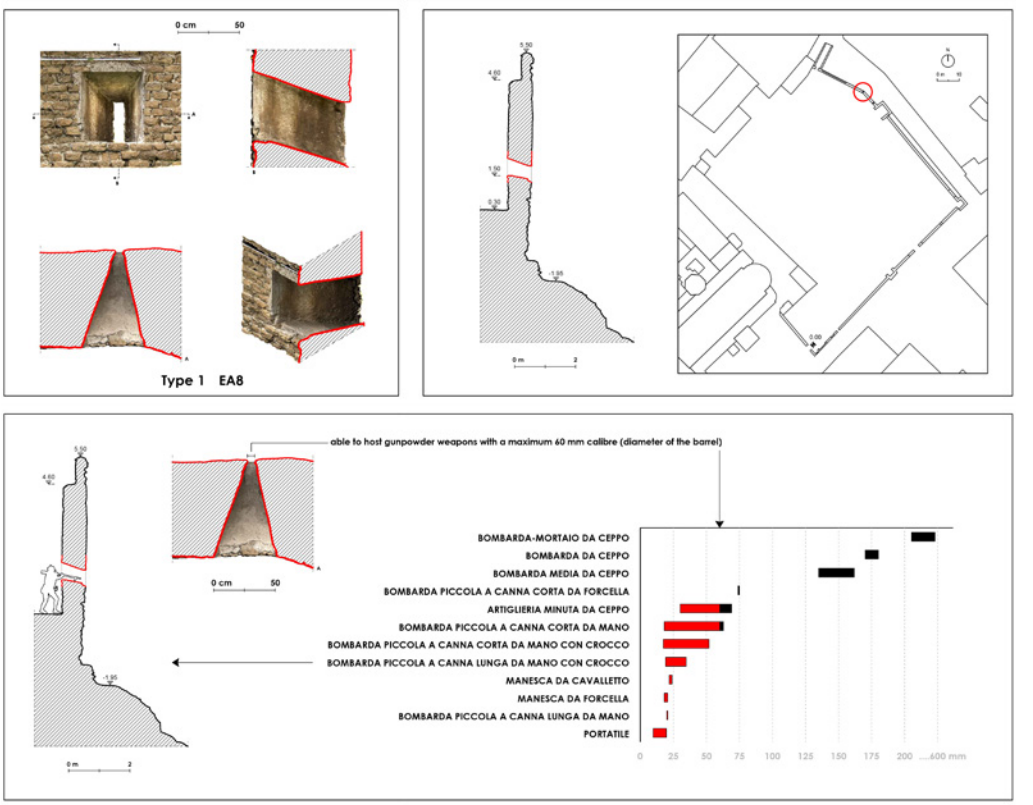

Figure 9. Analysis of the compatibility of modern weaponry with the openings built during the second half of the 15th century (Phase 6).

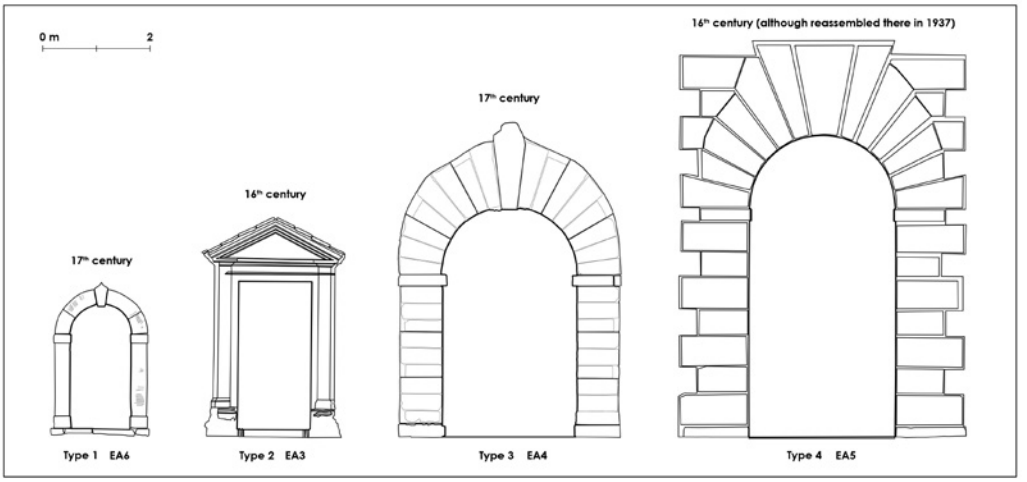

Figure 10. Doors and gates from the modern period surveyed at the fortress.

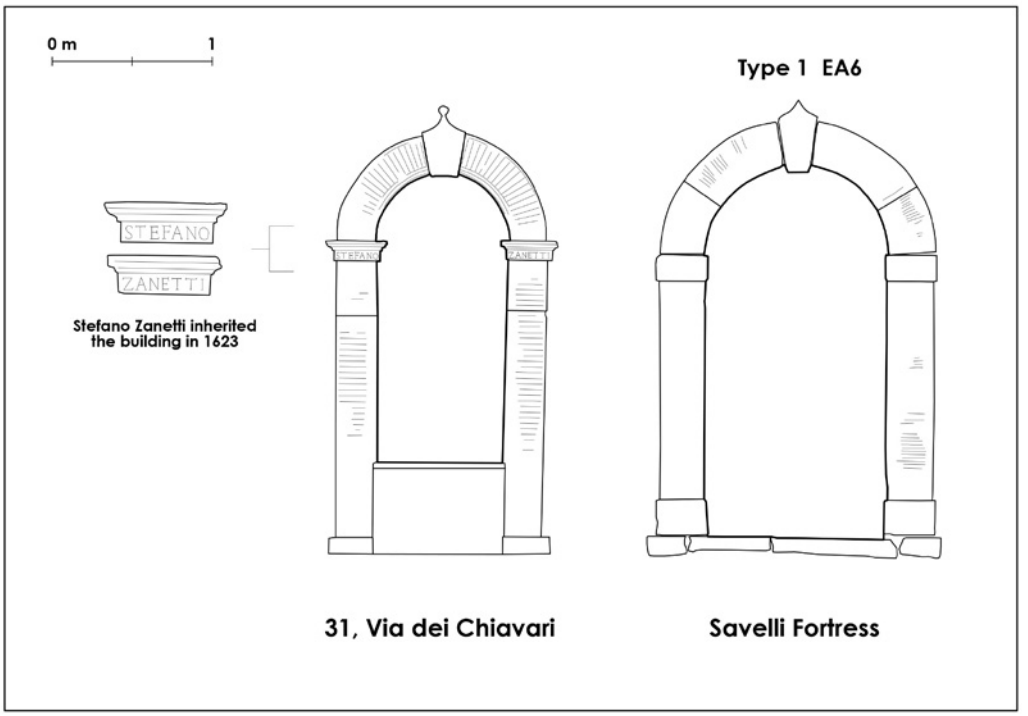

Figure 11. Comparison between the gate of the fortress and a directly dated match from the City.

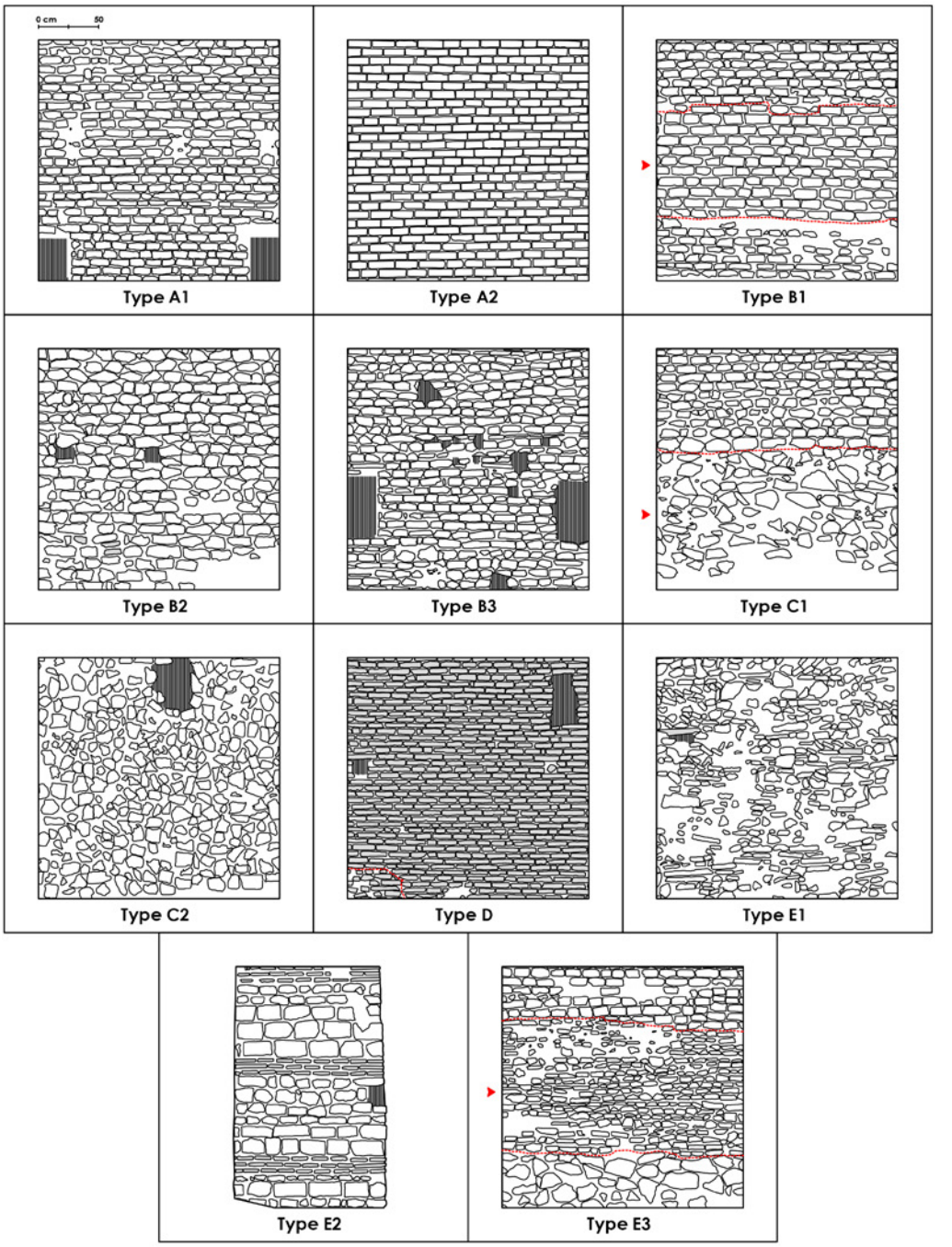

Figure 12. Chrono-typological repertoire of masonry techniques. The earliest typologies are indicated by the following codes: B2 (Phase 1, first half of the 13th century); A1 (Phase 2, second half of the 13th century), B3 (Phase 4, second half of the 14th century), D (Phase 5, 15th century).

Table 1. Description of the different masonry types.

Type	Description
A1	Structures built with carefully refined small rectangular blocks featured by a flat surface. Blocks (commonly defined 'tufelli') are laid on thin mortar joints. These walls are the output of a building organisation where stonecutters had a preeminent role.
A2	Structures built with carefully refined rectangular blocks. Blocks are reused, rusticated and small-sized. They have been regularly laid on thin mortar joints. The reuse of previous structures is demonstrated by some elements: an inhomogeneous deterioration of the surface, fractures and traces of pointed tools that re-worked previously refined blocks.
B1	Structures built with roughly refined, rectangular blocks, lacking in refining of the surface. Blocks are small and laid in regular rows on thin mortar joints.
B2	This type is similar to the ones above, although its building components are more irregular. Therefore, its mortar joints are characterised by a varying thickness.
B3	Structures built with roughly refined building elements. Blocks are small, reused and with a flat surface. They are laid in regular rows, on mortar joints featured by a varying thickness.
C1	Structures built with barely refined and heterogeneously-sized blocks, irregularly assembled on mortar joints with a varying thickness. The building organisation did not require the presence of a stonecutter. Walls were exclusively assembled by masons.
C2	This type is similar to the one above, although its blocks are smaller.
D	Structures built with reused bricks, prevalently laid as stretchers and in regular rows. The layout is irregular and with thin mortar joints. This technique seems to have pointed towards a rationalisation of the resources available, selecting and assembling reused materials.
E1	Structures in mixed materials: roughly refined stone blocks and a minor presence of bricks. Blocks are small, reused and lacking in refining of their surface. They were irregularly assembled, leaving mortar joints with varying thickness. Bricks are also reused and were utilised in fragments.
E2	Structures in mixed materials: roughly refined stone blocks and bricks. The first ones are heterogeneously-sized and had their surface roughly flattened out. They are laid in regular rows on mortar joints with varying thickness. Brick instead, are laid in bands composed of regular rows. They are mostly laid as headers, generating an irregular layout with medium mortar joints.
E3	Structures in mixed materials: barely refined stone blocks and a minor presence of bricks. Blocks are reused, small and lack in refining of their surface. They are laid in irregular rows on mortar joints with varying thickness. Bricks were reused and assembled in fragments on irregularly thick mortar joints.

Conclusions

This study has demonstrated that Rocca Savelli can be classified in the typology of the fortified enclosures: the entire perimeter of the walls was built in the same period. However, data do not allow a full understanding of the initial project. It is still necessary to clarify if the fortification hosted other contemporary buildings in its inside.

Moreover, another fascinating hypothesis cannon be excluded: the fortification functioned as a defence for an earlier residential settlement located on the hill, built before the 13th century foundation. This possibility still awaits further evidence: something that encourages future investigations.

Furthermore, it will be necessary to extend the focus to other aristocratic defensive structures: for example, the apparently similar Caetani *castrum.*

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The use of mudbricks and earth in modern Umbrian architectures: a preliminary report

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Abstract

The paper concerns with the use of unbaked bricks and clay in late medieval and early modern architectures in Umbria. In this central Italian region, a few structures are featured by such building materials, especially in areas lacking in good stone deposits. The topic has been sporadically investigated by previous studies and awaits systematic approaches. In particular, it is necessary to clarify the chronology of these building technologies and, regarding unbaked bricks, their relationship with the local baked production. Many different types of evidence will be considered: written sources, historical cartography, stratigraphic data, chrono-typological and mensio-chronological serialisations. Therefore, such focus fully locates the research within the borders of architectural archaeology. The expected goal is specifying the socio-economic, technical and chronological context in which clay-based techniques were developed and used. The paper also aims to enhance the attention and supervision on this type of material culture by related public institutions.

Keywords

Unbaked bricks, perishable materials, masonry techniques, brickmaking, mensio-chronology.

The role of earthen techniques in ancient and early medieval architecture is well-known in archaeological studies, due to ever growing discoveries.[1] What is less prominent is the use of earth across the late Middle Ages and the modern period. Earthen architectures have been registered in rural contexts of several Italian regions, with a particular frequency during the 18th and 19th century.[2] To introduce the topic, earthen building techniques can be divided into two main categories:[3]

- Rammed earth techniques (also known as pisé), built by pressing clay-based earth within wooden formworks.
- Masonry in unfired bricks (also known as earth bricks, mudbricks, or adobe), which is identical to brickwork, with the only exception that bricks were not fired.

A third typology is a mix of earthen solutions and fired bricks or stones. In most cases, the base of the structure was built in unperishable materials (usually bricks and lime), to shield earthen fabrics from ground humidity.[4] A similar protection was achieved through plastering the surface of the wall.[5]

[1] An overlook on the ancient use of these techniques is available in Cagnana 2000, 90-92; Saracco 2010, 22-24; Santangeli Valenzani 2015, 55, 57-58, 66, 110-112.

[2] Studies on different regional areas can be found as follows: on Piedmont, Pagella Poggio 1992; on Marche, Saracco 2010; on Tuscany, Francovich, Gelichi, Parenti 1980, 207-217; on Abruzzo, Mazzanti 2012; on Sicily, Germanà 2015.

[3] On these two categories and possible variants, see Pagella Poggio 1992, 11-20; Cagnana 2000, 89-90; Mazzanti 2012, 540; Pittaluga 2012, 699.

[4] Del Rosso 1793, 25; Pagella Poggio 1992, 13; Saracco 2010, 66; Mazzanti 2012, 540.

[5] Del Rosso 1793, 29; Pagella Poggio 1992, 24; Cagnana 2000, 90.

This paper deals with the use of unfired bricks and other clay-based architectural solutions in Umbria (central Italy), a region where these masonry techniques are widely unacknowledged. This research aims to offer a preliminary survey of the remains of such building practises, in parallel with what has been done in neighbouring regions (Saracco 2010, 29), and to investigate the chronology of the surviving evidence: an essential historical information affected by a series of methodological issues.

State of the art in Umbria

At present, there has been little attention on earthen structures in Umbria. Besides studies on other regions that have 'accidently' mentioned Umbrian structures, the list of 'recent' contributions on earthen structures is very limited. In first instance, studies by Henry Desplanques (1955, 81) and Bernardino Sperandio (2010) have briefly mentioned earthen masonry. Desplanques mostly profited of a 1934 survey edited by the Central Institute of Statistics of the Italian Kingdom. This study recorded 52 rural structures built in earth and greenery ('Case in terra e fogliame') in Umbria. Since 47 out 52 were meant to be demolished, the report showed the poor conditions of these structures at the time (ICSRI 1934, 19). At the same time, the document did not consider dwellings built of both earth and unperishable materials: a very common occurrence as shown below. According to Sperandio, earthen architectures became common during the 19th century due to economic reasons (Sperandio 2010, 421 and 424). However, the author fails to provide clear evidence for this assumption. Umbrian earthen structures are also briefly mentioned in the survey on these building techniques in Marche region by Marco Saracco (2010, 24). This author suggested a late 19th-early 20th century chronology for some rammed earth structures noted in the Trasimeno area.

Published sources on earthen building in Umbria.

During the Roman period, mudbricks were used in the region as documented by Pliny the Elder on the walls of Mevania, nowadays Bevagna (Plin., HN 35.173) and by recent archaeological discoveries (Ceccarelli 2018, 35-39). When the attention is focused on the late medieval and early modern period, written and archaeological evidence is rather scarce, mostly due to the lack of archaeological research on these chronologies in Umbria. However, two 18th century sources provide an interesting insight on two specific areas of the region: the Trasimeno Lake and the southern Umbrian Valley.

Around 1745, the local historian Durastante Natalucci testified the abundance of earthen houses in the valley near Trevi (central-eastern Umbria), by the villages of Cannaiola and Picciche:

> *'...the dwellings [of Cannaiola], basically everywhere, are made of fired bricks while, according to the elder, they were earthen, as it can still be noticed in same places.' (Natalucci 1985, 411).*

> *'...the people's houses [in Picciche] ... are all humble and mostly made of earth.' (Natalucci 1985, 430).*

Earthen structures were therefore relatively common around Trevi, but they were already being replaced by buildings made of unperishable materials, and only lower social strata continued to use them.

In the same century, Umbrian earthen structures are briefly mentioned by Giuseppe Del Rosso in his 1793 manual on the reintroduction of similar building techniques in Tuscany. When discussing the use of earthen houses among the farmers of the Chiana Valley, he testified the use of mudbricks in the Papal areas just outside the Tuscan border, along the Trasimeno Lake, together with the wide use of clay instead of lime as binding material (Del Rosso 1793, 47-50, 58-59, and 65).

Survey of the written and archaeological evidence

Surveying the remains of the earthen architectures across the region is fundamental for understanding the significance of such techniques in the local pre-contemporary landscape. A similar approach, also considering oral testimonies of the local population when available, has been carried out in other Italian areas (Pagella Poggio 1992, 70). At present, Umbria still lacks a comprehensive study on the topic. However, it is possible to offer an initial list of sites where earthen buildings have been noted, both by previous studies and by the present one (fig. 1).

1. North-eastern borders with Marche region. Earthen huts are documented as shelters for refugees from the village of Sigillo in a nearby woodland in 1943-1944 (Cristofaro 2009, 134).
2. Trasimeno area. Besides being testified by Del Rosso at the end of the 18th century,[6] earthen structures in this area have also been noted by M. Saracco (2010, 24), who records the presence of late 19th-early 20th century buildings. Based on the surviving evidence, earthen structures are part of farmhouses and other rural buildings.
3. Countryside around Perugia. It has been possible to survey two earthen structures around the main Umbrian town. The first one is located about one kilometre south-east of Torgiano, along the Assisana Road.[7] Another mixed-technique structure, partially in rammed earth technique, has been surveyed in front of the church of San Cristoforo of Piscille, on the hillside near Perugia.[8] Both the Torgiano and the Perugia buildings will be analysed in detail in the following section.
4. Countryside of Trevi. Besides Natalucci's testimony above (1745), it has been possible to survey five structures partially composed of mudbricks. Two of them are in the village of Picciche, one in Cannaiola, one in San Luca and another one in nearby Fratta (within the municipality of Montefalco since 1816).[9] They can all be interpreted as modest residential buildings. In Picciche, oral witnesses document other earthen structures identified during restoration works.[10] In the same village, another structure (seemingly an isolated aristocratic dwelling) is built with fired bricks bound with clay.[11]
5. Countryside around Montefalco and Bevagna. The presence of earthen huts in the countryside between these small towns was witnessed by Desplanques (1955, 81).

[6] Del Rosso 1793, 65: 'In those areas of the Papal States located beyond the China River, in the district of Castiglion del Lago...almost every country house scattered there, and even the manors belonging to very wealthy men are composed of fired bricks. Besides the base of the building, they are almost entirely built with no lime as it is scarce there, so the portion above the ground is laid with earth'.

[7] It is possible to find the building at the following coordinates: WGS84 43.035252, 12.448580 (Assisi Road).

[8] It is possible to find the building at the following coordinates: WGS84 43.095431, 12.406877 (39, Assisana Road).

[9] These structures can be found at the following coordinates: 42.847776, 12.700014 (Picciche, Via Tatarena – Via dello Scalone); 42.844190, 12.698345 (Santo Stefano Road); 42.862198, 12.711847 (Cannaiola, Via Sant'Angelo Nuovo, 47); 42.857223, 12.699151 (San Luca, Le Selvette); 42.845426, 12.687598 (Castle of Fratta).

[10] I must thank Mr. Manfredo Borasso, builder from Trevi, who informed me (11/12/2021) of having found other earthen fabrics during some restoration works in one of the buildings along Tatarena road in Picciche.

[11] 42.842380, 12.697614 (Picciche, Via Santo Stefano).

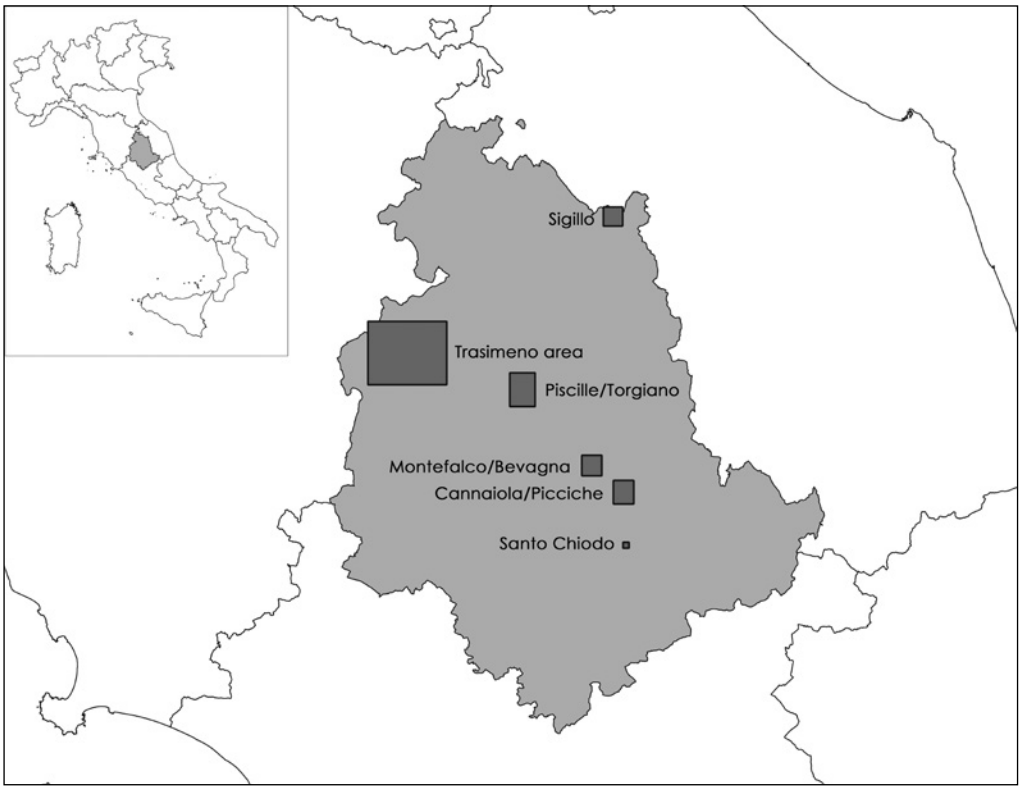

Figure 1. Location of sites and districts mentioned in the paper.

In 2013, I recorded the oral testimony of a farmer, born and raised in the village of Pietrauta, two kilometres west from Montefalco.[12] He recalled the presence of a hut (approximately 4x5 m) built with 'mud and hay'. According to the elder of the village, it was the house of local farmers. In ca. 1940, the structure was reused as a shelter for farmers and animals during heavy rains. This had brought to alterations of the original structure. It has not been possible to clarify the exact location and possible remains of the hut.

6. Rural surroundings of Spoleto. The only structure recorded here is the shed of a farmhouse, which was photographed in the 1970s (Gentili et alii 1978, 601). The picture shows the poorly preserved remains of a rammed earth structure. It has not been possible to ascertain if the structure still exists at present.

[12] Oral testimony recorded on 29th September 2013: '*Erano fatte de paja e fango, terra erano arde un pajo de metri; ce ija dentro le persone con tutte le vacche, il tetto era de cóppi. Stijano a Montefargo quando stijo a garzone di sotto a Pietrauta, jú per quilli campi, ce stija 'sta capanna che dicijono li vécchi che ce erano abitate le persone llì; doppo l'ijono trasformata in capanna, pe' quanno piovija se ija jú. L'ho conosciute, dunque, che c'avrò avuto 16-17 anni* (1944-45). *Ijono missu li travi de legno: uno dietro, uno in mezzo e uno davandi e bastoni a regge' 'sti cóppi; ce stijano travi lunghi che attraversavano e 'sti bastuni che reggijono li cóppi stijano per quest'andru versu. Saranno state quattro per cinque, una ventina de metri de spazio. Lu pianu era terra. Non ci stijano mattuni: se erano stati lehati o se era creata a quella maniera, era tuscì. Li vécchi s'arcordavano che c'erano abbitate* (le persone), *dice, fino a pocu tempu fa, mica tant'anni prima! Ci stija 'na finestrella da 'na parte, chisà se pe' lu pezzu davanti che ijono levatu se ci stija quarghe andra finestra, perché pe' entra co' le vacche dentro duvija apri' davanti. Davanti stija apertu e le tre mura, ce stijono li fianchi e lo dietro e da 'na fiancata ce stija 'na finestrella...*' (interviewer: Stefano Bordoni; witness: Nazzareno Bordoni, 1927-2018).

This short list of evidence confirms the survival of these techniques into the early 18th- 20th centuries.

Dating the archaeological evidence

The dating of earthen structures has been discussed in recent years in academia, stressing out the many problems related to the use of traditional methods (Mannoni 1984). Compared to other building techniques, earthen structures present objective difficulties (Pagella Poggio 1992, 70-72; Pittaluga 2012, 700-701; Pittaluga, Pagella 2014, 6-7). For example, the rarity of architectural elements valid for chrono-typological purposes or the still debated validity of mensio-chronological approaches when applied on mudbricks (Pittaluga, Pagella 2014, 7). On the one hand, chrono-typology often loses part of its efficacy in vernacular structures (Brogiolo 1988, 31-32); on the other hand, mensio-chronology is only valid for standardised productions under specific norms (Mannoni, Milanese 1988), which must yet be confirmed for mudbricks. To present, important elements receiving a certain consensus for the chronology are the following:

- use of dating graffiti on the earthen fabric;
- use of dating finds within the earthen fabric;
- chrono-typological evidence, when stratigraphically connected;
- dated plasters;
- oral interviews;
- written sources
- historical maps.

These elements have various chronological significance. In particular, the presence of a certain building in historical maps does not provide evidence on the identification of preserved portions as the ones drawn on the map (Pagella Poggio 1992, 71). Absolutely or relatively dated plasters exclusively allow an ante-quem chronology for the wall underneath (Pagella Poggio 1992, 74). Considering both methodologies and limitations, some of the most informative structures surveyed in Umbria has been analysed to specify their period of construction.

Torgiano – Assisana Road (fig. 2)

It is a typical farmhouse with external stairs for the second floor, originally built with rammed earth, alternated to rows of fired bricks. The building's owner, Mr. Luciano Cardinali, reported that the masonry was already there in the 1960s, when his family moved in.[13] The building is represented in the 1820 maps of the so-called Gregorian Cadastre, and the planimetry seems to mostly overlap with the present structure.[14]

The stratigraphic analysis of a highly indicative selection of the fabric has provided more chronological information. The rammed earth structure was restored twice with a similar masonry technique before a third significant intervention in bricks and lime. Data collected from the southern façade of the building suggest that this restoration followed an event causing a significant structural damage. Two breaches occurred across the wall and the roof

[13] I am grateful to Mr. Cardinali for having allowed me to access his property and the information he provided.
[14] Perugia, Archivio di Stato, *Catasto Gregoriano*, folder 162 (Torgiano II, 7/4), map 4, parcel 387.

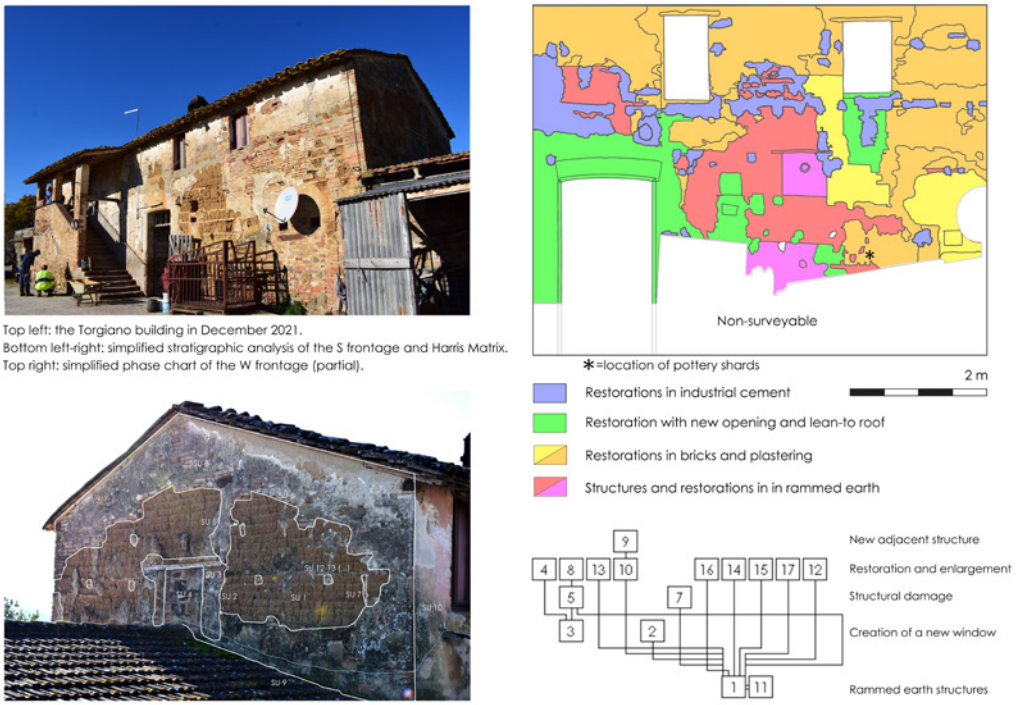

Figure 2 (a-d). The Torgiano farmhouse (stratigraphic details, Harris matrix and relevant building phases).

was completely reconstructed (SU5 and SU7). Consequently, the building was also replastered. Three pottery fragments have been noted on the nowadays eroded surface of the plaster. Although scarcely indicative, they belong to the bottom of an undiagnostic glazed pot and the handle of a slip-painted basin (18th-19th cent.?).[15] This event preceded another building phase featured by the creation of the external stairs and a lowered-arch door, often used in utilitarian architectures in Umbria between the late 19th and early 20th century.

Trying to understand the structural damage shown by the stratigraphic palimpsest, it is possible to propose earthquakes as most likely causes. Although Umbria is a highly seismic area, the only telluric event causing damage around Torgiano in modern times is the one registered in January 1832 (estimated 6.3 Mw). For example, the near centre of Bettona (4 km from the building) suffered effects classified as an 8 degree on the Mercalli scale.[16] Such destructive power is capable of considerable damage in ordinary buildings and even greater damage in poor ones (Brazee 1978, 52-53). A seismic interpretation is further favoured by the limited seismic resistance of the rammed earth, according to recent studies (Gallego, Arto 2015). Considering these chronological elements, it is possible to propose a chronology earlier than the first half of the 19th century for the Torgiano earthen structure.

[15] On this class in Umbria, see Busti, Cocchi 1996, 42-49 and Bordoni 2021 b, 184-186.
[16] Guidoboni, E. et al. 2018, 'CFTI5Med, Catalogo dei Forti Terremoti in Italia (461 a.C.-1997) e nell'area Mediterranea (760 a.C.-1500).' *Istituto Nazionale di Geofisica e Vulcanologia.* URL: http://storing.ingv.it/cfti/cfti5/quake.php?05892IT. DOI: https://doi.org/10.6092/ingv.it-cfti5.

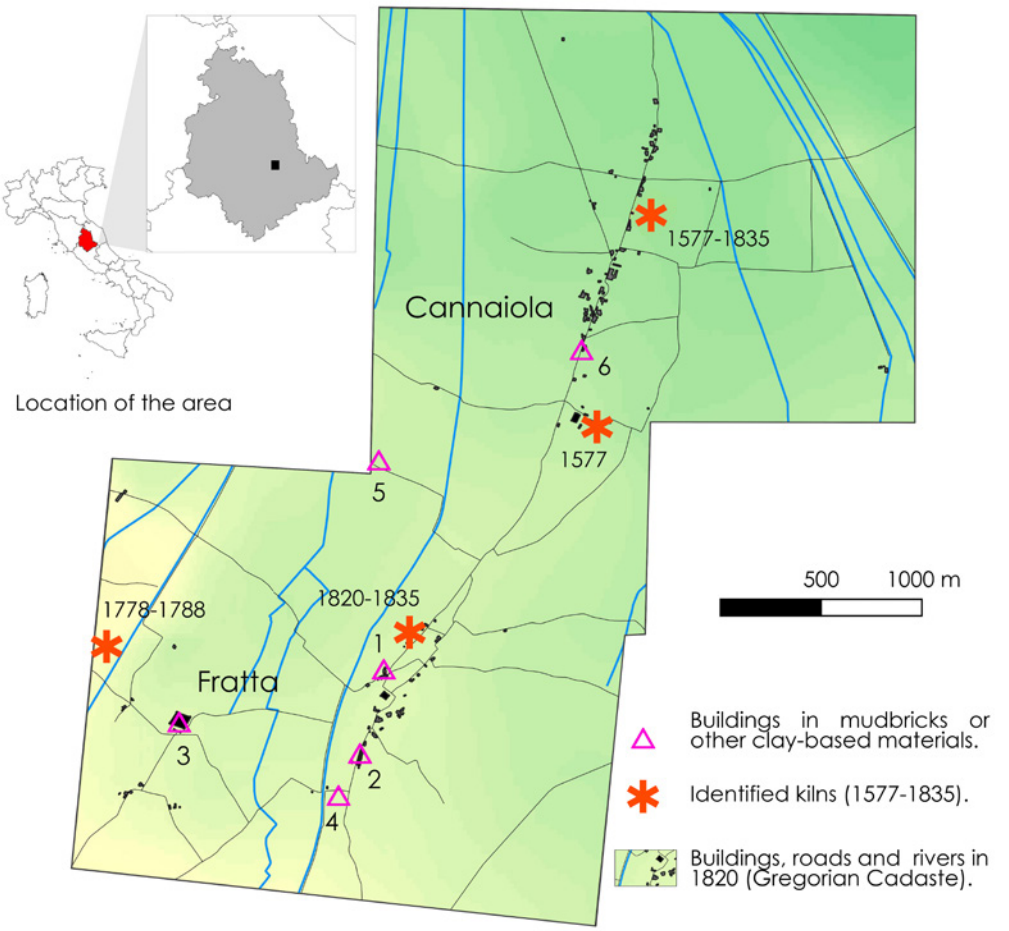

Figure 3. The Cannaiola-Picciche-Fratta district with the locations of mudbrick structures and identified kilns.

Picciche – Tatarena road (fig. 3, 1)

It is a residential building with farming facilities, located outside the castle of Picciche, a settlement entirely reorganised around 1516 (Natalucci 1985, 430). The earthen portion is built with accurately shaped mudbricks, sparsely alternated to rows of fired bricks. The first floor of the building is made of fired bricks, creating a valid isolation for the earthen masonry. The building is already represented in the 1820 maps of the Gregorian Cadastre.[17] On the other hand, drawings of the castle by Cipriano Piccolpasso (ca. 1575) do not represent buildings in the area surrounding the castle walls (Piccolpasso 1963, tab. XVI). The only noticeable element in the present-days façade, which follows the rounded shape of the road, is a painted chapel dating back to the early 16th century according to some authors (Quirino 1987, 87). The plaster covering most of the wall surface does not allow the understanding of

[17] Spoleto, Archivio del Consorzio della Bonificazione Umbra, *Catasto Gregoriano*, folder of San Lorenzo and Picciche, map 5, parcel 737.

the stratigraphic relationship between this chapel and the rest of the building. However, the stratigraphy shows that the red-painted plaster covering the façade is clearly later than the paintings of the chapel.

Further information can be provided by the first floor of the building, built in fired bricks. These are all reused bricks, but relatively homogenous in terms of size. This is probably due to the reuse of construction material from a single building. When analysed, they generate a 29.8x4.8 cm average, which is comparable to the 29.9x4.8 cm average from the Villa Faustana near Borgo Trevi (4 km NE from Picciche), dating back to 1569. This further confirms a chronology equal or later to the mid-16th century for the portions in mudbricks, in accordance with what said above.

Picciche – Santo Stefano Road (fig. 3, 2)

It is a house block, about 100 m south from the church of Santo Stefano. Mudbricks, now badly eroded, appear regularly shaped. They were coated with fired bricks laid as shiners, stone slabs and/or plaster to increase their insulation. These structures are not very informative on absolute chronology. As it appears on historical maps, the entire block was already built in 1820[18] and some of its portions are chrono-typologically datable to the late 17th-early 19th century. However, the stratigraphic relationship between mudbrick fabrics and this part is unclear. One of the two mudbrick units shows an evident 20th century restoration with concrete blocks and a steel lintel.

Picciche – Santo Stefano Road (fig. 3, 4)

An aristocratic cottage is located on the border between Picciche and Castel San Giovanni. Although being built with fired bricks, the binding material is composed of clay. From a chrono-typological point of view, the architectural elements of the building suggest a late 18th century chronology (rounded windows, T-shaped jack-arch windows). However, the building is absent from the 1820 cadastre.[19] Therefore, we must assume that it was built later, in the 19th century, probably within the first half.

Cannaiola – 47, Sant'Angelo Road (fig. 3, 6)

Rectangular structure along the road, mostly plastered. The building does not show any chronologically indicative feature. Where the plaster has fallen, just underneath the roof, it is possible to see the wall fabric, composed of brick and mudbrick portions. The building is represented in the 1820 Gregorian Cadastre already with the current planimetry.[20]

San Luca – Le Selvette (fig. 3, 5)

It is a rectangular farmhouse with external stairs to the second floor, just few meters from the present municipal border between Trevi and Montefalco. Where the plaster has fallen, it is

[18] Spoleto, Archivio del Consorzio della Bonificazione Umbra, *Catasto Gregoriano*, folder of San Lorenzo and Picciche, map 8, parcels 524-526.
[19] Ibid., *Catasto Gregoriano*, folder of San Lorenzo and Picciche, map 7, parcel 849.
[20] Ibid., *Catasto Gregoriano*, folder of Cannaiola, map 8, parcel 263.

possible to notice vast portions in mudbricks. Other parts of the structure are made of bricks laid as rowlocks, most likely to protect the core of the masonry in mudbricks. The building is not represented on the maps of the Gregorian Cadastre. Little can be said in terms of chrono-typology, besides the general typology of the farmhouse that should date back within the first half of the 20th century. However, it has not been possible to closely inspect the building, which lays in a private property.

Fratta – Structure within the castle walls (fig. 3, 3 and 4)

It is a small residential building located within the defensive system of Fratta, a castle mostly rebuilt at the beginning of the 16th century (Natalucci 1985, 426). Mudbricks are used for the filling of a jack-arch window, later replaced by another opening. The building is represented in the 1820 map of the Gregorian Cadastre.[21] Chrono-typological evidence suggests a date later than the late 15th – late 16th century for the mudbrick part. Indeed, the window filled with mudbricks replaced previous openings composed of a monocentric arch in rowlock bricks, surrounded by a crown of bricks laid as headers. This typology is widely documented in the region between the second half of the 15th and the whole of the 16th century. Besides its partial remains, some chronological considerations can also be drawn from the jack-arch window: a solution common in Umbria from the second half of the 16th century and widely applied until the whole of the 19th century. This range can be narrowed down by considering the size of its fired bricks. Despite not being able to take direct measures due to security reasons, bricks can be estimated around 8 cm in width. In Umbria, this thickness was exclusively reached around the 17th-18th century (Bordoni 2021 a, 287-296). In the municipality of Trevi, the bricks used in building the churches of Santa Croce (about 1685, average thickness: 8.2 cm) and Sant'Angelo of Cannaiola (1602-1684, average thickness: 8.9 cm) show similar values. Since mudbricks sealed the window, a late 17th-early 18th century chronology can just be considered as a terminus post-quem, although mudbricks are earlier than other 20th century alterations.

A possible mensio-chronology for mudbricks

Mensio-chronology of fired bricks is considered a reliable dating method and historical-economic indicator (Mannoni, Milanese 1988). However, the application of mensio-chronological analyses on mudbricks is still an ongoing issue. The crucial point is the relationship in the production of mudbricks and their fired counterparts. Were mudbricks made by the same kilns that produced the fired ones? Or were they the output of completely different and maybe 'homemade' productive chains? On the one hand, we would have bricks reasonably produced with the same standardised shapes of the fired production, although non affected by the shrinking in volume of the firing process (Pagella Poggio 1992, 19; Pittaluga, Pagella 2015, 292). On the other hand, we would have two completely unrelated productions, making any mensio-chronological approach unapplicable. The debate is still open, and its conclusions vary from region to region. For example, research has excluded a standardisation of the mudbrick production in some areas around Alessandria in Piedmont (northern Italy) (Pagella Poggio 1992, 19). At the same time, mudbricks studied in other settlements of the same regions match the size of the fired counterpart (Pittaluga, Pagella 2014, 7; Pittaluga, Pagella 2015, 292).

[21] Ibid., *Catasto Gregoriano*, folder of San Lorenzo and Picciche, map 5, parcel 737; folder of San Lorenzo and Picciche, map 8, parcels 524-526; folder of Fratta, map 6, parcel 4.

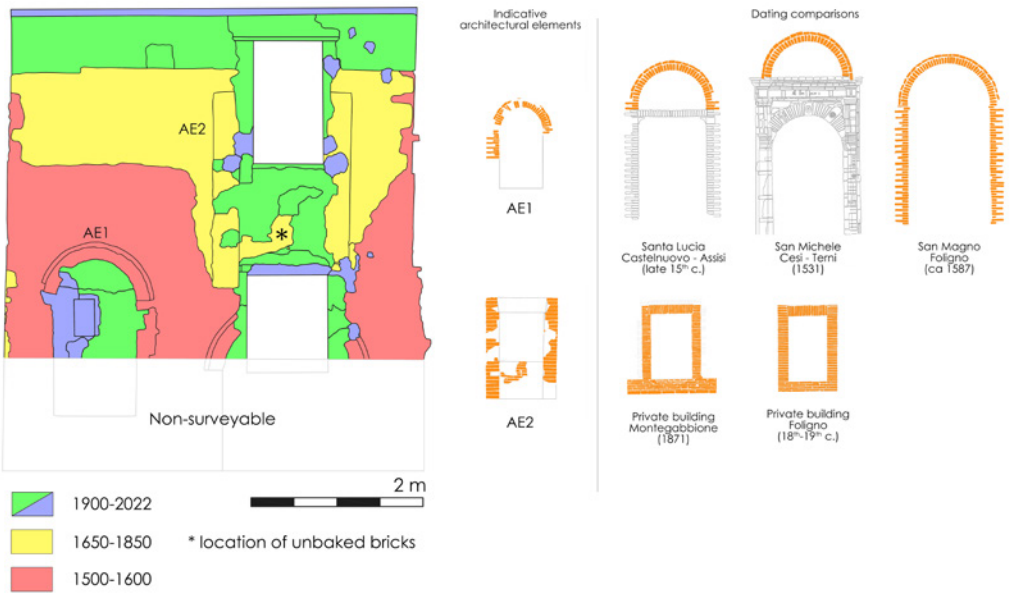

Figure 4. The Fratta structure (main stratigraphy, building phases and chrono-typological comparisons).

In Umbria, the above-mentioned cases of Picciche offer three statistically valid samples to test the relationship between mudbricks and fired bricks. For a proper comparison with the fired production, a hypothetical 8-10% shrinking in volume after the firing process has been considered. According to this, the two samples from Picciche would have ranged between 6.4 and 6.9 cm in thickness (tab. 1). Following a regional survey I have conducted, values of 6.0 cm or above are most likely reached between the late 16th and the 19th century (Bordoni 2021 a, 287-296). This is valid in Trevi as well, with values equal to 6.0 cm or above documented in the period between the 17th and the mid-19th century. The sample from Tatarena Road is particularly interesting, with values are exactly midway between a 1785 brick buttress surveyed in Trevi and the nearby structures of the Porta Nuova (1854-1858), suggesting a possible late 18th – mid-19th century chronology.

However, it is necessary to find evidence on the production of mudbricks by the local kilns to validate the application of mensio-chronology on the production of this building material. To verify this possibility, I have invested part of this research in the well-documented local archive. A production of bricks in the Trevi district is demonstrated since the first half of the 15th century (Bordoni 2019, 49-50). However, a series of still not published documentations underlines the extent of such production and its later shift from Cannaiola to nearby Fratta around the mid-18th century. In fact, mudbrick structures cluster in an area where there are at least five identifiable kilns recorded between the second half of the 16th and the mid-19th century (fig. 3).[22]

[22] Trevi, Archivio delle Tre Chiavi, Folder 28, File 526; Register 304, 50, 64 and 264; Register 445, 9 (front) and 481 (front); *Registri delle assegne*, 2 (Fratta); *Ristretti di tariffa*, *San Lorenzo e Picciche*; *Ristretti di tariffa*, *Cannaiola*; Foligno, Archivio di Stato, *Catastini*, Register 50, 1273.

Table 1. Mensio-chronological experimentations and comparisons regarding the mudbrick samples surveyed

Building	Length (cm)	Theoretical length after firing (cm)	Width (cm)	Theoretical width after firing (cm)	Thickness (cm)	Theoretical thickness after firing (cm)	Theoretical area after firing (cm^2)	Year
Tafarena road, Picciche	33.2	32.0-32.2	17.1	16.5-16.6	6.6	6.4	212	-
S. Stefano road, Picciche	31.5	30.4-30.6	15.5	15.0-15.1	7.1	6.9	217	-
Possible comparisons								
Buttress, Fantosati road, Trevi	-	31.7	-	-	-	7.3	231	1785
Porta Nuova, Trevi	-	32.4	-	-	-	6.0	194	1856

In particular, the Libro dei Fornacchiari (literally, 'Book of the Kilnmen'), a registry of the taxes paid by the local kilns to the Commune of Trevi between 1594 and 1797, represents an extraordinary testimony on small-scale dynamics of brickmaking in modern Umbria.[23] Its thorough analysis, that would take too much space to be presented in this paper, has provided evidence on the relationship between kilns and mudbricks. A 1676 record documents the payment of 200 mudbricks by the brickmaker Pasquasio of Rainaldo,[24] destined to restore the public bakery in Trevi. This suggests the same thermic use for mudbricks that Cipriano Piccolpasso proposed in his manual (Piccolpasso 1857, 29).

The archive also contained a 1589 agreement between the commissioners elected by the Commune and the local kilnmen. This document mentions a long list of products fired in the kilns active around the town. Among the various agreements, kilnmen were obliged to '... vendere e dare lo lavorio di ogni sorte quale ce sia alla fornace cotto, o, crudo come piacera a chi lo vole comprare...' (...to sell every kind of product available at the kiln, fired or unfired, to the buyer...).[25]

These two sources, at least, imply that kilns made and sold both unfired and fired bricks, further encouraging the application of mensio-chronology in the future and with wider datasets.

Conclusions

Although this research is in a very preliminary stage, it is already possible to point out some innovative results. First, some considerations can be drawn on the different distribution of rammed earth and mudbrick structures across the region (fig. 5). Rammed earth seems to mostly cluster in the former district of Perugia (Piscille and Torgiano), while mudbricks have a spot of high concentration in the area around Trevi (Picciche, Cannaiola, San Luca and Fratta). Further field research is needed to confirm the existence of two different building traditions connected to the use of clay in architecture.

[23] Trevi, Archivio delle Tre Chiavi, Folder 28, File 526.
[24] Ibid., 51 (front).
[25] Trevi, Archivio delle Tre Chiavi, Folder 28, File 51.

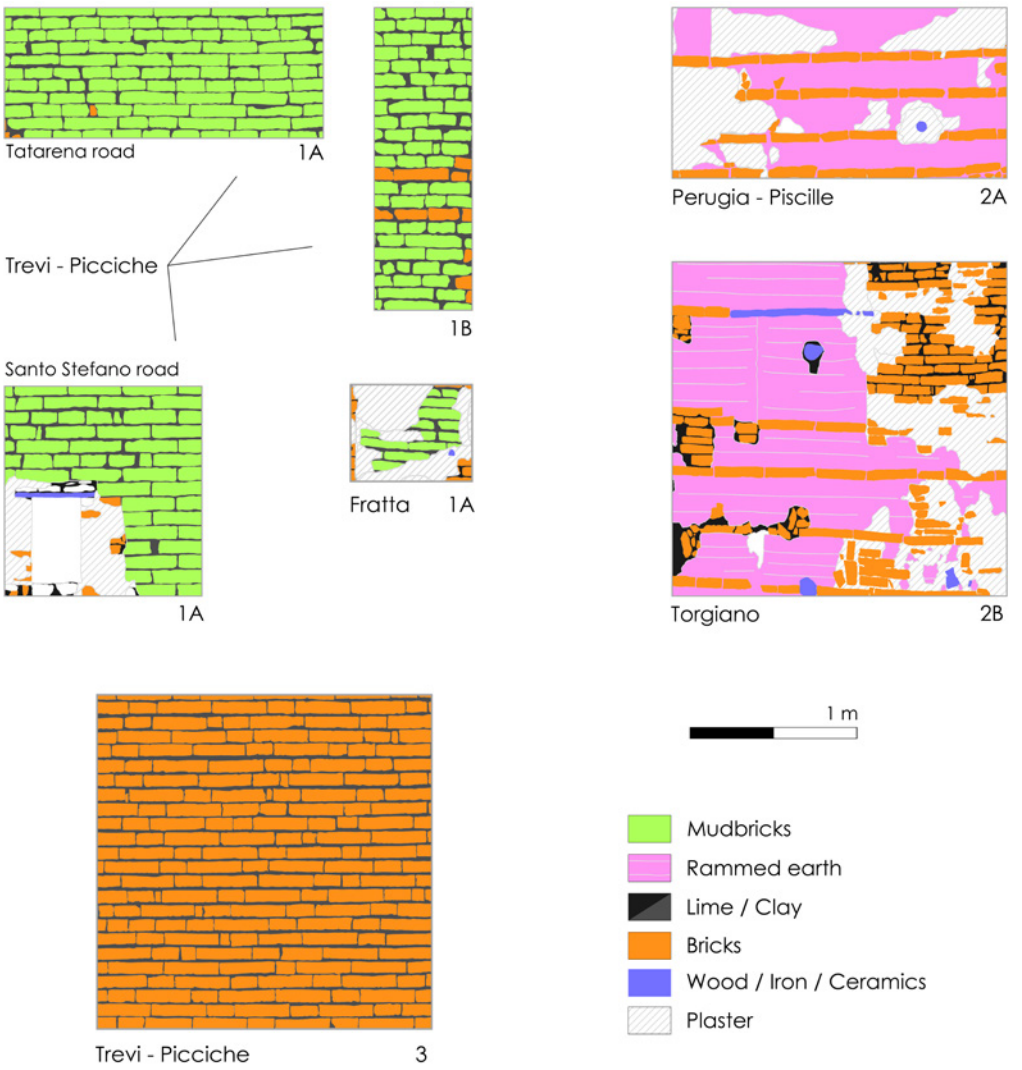

Figure 5. Synoptic catalogue of the masonry techniques (mudbricks: 1A-1B; rammed earth: 2A-2B) recorded during the survey.

In terms of chronology, both written and archaeological sources record the production of mudbricks between the late 16th and the 19th centuries, when they are (at least partially) connected to the activity of local kilns. This chronological range is not peremptory and may be extended through further evidence. A late 15th century source might document earthen structures in the same valley of Cannaiola and Picciche (1493):

> 'The fload has been so violent to demolish all the earthen houses (?) in San Lorenzo, San Giovanni, Casa Paduli and Castel Nuovo, at the borders between Trevi and Montefalco.' (Pirri 1921, 141).

Less information is available on rammed earth structures, although the Torgiano building may had been built by the early 19th century. Between the late 18th and mid-19th century, written sources on the Trasimeno area together with the building in Picciche also show the use of clay as binding material for fired bricks. In this case, further research is needed to verify the extent of such practise. Later, the use of earthen architectures survived in poor rural settings, mostly huts for farmers, until the first half of the 20th century.

These chronological ranges find sound comparisons in other Italian regions. The oldest earthen structures that are still standing in Italy date back to the 17th century (Cagnana 2000, 92; Pittaluga 2012, 699; Germanà 2015, 166). At the same time, several regional examples of these building techniques are dating back to the late 19th - early 20th century (Pagella Poggio 1992, 37-51; Saracco 2010, 42, 56; Mazzanti 2012, 542, 544).

To improve the data set on these building techniques, both systematic on-field surveys, and extensive archival research will be crucial. The need for a comprehensive and georeferenced documentation of the remains is an imperative step for a better understanding of this widely unknown architectural 'chapter'. Due to the lack of public supervision and resources on this topic, it may even be too late to produce a clear picture on the use of earth in the modern past: a practise that was surely wider than its current few remnants document. However, it is necessary to save as much information as allowed by the present architectural landscape before other irreversible losses. The clock is ticking.

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A diachronic multi-source approach to the study of a historical landscape in Central-Western Europe: the Blies Survey Project

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Abstract

Blies Survey Project (BSP) is an international cross-border research project aimed at reconstructing the historical landscapes around the ancient settlement of Bliesbruck-Reinheim, within a radius of 12 km. The research project is focused on a region located between the eastern part of the Moselle department in France and the southern part of Saarland in Germany, between two river valleys (namely the Blies and the Sarre) characterized by a long-lasting human occupation, from prehistory to the present. The geomorphological context and the natural environment of the riverbanks and the low hills have been significantly interrelated with settlement patterns and human occupation.

Keywords

Landscape, Settlement, Diachronic perspective, Archaeological field survey, Geophysical survey

Introduction

The Blies Survey Project (BSP) aims to study a region located in the eastern part of the Moselle in France and in the southern part of the Saarland in Germany (Hérapel, Schwarzenacker, Saarbrücken and Sarre Union), within a 12 km radius of the minor settlement of Bliesbruck-Reinheim, at roughly half the distance to other minor settlements (Fig. 1) (Antonelli, Petit, Casolino 2022; Antonelli 2022).

This territory can be defined as the area of influence of the ancient settlement of Bliesbruck, where archaeological research has a long history, that has become systematic only since the early 1980s (Petit 2012, 425). It is located 75 km east of Metz and 15 km from Saarbrücken, in the valley of the river Blies, a tributary of the Saar, into which it flows at Sarreguemines.

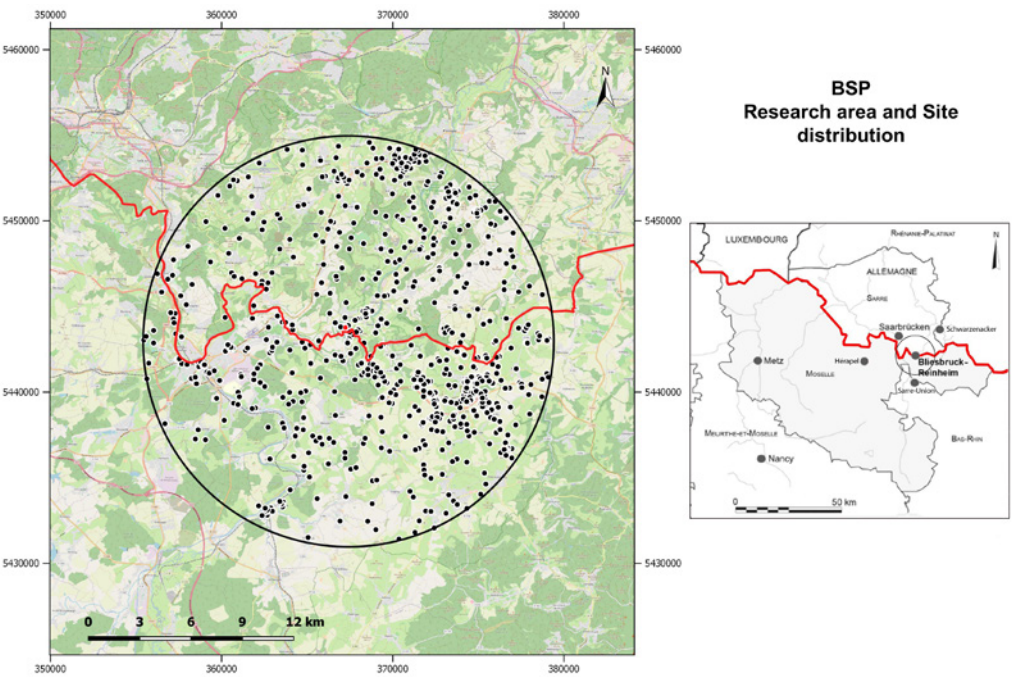

Figure 1. The BSP research area.

Within the two current villages of Bliesbruck and Reinheim, the Blies valley is dominated to the north by the 'Homerich', a hill which rises 60 m above the valley and, due to its position and topography, has a particular importance in this micro-region. Thus, from the end of the Bronze Age to the early Middle Ages, settlements, sanctuaries, and necropolises developed in the valley at the foot of this elevation, whose main role is still today very partially defined.

Presently, this territory cut by the Franco-German border witnessed to an eventful history since the end of the 18th century and has now become a European centre for research and heritage development following the creation of the Archaeological Park supported by two local authorities, the Moselle Department, and the Saarpfalz-Kreis, with the support of the French Ministry of Culture and the Ministerium für Bildung und Kultur resp. Landesdenkmalamt of the Land Saarland.

The archaeological research carried out since 2004-2005 as part of an interdisciplinary programme (Petit, Reinhard 2009) has delimited the chronological framework of the Blies Survey Project, ranging from prehistory to the end of the Middle Ages, in a diachronic view of the Bliesbruck-Reinheim area, its territory and environment.

The space structured by the lower course of the Blies river represents a favourable area for studying the socio-environmental dynamics due to the natural characteristics and the human activity dating back at least to the Paleolithic (Bravard, Magny 2002).

The objective is to analyse the complex relationships between man and his environment, namely, on the one hand, the anthropic influence on this environment and, on the other hand, the adaptation of human settlements to environmental transformations. This analysis should make it possible to determine the relationships between human settlements and the environment during the different periods of occupation, within the framework of the development of a predictive approach for the detection of new archaeological sites. This objective requires the restitution of the characteristics of this natural space and its modifications in the long term, due to anthropisation. For this purpose, the characteristics of the environment of the settlements will be documented by means of mapping geographical, pedological and sedimentological data and by the enhancement of existing data. Special attention will be paid to changes in the relief, erosion phenomena and changes in the river system and valley bottoms (*Flussaue*). The relationship between human settlements and geo-ecological factors will be analysed and modelled using a Geographic Information System (GIS).

The overall objective is therefore to understand the settlement patterns of the area as an object of study over the long term and their transitions in relation to the Celtic princely centre of Reinheim and the Roman settlement of Bliesbruck.

This project aims to structure a European research network that will allow the sharing of methodologies, practices, and knowledge. This research, which has a strong propaedeutic connotation for the enhancement of cultural heritage in the region, is also linked to the improvement of cultural tourism, which is the driving force behind the region's development.

Geology and geomorphology of the research area

The research area extends over a length of about 20 km on the lower course of the Blies and Saar rivers, as well as their tributaries. Seventy per cent of the watershed substrate of the Blies river is sandstone, hence the mainly sandy nature of its alluvium. The main tributary of the Blies, the Schwarzbach, on its left bank, flows completely over Voltzia sandstone (Upper Bundsandstein), which further increases the sand content of its alluvium. At Gersheim, 5 km upstream of the Bliesbruck-Reinheim site, the river meets the limestone layers of the Muschelkalk. These layers form the geological matrix of the Bliesbruck region (Fig. 2).

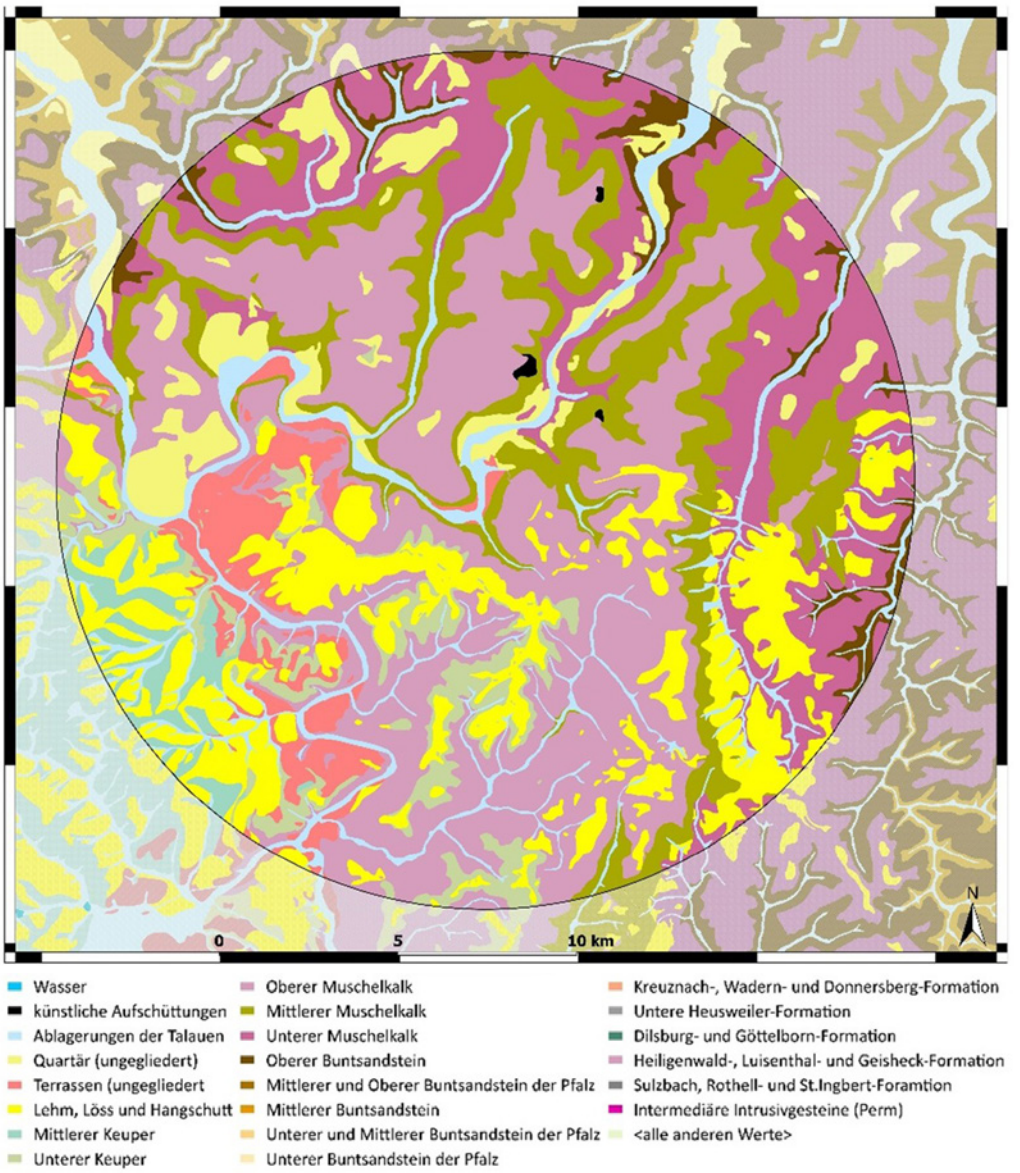

Figure 2. Simplified geological map of the research area, by J. Kubiniok.

On the German side, the Saar-Blies-Gau adjoins the Plateau Lorrain according to the terminology of H. Schneider (Schneider 1972, 7–10). In this morphostructural unit the large valleys are incised into the Lower, Middle and Upper Muschelkalk suite with gentle slopes and rounded hills.

On the French side, the Lorraine Plateau between the Saar and Bickenalb rivers is characterized by slightly less pronounced relief with numerous elevated plateaus and gentle slopes. The other aspects of the landscape up to the confluence of the Saar and Blies rivers are identical to those of the Saar-Blies-Gau. The upper Muschelkalk layers (Limestone with Ceratites above crinoidal Limestone) are characterized mainly by erosion-resistant and permeable limestones and dolomites, whereas the middle Muschelkalk layer (grey and variegated marls) is highly impermeable and forms a horizon where numerous springs appear, fed by water that has infiltrated through the upper Muschelkalk beds (Kubiniok, Brück 2012; 2016).

The range of hills that separates the two valleys reaches altitudes comprised between 360 and 400 meters. On the plateaus and flats or slightly sloping surfaces, the soils consist of loess and materials from the degradation of the upper Muschelkalk layers. Here brown calcareous soils marked by stagnant water predominate. In areas with steeper slopes, making the transition to the sides, brown, nutrient-rich rendzina soils appear locally. The sloping terrain below the Upper Muschelkalk plateau is marked by thin rendzina soils (Barth, Kubiniok 1998). Because of the good water supply, this land is well suitable for agriculture. The terraces of the Blies river are marked by sandy-silty deposits and colluvium dating mainly from the last Glacial Period. In some places, the brown soils that have formed are covered by more recent sediments (Brück and Kubiniok 2006, 6–8). The most important river in the region is the Saar, which lies to the west of the project area, while the main axis is the Blies valley. Coming from the Hunsrück, a part of the Rhine Schist Massif, the Blies river crosses the present-day border at Bliesbruck and then flows westwards to the Saar.

The centre of the Roman settlement of Bliesbruck is situated on an alluvial terrace. The limestone plateau moves slowly westwards underneath the marly Keuper and Lettenkhole beds; the whole of these sedimentary layers is laid on the Sarreguemines syncline whose NE-SW axis drives substantially the course of the Blies river towards its confluence with the Saar (Weisrock and Franoux 1993, 225).

Review of regional studies

Approaching the study of the region, it is clear how different chronologies have been subject to different depth of analysis.

The first excavation activities in the area around Bliesbruck, during which the uncovered wall ground plans were discovered from the years 1841 and 1879 on the Reinheim 'Heidenhübel'. Subsequent old excavations include those from Bliesdalheim 'Ober den Heizwiesen' (1887-88), Wittersheim 'Im Tattenbach' (1899-1900) and Böckweiler (St. Stephan Church, 1941-42 and 1949-50) are worth mentioning (Stinsky 2018, 335-48).

However, a regional approach, with archaeological surveys, did not take place until the second half of the 20th century, under the authorization of the Service Régional d'Archéologie for

the French part, and of the Landesdenkmalamt for the German part. Following the creation of local units of the Société d'Histoire et d'Archéologie de Lorraine, several prospections took place in different parts of the region. Especially, A. Schutz and A. Goret between 1950s and 1980s explored the area of the Pays de Bitche (Petry 1982; Goret 1982). In the meantime, funerary areas of Bronze and Iron age are excavated in the region (Kolling 1968; Mathiot 2018a), with the exceptional findings from the Reinheim Tomb of the Celtic Princess (Echt 1999); in comparison with the prehistoric and ancient periods, the metal ages are much less well documented by archaeological prospections. This difference can be explained in large part by the nature of the remains that can be recognized during a survey campaign and by the few excavations that have been carried out in the study-area.

In the late 1960s and 1980s, archaeological excavations were carried out at the villas of Grosswald and Heidenkopf (Flotté and Fuchs 2004, 721-27). The end of the eighties marks the beginning of the excavation in the Roman *vicus* of Bliesbruck (Schaub and Petit 1991; Petit 2000, 2003; Flotté and Fuchs 2004; Petit and Santoro 2016; Antonelli and Petit 2017) and in the nearby villa in Reinheim (Reinhard 2010; Sărăţeanu-Müller 2011; Stinsky 2016), which contributed to bring new attention to the theme of minor settlements (Petit, Mangin, and Brunella 1994). A summary of the archaeological research carried out in the micro-region of Bliesbruck-Reinheim is given by J.-P. Petit (2012).

Almost in the same years J. Kubiniok studied the region from a geoarchaeological point of view, thus creating an important dataset (Barth and Kubiniok 1998; 2004; Kubiniok and Brück 2012; 2016; Kubiniok 2013). An extensive review of the medieval sources is produced by R. W. L. Puhl (Puhl 1999).

At the beginning of the 21th century, new projects started in the area, approaching the landscape with new methods and tools. The *Occupation de la frange orientale du territoire médiomatrique*, led by P. Nusslein and E. Thomann investigated the area between the Alsace Bossue and partially the Pays de Bitche, following the research by J.-P. Petit on the placement of minor settlements in the area (Petit 1999; Thomann and Nüsslein 2001; Nüsslein and Petit 2010). At the same time, surface prospection was led by S. Schmit in the south-eastern sector of the research area and by H. Cappel around Blieskastel (Schmit, Asselin and Detrey 2021; Blouet, Cappel and Schmit 2019; Schmit, Schnitzler and Chalte 2017). The Bronze and Iron age landscape of the region is reviewed by W. Reinhard's work and these studies are recently put in perspective by D. Mathiot (Reinhard 2003; Mathiot 2018b). In 2004 the *Carte Archéologique de la Gaule – Moselle* is published, reviewing all the archaeological evidence for the French area of the project (Flotté and Fuchs 2004). The studies of A. Stinsky (2015; 2018; 2019) on Roman rural settlement patterns build on previous works such as those of R. Göring (2000) and complete them with updated excavation and survey data. Large projects as Ruhrland have inquired the rural occupation from the late Iron Age to the end of the late antiquity, redefining the settlement pattern for the north-eastern Gaul, while a spatial quantitative approach to the Roman occupation of the area has been explored by A. Nüsslein (Reddé 2017; 2018; Nüsslein 2016a; 2016b; 2018; Nüsslein *et al*. 2017; Nüsslein, Bernigaud, and Reddé 2018).

However, the studies of E. Peytremann (2003, 2006, 2010) shed new light on the settlement pattern of the rural Middle Ages in northern France and also in the Moselle. For this area

we also mention the study on rural settlements in the early Middle Ages carried out by J.-M. Blaising (2003).

Methodology

This research follows the footsteps of the major research on the landscape and population that has characterised this part of Europe over the last 25 years, opening up to a definition of the archaeological landscape that is not limited by a single chronology and is the result of a constant relationship between artefact and ecofact, between man and the environment (Favory et al. 1999; Favory and Van der Leeuw 1998; Saligny et al. 2012; Gandini, Favory, and Nuninger 2012; Keay et al. 2020; Campana 2018; Vermeulen et al. 2017; Keay et al. 2005).

The methodology of the project aims both at integrating existing archaeological legacy data and collecting new data from different sources. Giving the rich data sets available from previous research, it needed methodological tools to normalise previous finds, as well as to improve and refine existing data. The targets in the operation were to review and possibly precise the existing data for the study region but also to double check if the survey methodology worked as expected. In this framework, it developed different tools dedicated to the kind of data we needed to elaborate.

Database of sites

The first tool to be created was a geodatabase dedicated to the data from literature and archives. The definition of database fields required extensive thought in order to have a closed vocabulary that was functional for data systematisation and analysis. 'Site' was defined as a geographically defined item which may have one or more settlement and/or chronological descriptions.

Being interested in recording the variation in different settlement patterns and over different chronologies, a two-level definition schema was designed, with a more general level and a specific sublevel, (e.g., Level I = Rural settlement, Level II = villa or farm).

During the first 3 years of activity, a total of 1217 sites were recorded in the database so far (Fig. 3).

All survey and bibliographic data were imported into a shared database with project partners and in a GIS platform.

The use of GIS is well established in the field of landscape archaeology (Conolly and Lake 2006; Chapman 2006; Campana 2018) although with its limits and critics, and it has been implemented elsewhere also for reviewing and testing legacy data (Verhagen 2018; Casarotto, Pelgrom, and Stek 2018).

Finally, applications of spatial analysis in similar regional studies have been implemented recently (Nüsslein 2018; Gillings, Hacigüzeller, and Lock 2020).

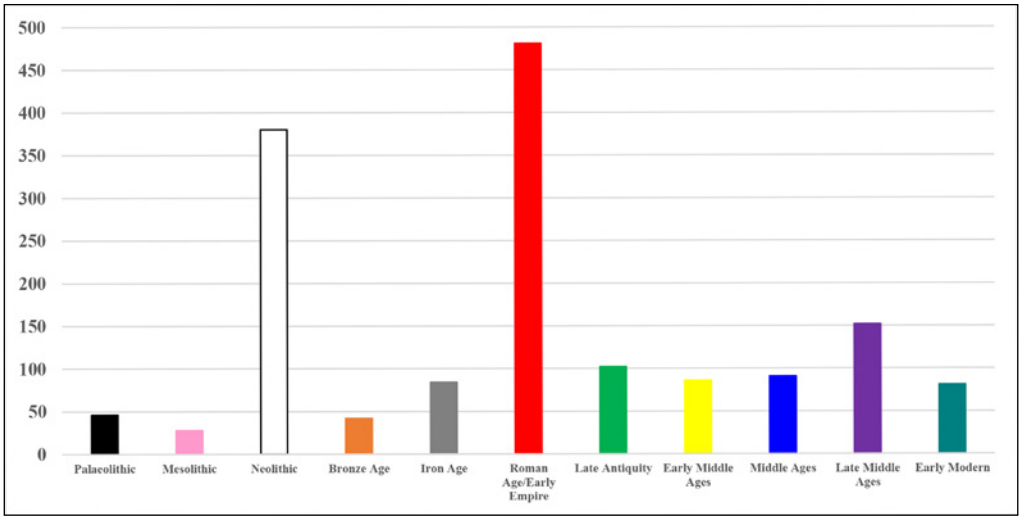

Figure 3. Number of sites divided by chronology.

The GIS also integrated the geographical data of the project area, in particular the cross-border mapping of geomorphological, land use, geological, and hydrological data, which was carried out by the Department of Physical Geography and Environmental Studies of the University of Saarbrücken under the direction of Prof. J. Kubiniok.

Intensive Survey

The methodology adopted for the archaeological survey is an implementation of the one already applied in the Limagne survey project as part of the research on the development of the territories of the Arvernes and their neighbours in the Massif Central (Trément 2011, 51–96). The fields to be surveyed are divided into Prospection Units (UP), that can be defined as the smallest unit of information spatially identifiable on a plot of land at the time of the survey, whether it contains archaeological information or not. Each UP is described by reporting its GPS coordinates, all the spatial, geomorphological, and archaeological information as well as information on the conditions of visibility on the ground. In concrete terms, the UP is a homogeneous work area that serves as a framework for the fieldwork, the collection, recording and mapping of data.

In our case, the maximum survey unit was 50x50 m squares. The choice of this measure was determined by the dimensions of the fields and the number of prospectors present in the field (ca. 10). A line spacing of 10 m was used and along each line the collection is done on a 2 m wide strip, which is equivalent to 20% sampling. This type of spacing was chosen based on the following factors: type of field workings, variability of materials, identification of areas of spread and concentration of materials. Artefact collection methods are proposed by the different research groups (Moreau *et al.* 2011; Banning et al. 2017), and this could allow us to start thinking about the effectiveness and possible standardization of these collection systems.

If in a UP there is a concentration of artefacts, the prospectors stop and further define the limits of the concentration unit (UC), dividing in into smaller squares of 5 m/side. Inside a UC all artefact visible on its surface are collected (sampling 100%).

To evaluate areas of artefacts concentration more precisely during field prospection, a parameter was established based on the densities recorded on a sample of 100 UP prospected in sites already known from bibliography and archive data.

Finally, we established a threshold that corresponds to the average of the values obtained, and thus the parameter is the following: 3 sherds/sqm.

Therefore, the prospectors:

- make a first preliminary walk in which nothing is collected but which serves simply to record the presence/absence of artefacts (of any nature: tiles, ceramic, lithic etc.) as well as to take note of the quantity;
- thus, the prospector evaluates the quantity of artefacts per sqm, and if it is bigger than 3 fragments it is considered a 'concentration';
- it is then possible to proceed to the collection according to the method indicated above for the Units of Concentration.

Visibility index

To establish the visibility index, ranging from 5 (very low), to 4 (low), 3 (average), 2 (high), and 1 (very high) we considered the use of the soil, the type of agricultural activity, the presence of vegetation, the light conditions, the climate, etc. (Terrenato and Ammerman 1996; Amato *et al.* 2016; Casarotto *et al.* 2017). In fact, weather conditions also have an impact on visibility: cloudy and/or rainy weather is favourable for prospecting and dry and/or sunny weather is less favourable.

The 'nuisance' factors, such as vegetation conditions, climate, dryness of the soil, elapsed time of ploughing, etc., also influence the quantity of visible artefacts on the surface. The visibility index has been applied also for the calculation of density in UP and UC, as a correction coefficient: as shown below, lower visibility indexes may correct upward the artefact density.

The data of the UPs and UCs are recorded on a database that integrates the two forms for the Prospecting Unit (UP) and the Concentration Unit (UC).

The integration of data allows us to finally define the Unit of Occupation (UO), and eventually its nature and chronology.

Calculation of the density of artefacts in the UP and in the UC

In the processing of survey data, it was applied a statistical method.

For UP and UC, the density of artefacts (or quantity/area) is estimated using a formula that applies a correction coefficient (visibility index):

$$Density = \frac{nFrg}{Sup} * K$$

where,

nFrg = n. of potsherds in the UP or in the UC
Sup = UP/UC surface area
K = visibility index

The result is therefore weighted according to the conditions of the surveys. This formula was applied for ceramic artefacts and for the following chronologies:

- Pottery / Roman Age, Late Antiquity, Early Middle Ages, Middle Ages, Late Middle Ages, Early Modern.
- Tile or brick/ Roman Age

For certain categories of artefacts, notably prehistoric artefacts or slags, we simply took into account the number of remains (NR), without calculating density, given the different relevance of this artefacts in the sheer quantity of the archaeological deposit.

Artefact treatment

The artefacts were recorded in the database within each UP or UC sheet, according to the type of collection of the artefacts (out of concentration, in concentration). We have also noted the presence of a significant amount of material 'out of chronology', which can be considered as 'background noise' that comes from the amendment of the land and can thus indicate the areas of artefact dispersal.

The study of tiles included two analytical phases: one directly related to the field survey; the other to be performed in laboratory.

A morphological classification was performed on the finds, taking as model the work on tiles carried out in eastern Gaul (Clément 2013). Archaeometric analyses were carried out on the tile samples, in order to classify the various mixtures, using an optical microscope and a lens. At present, 18 fabric types have been identified (some of them with variants).

Although the work needs further study and a larger sampling, at present it is interesting to note the identification of two macro-types of fabric, respectively attributable to the Kalhausen-Weidesheim and Les Horres sites. This is significant if we consider the position of these two sites, each connected to different supply basins, production-commercial dynamics and road networks.

Aerial/Remote sensing

Aerial photography activities were implemented during the third year of activities, with the aim of prospecting sectors poor in other kind of data, and to check for the presence of traces of sites. Several evidence were identified in the south part of the Blies Survey Project area.

The aerial data came from two different datasets. The first image dataset was the French Geoportal (https://www.geoportail.gouv.fr/) which includes contemporary and historical aerial photography (1950-1965, 2000-2005, 2006-2010), and the possibility to overlap them

with Cassini maps and the carte d'état-major (1820-1860). The second dataset came from drone aerial survey done during fieldwork campaigns.[1]

Remote sensing activities have allowed to survey approximately 325 hectares, identifying 11 new sites. Two sites already known from literature and classified as rural settlements, have been better defined as it was possible to read alignments traces that might indicate the spatial organisation of the settlements. In the study of the landscape, the 1m DEM (https: // geoservices.ign.fr/documentation/diffusion/telechargement-donnees-libres.html#rge-alti-1-m) by the IGN was a valuable tool to see small anomalies, paleochannels and similar features.

Geophysical surveys

The surface prospections are accompanied by geophysical measurements. These will be used to obtain further data on structure, type and size at specific sites. These measurements are carried out under the direction of Peter Haupt, Dominic Rieth of the University of Mainz and Andreas Stinsky. Depending on the site, three different measuring methods are used, sometimes in combination with each other: geomagnetics, geoelectrics and georadar.

For the geomagnetic measurements, a Ferex 4.032 fluxgate magnetometer with two probes was used.

The distance between the probes was 50 cm, four measurements were carried out per metre. The geoelectrical method using the RM 85 device; measurements were made with a distance of 50 cm between the electrodes. The georadar method using the IDS MT Hi Mod device, using a 200 to 600 Mhz frequency antenna. The profiles were measured at distances of 50 cm. The geophysical results complement the find measurements of superficially collected artefacts. Even without excavation, this provides initial indications of the use of the sites and provides important orientation for possible future excavation sections.

Non-invasive diagnostics have been implemented in the central area of the project (Bliesbruck's *vicus* and the surroundings of the villa at Reinheim) since long time (Posselt 2006; Posselt, Pfnorr, 2007, 2008). In the BSP project, several areas have been investigated in the region, using GPR and electrical resistivity as well as geomagnetic methods (Fig. 4). Eight areas have been investigated, bringing to light different kind of sites. The most important results come from the following sites: Reinheim BSP 176 (Haupt, Rieth and Stinsky 2019), Böckweiler BSP 970 e 971, 182, 368, 397 (Haupt, Rieth and Stinsky 2020), Breitfurt, Kirchheimer Hof, BSP 976 (Haupt, Rieth and Stinsky 2021), Ferme de Brandelfing, BSP 73 (Fig. 5).

Occupation Unit (UO): definition and interpretation

The Occupation Unit (UO) is an area characterized either by a significant presence of artefacts of determined chronologies (e.g., prehistoric flints) or where one or more high density cluster of artefacts collide. It should be noted that for some periods the amount of material surfacing is influenced by the historical and cultural character of the way in which the buildings were built: for example, the absence of tiles and a reduced diffusion of ceramic material (compared to the Roman period) in the contexts of protohistory and the early Middle Ages makes the

[1] Images taken with a DJI MAVIC 2 drone, in different light conditions (early morning, late afternoon).

Figure 4. Summary table. Areas of geophysical survey.

Location	Investigation method	Area	Trace interpretation
Reinheim BSP 176	GPR/Magnetometer	0,33 ha	The comparison of the data reveals three distinct buildings or structures (approximately 8x8 m). The hypothesis of a rural settlement, retained until now for this site, must probably be eliminated. Other interpretations can be envisaged: potter's or tile-maker's kilns, sanctuary or funerary structures.
Medelsheim BSP 166	Magnetometer	0,47 ha	The geomagnetic data revealed a very strong dipole anomaly not far from the well, which suggests the presence of a massive metallic object in the ground.
Böckweiler BSP 970	GPR/Magnetometer/ Electric resistivity	0,62 ha	Regular polygonal anomalies suggest the presence of small buildings.
Böckweiler BSP 971	GPR/Magnetometer/ Electric resistivity	0.02 ha	While in the geomagnetic map only a strong dipole is visible, the radar measurement revealed several anomalies. Their orientation is striking: most of them, especially in the eastern zone, are perpendicular or parallel to the direction of the ploughing.
Böckweiler BSP 182	GPR/Magnetometer/ Electric resistivity	0,13 ha	The geomagnetic measurements indicate structures oriented approximately NW-SE or SW-NE that are roughly perpendicular to each other. The geoelectrical measurement revealed another anomaly, which was not recognisable in the SW-NE oriented geomagnetic measurement. The radar measurement revealed, in addition to two smaller structures that are approximately perpendicular to each other, an area with higher values to the southwest of the measured area, which, also taking into account the geomagnetic results, could indicate the presence of building rubble.
Böckweiler BSP 368	GPR/Magnetometer/ Electric resistivity	0,41 ha	Only a few anomalies with high values could be recognised, as the disturbance caused by the device defect was particularly high here. Although anomalies are clearly visible, there is no recognisable structure that could be interpreted.
Böckweiler BSP 397	GPR/Magnetometer/ Electric resistivity	0,30 ha	Regular polygonal anomalies suggest the presence of small buildings.
Böckweiler BSP 506	GPR/Electric resistivity	0,04 ha	The site contains the shallow remains of the Carolingian church, which could be precisely located
Frauenberg BSP 116	GPR/Magnetometer	0,03 ha	The geomagnetic data reveals several anomalies that are difficult to decipher due to the narrowness of the area explored. The georadar measurements reveal anomalies corresponding to built elements contemporary with the two towers. To the north of the towers, weak anomalies indicate a space marked by the absence of constructions where a ditch could be located.
Brandelfing BSP 73	Magnetometer	2,42 ha	To the south-west three less marked anomalies appeared which could correspond to older building. They could also be lighter constructions contemporary with the other buildings of the farm.
Breitfurt, Kirchheimer Hof, BSP 976	GPR	0,05 ha	The structures in the western study area appear to be the remains of a building buried in the ground, based on the size and right angle of the linear anomalies. The structures appearing in the middle of the surveyed area could be related to the shaft, which was levelled during th construction works.

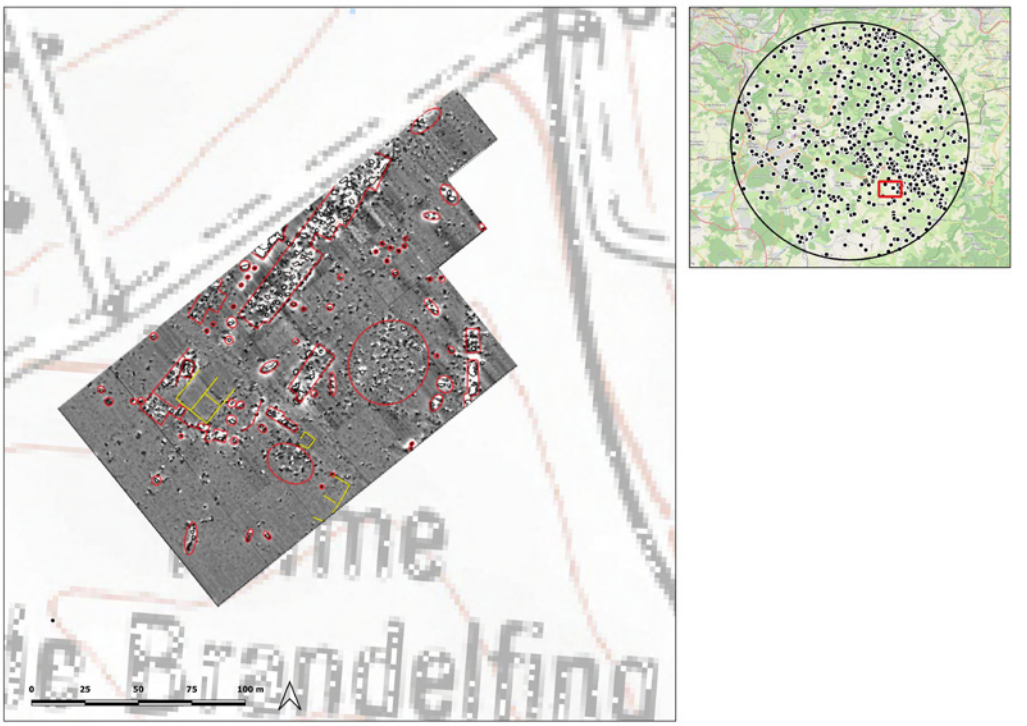

Figure 5. Measurement result of a geomagnetic prospection at Ferme de Brandelfing. Most of the recognisable structures are likely to be from the farm destroyed in the Second World War.

occupation less visible, and therefore in this case it will be necessary to apply a different scale of density values.

Normally, for the definition of the Occupation Unit we take into consideration the data collected in the field together with data coming from bibliography, archives, geophysics and geoarchaeology. The spatial definition of a UO is determined by the distribution of artefacts in the UCs and UPs, the positioning of aerial or underground anomalies, the morphology of the ground. In this framework UOs are a semi-interpreted concept, not yet defined by their supposed function but only by their spatial and quantitative attributes. The definition of 'concentration', 'diffusion' and 'dispersion' values in UOs is calculated by weighting the different degrees of density of the artefacts in the UPs and UCs.

Case application

Overlapping data: the case of Les Horres

Les Horres district was chosen with the intention of enhancing and refining the data already known from this site and it is solid evidence of the utility in the application of our multi-source methodology.

The district is located on the Lower Muschelkalk terrace on the north bank of the Blies, on a slight slope (5-8 degrees) facing south-east, at the locations 'Auf dem Horres' and 'Unter dem Horres'.

The area is already known for a Celtic funerary area from the La Tène A/B period (BSP 620, Reinhard 2010, 250–61), a Celtic building from the La Tène D period and a large Roman settlement, probably a sanctuary (BSP site 526), that has been investigated by geophysics and excavated between 2005 and 2008 (Reinhard 2010). Some Neolithic artefacts, as a Type 310 arrowhead at site BSP 429 and a Type 320 arrowhead at site BSP 430 were also found (Renard 2003). The settlement, probably a sanctuary (BSP 526), is located 1.5 km north-east of the minor centre of Bliesbruck. Its origin is an exceptional wooden building with a central plan dated to La Tène D130, polygonal in shape, consisting of a central space surrounded by a gallery and probably used for worship. It is characterized by a variety of Gallic coins which point out the relations with regions to the south-west and west (Wigg-Wolf 2010). All the studies underway tend to show that the Gallic polygonal building is of a cultic nature and that it is at the origin of a settlement from the Roman period, probably a vast sanctuary, abandoned during Late Antiquity. A thermal complex was also partially excavated. However, no temple has yet been found, although it is not impossible that a building consisting of a gallery with corner rooms identified by geophysical prospection corresponds to this type of building (Fig. 6). A cremation grave of the Roman period (BSP 468) probably marks the eastern limit of the settlement.

It is a vast district, explored by preventive excavations, aerial surveys and geophysical surveys.

Geophysical surveys in 2006 revealed traces of structures on both sides of the Reinheim-Gersheim road (Reinhard 2010, 252–53).

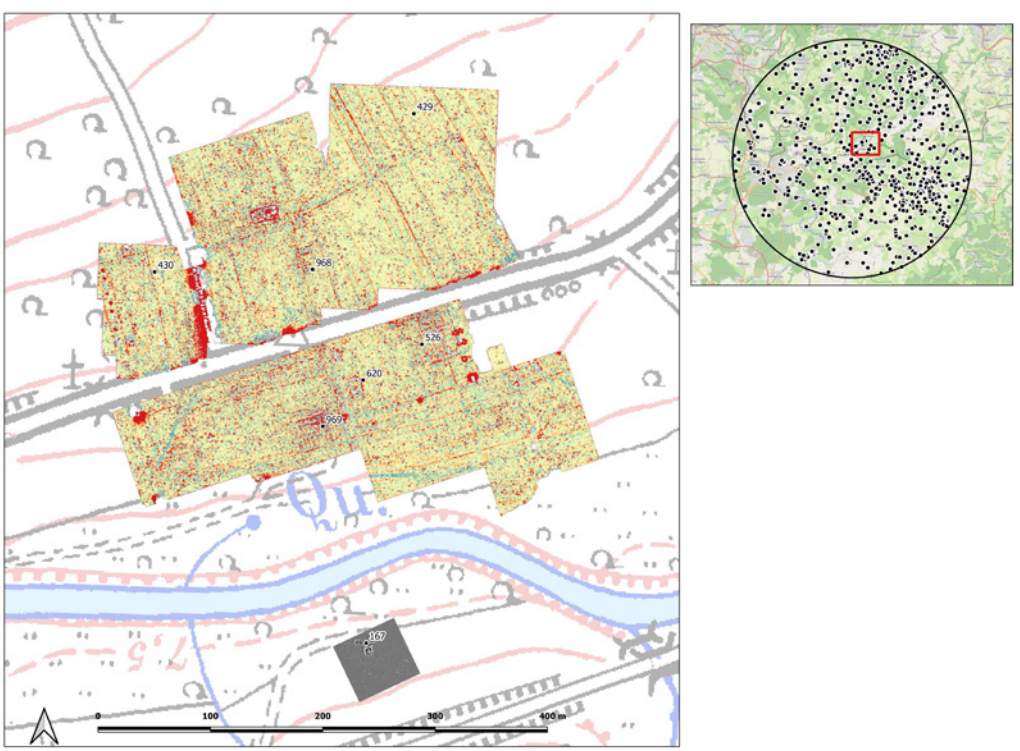

Figure 6. Reinheim, Horres. Site distribution and geophysics (geomagnetic and georadar methods).

Based on these previous investigations, Les Horres area was chosen with the intention of enhancing and refining the data already known from this site. The fields both north and south of the road, close to the previously surveyed and excavated areas, were surveyed.

Survey Raw Data

During 2018 and 2019 a total of 82 UP have been surveyed. Apart from one prehistoric Muschelkalk splinter, most of the artefacts belongs to the Roman, medieval and modern periods. Overall, the quantity of pottery from the Middle Ages and early modern period is small (73 fragments) and very scattered over the whole area surveyed, which may indicate areas where manure was spread or occasional use of the previous Roman site. Five slag finds are reported in four UPs in the western sector of the surveyed area, where small quantities of ceramics and tiles are noted, which do not allow us to identify it as a proper occupation (Fig. 7).

The abnormal density of potsherds determined the detection of three Concentration Units: south of the road (relating to BSP 969), in the area of the excavated buildings, north of the road in the mid-slope area (relating to BSP 968). These Concentration Units are characterized by a strong concentration of tiles and Roman pottery, while only the latter presents also some late antiquity sherds.

Overlaying the data: Weidesheim district

The Weidesheim district is located in the Saar valley in the municipality of Kalhausen, on the right bank, 10 km from Bliesbruck-Reinheim; it is a complex district which extends over 1.5 km along the Saar, lined by the coal-mining canal on its left bank, including the hamlet of Weidesheim (attached to the municipality of Kalhausen in 1811) and its surroundings. It is located on the south-eastern part of the limestone plateau overlooking the Saar valley and the narrow valley of the Achen stream, which flows into this river to the west of the hamlet. The valley is marked by the presence of a limestone hillock which emerges from the sandy river terrace.

In the district of Weidesheim several archaeological remains have been found.

The village of Weidesheim has been known since the 14th century as the site of a fortified house or castle which was destroyed in 1380, rebuilt and then altered several times before being replaced by a modern building in the 1780s and 1790s. The late medieval fortified building still has a massive four-storey tower, to which a stair turret was added in the 16th century (Antonelli and Petit 2022).

The 'état- major' map of the 19th century shows the integration of Weidesheim into the network of roads before the major changes associated with the construction of the railway and the Kalhausen station, which led to protohistoric finds.

Other works affected the place: agricultural work, which led in particular to the discovery of the *coloni Aperienses* inscription (ILTG 3798), the digging of gravel pits along the departmental road to the Lower Rhine, the digging of trenches from July 1944 for the installation of defensive positions around the station (the route is visible on the aerial photograph of 1948), the digging

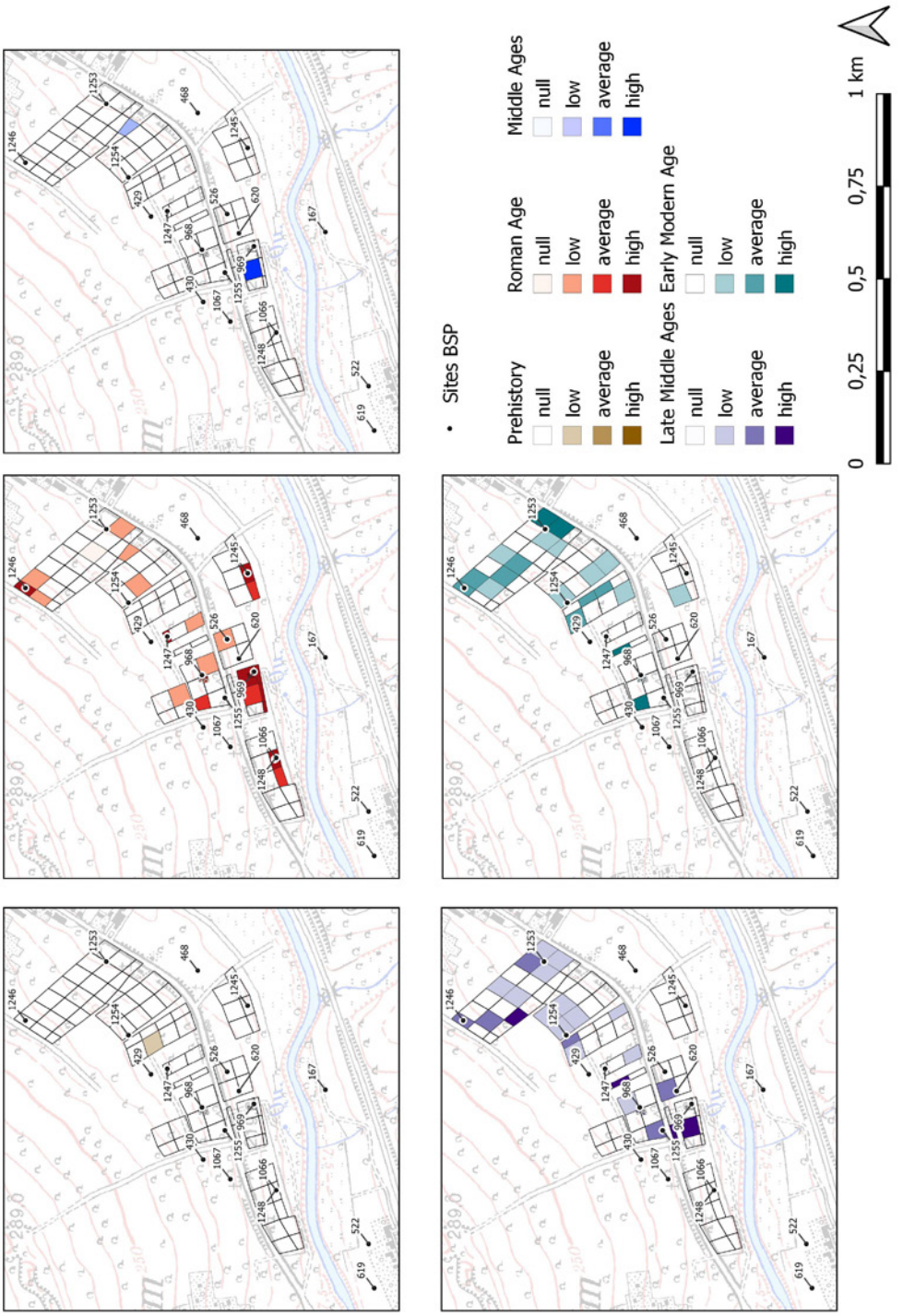

Figure 7. Reinheim, Horres. Prospection survey data density by chronology.

of trenches in Weidesheim, the construction in 1967 or shortly before of a bypass around the hamlet and the construction of a gas pipeline which crosses the site (BSP 782 and BSP 783).

The aim of the investigation was to refine the location of previous finds, to determine their extent and to identify any new signs of occupation. The operation also focused on the chapel and its sculpted blocks in place, to make an inventory of all the elements and to obtain details on the missing part of the chapel. Moreover, the district was also investigated through aerial imagery, in order to locate cropmark anomalies; the analysis of the 1-m DEM by IGN was also taken into account.

The archaeological surveys in Kalhausen 'Weidesheim' confirmed a Mesolithic presence in the sector known from literature only for sporadic elements (Geyer, Petit, and Sainty 1979). The BSP surveys allowed us to define the area and characters of this Mesolithic occupation. In fact, 46 distinctive objects (flakes, blades, neo-crests, cores with semi-transformed debris) were collected, with debris almost exclusively of local middle Muschelkalk t4b limestone. Two fragments of a Neolithic polished flint axe were also collected.

New data on the protohistoric period were not found during the surveys, despite the funerary finds made during the construction of the station at the end of the 19th century. However, the area near the discovery site, between the railway line and the Departmental Road 33, has been completely disturbed by quarry diggings that have become shrubby wasteland. In addition, the sector opposite the station is built, which also prevents further investigations.

A Gallic coin was found during surface prospecting, but it probably relates to the nearby Roman settlement. This type of coin (SST 186) is still regularly found in early Roman contexts (Féliu 2012).

In Roman times, there were many different types of occupation, but the situation is very different between the hamlet of Weidesheim and the Saar valley between the Achen stream and the Eichel stream. Here, surface surveys have located Concentration Units that, for the most part may be interpreted as clusters of buildings separated by distances of 200m. In general, the survey data do not suggest that these were monumental buildings; this impression must be put into perspective by the fact that the land concerned has been continuously ploughed and probably deeply. However, all the sources agree in suggesting the absence of significant solid buildings: few stones, few or no architectural elements, no painted plaster or tiles linked to hypocausts. The collected artefacts indicate that these buildings were covered with tiles. The concentration of finds north of the locality of Benchenn seems to be the most important one since the altar of the *coloni Aperienses* was found there (BSP 782 and BSP 783). The indications given by Keune (1897) are precise enough to locate the site of the discovery of this inscription. The artefacts, mainly tile fragments, cover an area of 1200 sqm. Very few sherds were found, a few fragments of sandstone and a fragment of marble. Keune states that the block was found in an environment of building remains, but he does not report any evidence of special or quality furnishings.

The quantity and density of tiles suggests the existence of one or more buildings in the centre of locality of Bennchen. The nature of the occupation remains difficult to determine, however the presence of a significant number of slags and the small quantity of fine ceramics allows us to argue that it is linked to artisanal activities. A fragment of a large-diameter millstone

found to the north-west of the concentration area, closer to the river, suggests the presence of a water mill (Picavet 2016, 695–712; Picavet et al. 2017).

The Concentration Units south of locality of Bennchen, is characterized by a large quantity of ceramics, including several fragments of fine ceramics, but also a significant quantity of slags. The quantity of ceramics at the site BSP 784 is very small, but the quantity of tiles is large and could therefore indicate the presence of a building. The area is characterized by the presence of slags.

The reading of aerial photographs from the French Geoportal made it possible to identify some traces in which two buildings are clearly visible, one rectangular and the other quadrangular, measuring approximately 380 sqm and 340 sqm respectively. These traces overlap precisely with the concentrations identified south of Bennchen (Fig. 8).

The archaeological surveys carried out north of Bennchen, near the settlement of Weidesheim, revealed a concentration of materials. In particular, many tiles and several quantities of pottery were found. This concentration led to reflection on the relationship between this concentration and those at Bennchen and, therefore, on the extent of the settlement in Roman times.

The occupation is attested in late antiquity by a few sherds found during the surveys and by the discovery of 4th century coins.

Data about the Middle Ages are scarce. Remains of the Merovingian period were discovered north of the church (BSP 681), but their location is uncertain (Flotté and Fuchs 2004, 532). The archaeological survey conducted in this area confirmed this occupation through the discovery of several fragments of Merovingian pottery.

The date of construction of the chapel is also difficult to determine. It may have been already built in the Romanesque period, as the semi-circular arch with its straight feet made of Roman sculpted elements might suggest, but it could also be a discharge arch for the Gothic arch. This architectural question still needs to be addressed. According to the written sources, the chapel was rebuilt in the 15th century, which indicates the presence of an earlier building. Furthermore, the chapel is placed under the patronage of Saint Martin, which could also indicate an earlier creation.

The period up to the 14th century is completely unknown. Data from written sources indicate that in 1346 the land and a castle belonged to the lords of Weidesheim and were a fief of the Lordship of Bitche. The castle was destroyed in 1380, mentioned again in 1444 and transformed in the 15th and 16th centuries. A tower similar to the Turmburg type 26 still remains, with plasterwork from the 16th century (Jacops, Guillaume and Hemmert 1990, 65). The outbuildings of the present castle still have gunports dating from the 16th century.

Artefacts found in the river district have allowed the identification of material from the medieval period at concentrations in the centre and south of Bennchen. Similarly, in the area of the current settlement of Weidesheim on the concentration from the Roman period, where fragments from the Merovingian period were also found, a significant presence of medieval pottery was recorded (Fig. 9).

Figure 8. Kalhausen, Weidesheim. Site distribution and aerial (Géoportail, 2012) and drone photos.

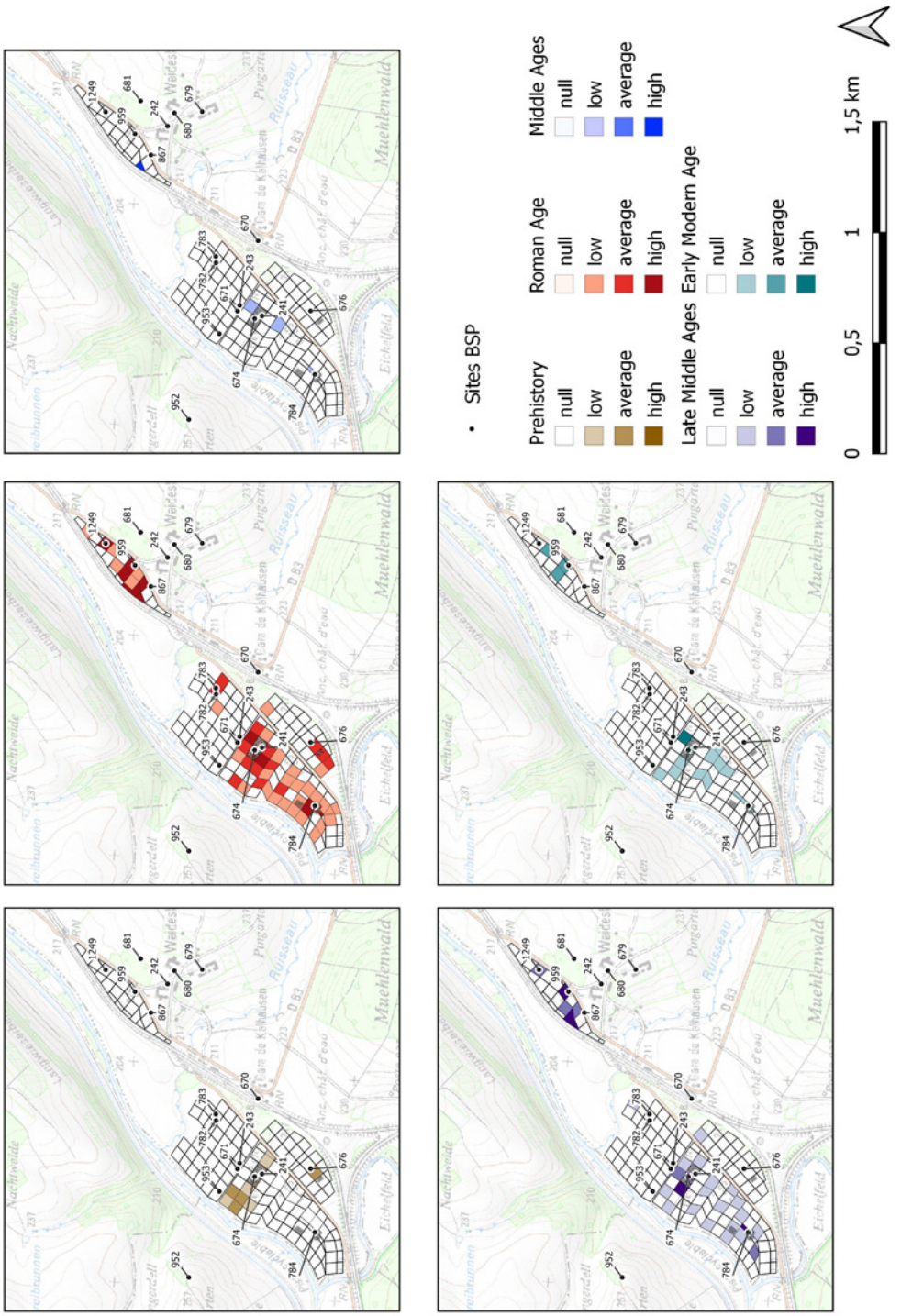

Figure 9. Kalhausen, Weidesheim. Prospection survey data density by chronology.

Discussion

In the Les Horres district, the analysis of the collected data allowed us to identify six Units of Occupation (UO) for the Roman period and five for the medieval one (Fig. 10).

In particular, for the Roman period in UO 2 the occupation is superimposed on a quadrangular structure (28 x 28 m) identified by geophysical prospection. In UO 10 the diffusion of the concentration of furniture corresponds to excavated structures: circular sacred building of La Tène D1 and main building. The dispersion in UO 10 is superimposed on a circular building (hypocaust) with three annex buildings. UO 23 corresponds to a building complex known from geophysical surveys. OU 31 and OU 32 are two occupations that may correspond to other buildings.

The sanctuary of Horres has only been explored on a small area, and the buildings identified by geophysical prospection remain to be defined more precisely. The methodical BSP surveys confirmed the presence of several occupation units around the sanctuary and also revealed new occupation areas (UO 11, UO 31, UO 32). The supposed buildings (UO 11 and 31) are located at a distance of about 160-190 m from the centre of the sanctuary (BSP 526).

The settlement appears to be quite large and is bounded to the east and west by the burial areas (BSP 522 and 421).

Finally, OU 27 is located to the NE, approximately 600 m from the central core and 400 m from OU 31. It is hypothesised that this is a rural settlement on the periphery of the main settlement, located at a distance of 600 m from yet another rural settlement located to the NE (BSP 465).

Figure 10: Reinheim, Horres. Definition of Roman (in red) and medieval (in purple) Occupation Units.

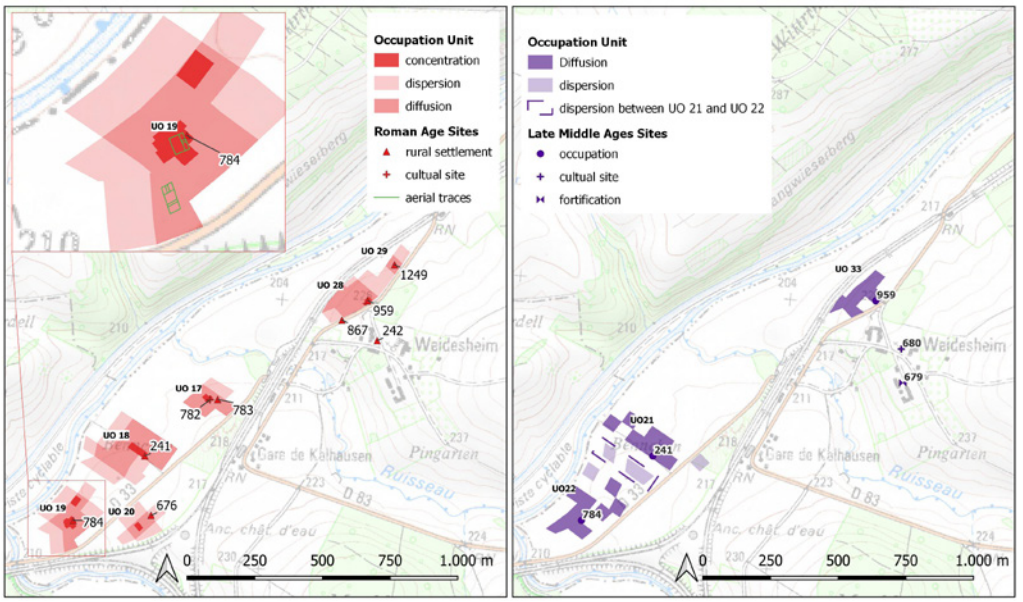

Figure 11: Kalhausen, Weidesheim. Definition of Roman (in red) and medieval (in purple) Occupation Units.

For the medieval period there are five Occupation Units (UO 41, 42, 43, 44 and 45). This could be areas where manure was spread or occasional occupation of the previous Roman site which may be linked, as in the case of the Bliesbruck agglomeration, to the recovery of materials within the more general framework of the exploitation of Roman sites (Clemens and Petit 1995).

The extensive collection of data from aerial and surface surveys increasingly shows the central role of the Kalhausen district (Fig. 11). The BSP surveys made it possible to define more precisely the surface of the prehistoric occupation (UO 16). It confirms that this is probably a station camp from this period, probably of lesser importance in comparison with that of Reinheim 'Allmend C' on the banks of the Blies river (Donié, Erbelding, and Rick 2001), dated back to Early Mesolithic. The surveys also revealed some rare Neolithic artefacts.

For the Roman period, UO 17 is located in the area where an altar and traces that may correspond to a sanctuary were discovered in the past (BSP 782-783; these are presence of rubble and tiles identified by an ancient survey and a preventive investigation). The methodical survey BSP made it possible to define precisely the area of distribution of the material. The discovery of a marble fragment in UO 17 is reported.

In UO 18 the discovery of a fragment of a large Eifel basalt millstone is noteworthy.

The occupation units vary in size, with UO 18 and 19 being larger. Furthermore, UO 19 corresponds to the traces identified by aerial photographs in which two buildings are clearly visible, one rectangular and the other quadrangular of about 380 sqm and 340 sqm respectively.

The occupation units identified at Weidesheim Bennchen show a complex site, along the Saar, characterised by the presence of a sanctuary and several nuclei.

The organisation of the occupation units (distance and surface) is very similar to those identified at Reiheim Horres.

Finally, UO 28 is characterised by the presence of ceramics and tiles and appears to be oriented in a NE-SW direction. The concentration in UO 28 corresponds to the anomalies identified by the drone. UO 29 is approximately 160 m away from UO 28. If the interpretation of UO 28 as a rural settlement is accepted, UO 29 could correspond to a related building.

For the medieval period, there are two occupation units (UO 21 and 22) which are characterised by the scattering of material of the same typology: it is hypothesised that these are two different occupations which can be linked to the same site (village?). The total extension would amount to 5.130 ha.

There are traces of fortification (BSP 679) about 800 m to the north: the archives mention a hamlet and a castle in the 14th century, a fortified house in the 15th, 16th, 17th and 18th centuries and at 900 m the chapel of Weidesheim (BSP 680) is noted.

The late medieval settlement of Weidesheim, Bennchen (UO 21, 22) could be related to the chapel and the Weidesheim estate and could be one of the villages in the Weidesheim territory.

To the north of Bennchen, the late medieval occupation of Weidesheim (UO 33), could be related to the chapel and the castle attested as early as the 14th century. The ceramics collected during methodical BSP walking surveys confirm the 14th century date. Thus, the occupation to the north of Bennchen would constitute the north-western limit of the settlement linked to the medieval fortification (at least from the 14th century) and the chapel. The settlement with the fortification and the chapel would have an extension of about 5.100 ha.

The date of the construction of the chapel is difficult to determine, as it already existed in the Romanesque period, but the actual construction date is unknown. Its foundation in the Carolingian period has not yet been confirmed. It remains only a hypothesis based on the location of the church in relation to an ancient settlement and on the reuse of carved blocks and Roman architectural elements.

One issue that came out unambiguously from our evaluation is that certain chronologies tend to appear less (or not at all) from surface prospection (for example for the Bronze, Early Iron Age and early and high Middle Ages).

At this point we can present some preliminary consideration in the evaluation of the methodology of our project.

In dealing with the amount of data already collected from previous research, a few issues emerged that are worth exploring. The existing data are a mine to be exploited: the possibility of collecting and systematising existing data, that have been investigated with different techniques and methodologies on both sides of the Franco-German border, has highlighted how data themselves are known as crystallised in time and space but they reserve the possibility of being deepened and refined if investigated through capillary research methodologies and

with a diachronic and multi-source approach. A major limitation of previous spatial studies is that they are embedded in research projects that are strongly chrono-typologically framed. They have therefore failed to consider the fact that the landscape is a palimpsest of anthropic and natural actions which require a temporal dimension in order to be fully understood, in their antecedents and consequences.

At the same time the specific survey and artefact collection methodology was effective in identifying and delimiting underground structures and buildings, as it is clearly shown by the overlapping of some UOs with the geophysical anomalies. Thus, our survey tool allowed us to tackle one of the issues related to previous data, or the low spatial and typological definition of data themselves. By utilizing aerial, surface and geophysical surveys on previously known sites we have been able so far to refine and enhance our data resolution. It is the case of Kalhausen – Weidesheim district, where we have been able to precisely locate the sites along the riverbank as well as to add new spatial and quantitative data on the prehistoric occupation; unsurprisingly, also data from much later chronologies came out, helping us to understand the long-term pattern of the occupation of the district.

One issue that came out unambiguously from our evaluation is that certain chronologies tend to appear less (or not at all) from surface prospection. It is the case for example for the Bronze and Early Iron Age artefacts, whose presence is close to zero from surface prospection, while general evidence in the region suggests that Bronze and Iron Age sites were fairly common and distributed. This absence is due to several factors. The materiality of Bronze and Iron Age differs greatly in terms of quantity and durability. Most of the recorded sites for those periods are funerary areas and more specifically mounds and urn fields, found by excavations. Residential settlements are almost unknown in the area, apart for the Bronze Age village near the Roman villa of Bliesbruck; probably also the fact that those settlements were supposedly built almost exclusively by wood makes them hard to find by means of surface surveys. To overcome the issue, we will experiment with different kinds of remote sensing (especially with LiDAR) that may help us to find hillforts and other kind of settlements.

A similar problem emerged also for the early and high Middle Ages. For these periods our surveys recorded few ceramic materials; moreover, medieval settlements were characterized by constructions made of perishable materials, which are quite invisible in surveys. If we were to compare the sheer quantity of potsherds from other periods (i.e. Roman pottery) we would be led to argue that medieval settlements were at least few and reduced in size. By crossing prospection data with other sources (such as archive and literary sources), the (scarce) quantity of material can be put in a correct historical and archaeological perspective.

The last issue is related to the nature of the bibliographic and archaeological data in terms of their distribution. If we look at BSP's research area, we notice how some areas seem to present less evidence than others; this is especially true for the southwest quarter of the research area. The reasons for that are not related to the settlement patterns of the area: the area west to the course of the Saar is covered by woods to a greater extent than other areas and is, in its northern district, more urbanised, thus affecting the visibility of the archaeological evidence.

Conclusions

BSP project aimed at the reconstruction of the historical landscapes of the Blies river district. In our investigation, the development of an integrated multi-source approach was crucial to review refine and update previous bibliographic data in the region; this, in turn, produced an enhanced image of the settlement pattern and the historical processes that affected the area. Both field and bibliographic data elaborated through a quantitative approach allowed a spatial definition and a chronological transformation of the sites. Specifically, the definition of Prospection and Concentration Unit and the analysis of artefacts in relation to their chronology, have made it possible to link the quantitative data to the spatial definition, leading to the definition of precise occupation areas depending on the individual chronologies. This allowed to theorise the Occupation Unit in which the component of space and time allow to reconstruct the development of a site in its becoming. This is especially clear for Les Horres and Kalhausen districts, where the application of such methodology led to an increase the data resolution. In this first phase of the work this methodology gave excellent results in terms of the precise definition of sites plan and chronology. Starting from this, the second phase of the project will aim to analyse the relationships between the sites for a definition of their function and to reconstruct the settlement systems.

Acknowledgement

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The 3D reconstruction model of the Roman theatre of Falerio Picenus (Falerone, Italy): promoting cultural heritage, understanding our past.

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Abstract

Falerio Picenus (now Piane di Falerone) was a rather important town in Antiquity, as we can presume from the ancient sources, from the communication routes that crossed it, and from the remains of the ancient monuments still preserved. A theatre, an amphitheatre, monumental cisterns and tombs were discovered, but all of them were stripped of their decorations during Late Antiquity and Middle Ages. This paper presents a three-dimensional reconstruction of the city's theatre, based on a new survey of the structures using a long-range 3D laser scanner, combined and integrated with photogrammetry and direct survey. The model is supposed to serve not only as a show case of the original shape of the public building, but also as a real research tool.

Keywords

Falerio Picenus; 3D reconstruction; Theater; Roman Archaeology

Introduction

Falerio Picenus was an ancient city that arose on a plateau to the left of the Tenna river, in the Marche region, where today the modern village of Piane di Falerone (FM) stands, in a favourable position.[1] *Falerio Picenus* was an important stage on the ancient road that led from *Urbs Salvia* to *Asculum* and reconnected this area with the *Salaria Gallica* road (Quilici 2007; Giorgi 2000; 2021), but it was also a leg on the path that linked this valley and the Apennine with the coastal road system, following the Tenna.[2] The area had already been populated by the *Picentes* before the arrival of the Romans, who possibly founded a village here,[3] and a steady larger centre arose in 49 BCE, and acquired monumental relevance later, when a colony of Augustinian veterans was established (Perna 2012; Tosi 2003, 331; Paci 1995). The city flourished, until in late antiquity the inhabitants were forced to take refuge in more defensible positions due to the, so-called, barbarian invasions and the Greek-Gothic war. People moved up to the hill that today is home to the modern town of Falerone (Maraldi 2002, 106-8).

[1] I would like to express my deepest gratitude to E. Giorgi and F. Grilli for having continuously stimulated this research and for their precious advice during the work.

[2] The course of these roads is attested by six milestones that were discovered near Falerone, dating back to between 305 and 365 CE (Paci 2020, 185; Perna 2012, 383). On the evolution of the road system in late antiquity, refer to Pasquinucci *et al.* 2000 and Campagnoli, Giorgi 2006.

[3] This consideration arises from the observation that the site is surrounded by villages of this culture (Grottazzolina, Montegiorgio, Belmonte Piceno, Penna San Giovanni and Fermo), rather than by archaeological elements, at the present state of knowledge. Probably here there was the population of the 'Papuni' mentioned in some epigraphs in the area, see Giorgi-Demma 2018.

The archaeological site was discovered in 1595 on the occasion of the fortuitous discovery of an inscribed bronze plate found near the theatre (CIL IX, 5420; Catani 1989, 254). It was an edict of the emperor Domitian, who in 82 CE settled a territorial dispute between the inhabitants of *Falerio Picenus* and those of *Firmum*, regarding the possession of some territories that had remained unassigned (*subseciva*) during the previous land division operations (Giorgi 2020). At the time of the discovery, the area belonged to the Church, and therefore the inscription was donated by the discoverer to Cardinal Pietro Aldobrandini, who probably carried out new archaeological research. No documentation survives of these activities, except for the tradition that in those years a lot of statues and inscriptions were discovered (Colucci 1788; Catani 1989, 254; Maraldi 2002, 9). The first documented investigations at the site took place in the eighteenth century. In 1777 Falerone and a series of other archaeological sites in the Marche region, suche as *Cupra Maritima*, *Helvia Ricina*, and *Urbs Salvia* were investigated in search of 'beautiful finds' with which to enrich the rooms of the Pio Clementino Museum in Rome, one of the most important collections of the future Vatican Museums (Catani 1989, 191-196; Cingolani 2018).

These early investigations focused especially on the theatre (Catalani 1778, 27; Montali 2015, 53), which has always remained visible and was still at the time well preserved. At the eyes of the first explorers, it was a magnificent structure (Bonvicini 1971b), today difficult even to imagine, given its present state of conservation: an imposing structure, but completely deprived of its decorations, a destiny in common with many other theatres (Fuchs 2021). The amphitheatre was also partially excavated along with other areas (Catalani 1778, 27; Montali 2015, 53). After a few months, when the excavators believed that it was no longer possible to find anything important at the site, the digging was abandoned and the materials discovered were sold or brought to Rome (Catani 1989). Fortunately for us, the excavators wrote, if not actual excavation reports, at least notes, and a local notary, B. Agabiti, drew the most significant findings as they were being discovered (Bonvicini 1971b).

New research in *Falerio Picenus* was organized only in 1836 by the brothers Gaetano and Raffaele De Minicis, who bought the land where the theatre was and started digging there as well as in various other areas of the ancient town (Montali 2015). They had more noble purposes than the mere search for beautiful objects: they did it to increase our knowledge of the ancient city, 'nella certezza di vantaggio non iscarso tornerebbe l'esame di questi ruderi alla scienza archeologica, ed all'architettura' (Bonvicini 1971a) and they left us a precious diary of the excavation activities, drawn up daily by Raffaele De Minicis, as well as a beautiful representation of the structure immediately after the research (Fig. 1) and drawings of the finds (Bonvicini 1971a). Various epigraphs useful for the dating of the theatre and for the understanding the chronology of the ancient structures of Falerio were found during this research and furthermore, by investigating areas not excavated in the eighteenth century, they found various decorative elements and statues (Fig. 2. Bonvicini 1971a, 100-101). A great debt of gratitude for the study of the whole city goes to P. Bonvicini, an honorary inspector of the Superintendency, who in 1954 and 1991 was the author of the most important studies about *Falerio Picenus* and its theatre. He is also the author of a good planimetry and a reconstructive drawing of the elevation of the theatre that has been, in large part, accepted in our model. It is a work that is still useful for us, even if it has been updated by L. Maraldi in 2002, R. Perna in 2012 and by our team. In recent years, scholars focused particularly on the theatre (Paci, Montali 2011; Montali 2015), by outlining in more detail the activities of the

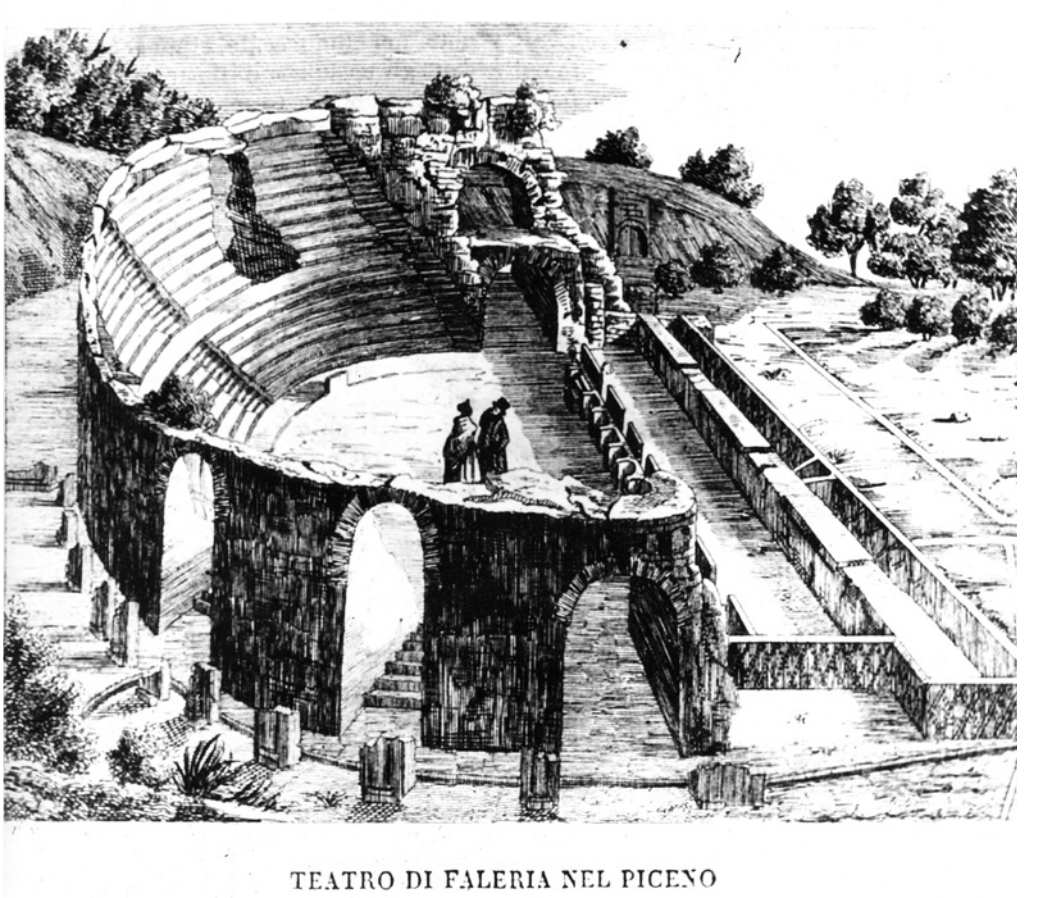

Figure 1. Illustration of the Falerone theatre by P. Mori after the excavations carried out by the De Minicis brothers (Campanari 1840, plate outside the text).

De Minicis brothers and a careful technical analysis of the structure. In the last few years, the collaboration between the Municipality of Falerone, and a Hungarian research group headed by Z. Ordasi and I. Váli, in collaboration with S. Cecchi produced the first three-dimensional reconstruction of the theatre (Ordasi 2016; Cecchi 2016), a work that remained unfinished.

The new research project

Between the fields and the modern rural structures of Piane di Falerone, various pieces of evidence of the ancient town can be observed: the theatre, the amphitheatre, two cisterns, the remains of a temple and some funerary monuments (Maraldi 2002). These provide but a glimpse of the importance of the city in ancient times; in fact, the lack of a recent overall study on the town, not concerning just single monuments or aspects, still prevents us from achieving a complete understanding. To address this issue, a project was instituted by the Superintendence of Archeology, Fine Arts and Landscape of the Marche Region, the University of Bologna (Department of History and Cultures) and the Municipality of

Falerone, directed by E. Giorgi, F. Grilli and P. Storchi. Our aim was not only to improve the knowledge of the city as a whole, but also to make the single structures of the ancient Roman city comprehensible to everyone, through new and updated studies for each known building, and supported by the latest technologies. The study regards monuments and their context, through the investigation of the in-between areas, undertaken through the analysis of archaeological data, epigraphy and written sources. The analysis of satellite, aerial and drone imagery making use various sensors, of geophysical surveys is ongoing and will possibly followed by archaeological excavations. To make monuments accessible to the wider public, three-dimensional computer digital reconstructions and modelling is being created and an approach that allows people to see the model directly on the site, simply by scanning a QR code with their smartphone.[4]

Figure 2. Marble statue of Cereres probably originally located in one of the niches of the scaenae frons of the theatre of falerio picens, but discovered in one of the vomitoria*. Antiquarium of Falerone. Courtesy of the Italian Ministry of Culture*

The principal aim of digital reconstructions is to facilitate an immediate and effective knowledge of monuments that are no longer or only partially preserved (Remondino-Campana 2014; Limoncelli 2019, 28; Viccei 2019, 85), but they could be much more than that. We have tried to create a reconstruction of the theatre that is not only of great visual impact, but also reliable from the archaeological point of view, a model could be used as an actual study tool.[5] In this particular case, the model enabled us to check whether the architectural elements discovered in the area could fit on the reconstructive skeleton according to their size and the general harmony of the building (Gabellone *et al.* 2017), or to test previous hypotheses (Viccei 2019, 88). As already widely demonstrated, this is a very useful practice and transforms a work of virtual archaeology into a real virtual restoration.[6] It is the only way,

[4] For the importance of 3D models, see D'Andria 2017, 78-83. On the QR technology for a wider public see the case of the theatre of Taormina (Malfitana 2017).

[5] Barcelò 2001. Some good examples of models created for study are: Verona (Tronchin-Bevilacqua 2022), Volterra (Fuchs 2021), Segesta (D'Andria 2017), Herapolis (D'Andria 2012).

[6] Maldonado 2005; Limoncelli 2012; 2019; Forte 1997; 2004; 2007; 2014; Barcelò *et al.* 2000; Gianolio 2012; Bennardi-Furferi 2007.

in our opinion, to obtain a convincing model, while it has recently been pointed out that many reconstructions that can be seen online or in archaeological sites should be considered as approximate, if not incorrect, beyond the understandable margin of uncertainty that always remains in these kind of works.[7]

The modelling of the theatre

As M. Luni affirmed, the theatre of *Falerio Picenus*, together with the nearby structures of Ascoli, *Urbs Salvia*, *Ricina*, *Ostra*, *Pitino Mergens* and *Suasa* have been, over the centuries, almost completely robbed of their decorations and it is therefore extremely complicated to propose what they might really have looked like in antiquity (Luni 2003, 242; Voccei 2019). In the case of Falerone, however, many decorative elements were still preserved in the eighteenth century, and in the nineteenth century; we are able, therefore, to propose a 3D model based on an adequate amount of data (Gabellone 2017, Viccei 2019, 88-89).

The Falerone theatre is the smallest of the *Regio V Picenus* to date (Fig. 3) (Capodaglio-Cipolletta 1999; Luni 2003, 243; Tosi 2003). Its orchestra measures 18.60 m and the *cavea*, which opens to

Figure 3. Aerial Photograph of the theatre. Courtesy of the Italian Ministry of Culture

[7] A problem which, as noted by R. Viccei (Viccei 2019, 84-85), perhaps derives from the fact that many working groups prefer ostentation over a philologically accurate reconstruction. Se also Tronchin-Bevilacqua 2022, 184; Limoncelli 2019; Viccei 2019, 85; Gabellone *et al. 2017.*

the south east, is 49.20 m long. It has a simple architectural structure: it is a self-supporting building, with the first and second tiers of seats supported by an earth fill (*aggestus*) held by retaining walls, as in Urbino, Gubbio and Mevaniola (Bonvicini 1991; Ortalli 1994, 284-288; Maraldi 2002, 38; Luni 2003, 245), while the third level of the *cavea*, which has now disappeared, was supported by a vaulted gallery with brick pillars, of which only the lower portions are still partially preserved. This external arcaded façade represents a peculiarity in the theatrical architecture of ancient *Picenus* where most of the theatres, lean on natural slopes, such as the ones of Urbisaglia, Fermo and Ascoli (Tosi 2003, 337). To date, this architectural feature is known only in *Helvia Ricina* and *Interamnia*, and the Falerio theatre seems to be the most ancient of the three. Access to the structure was possible through four *vomitoria* that, from the external ambulatory, led to the *praecintio*, the horizontal corridor that divided the *cavea* into two sectors, with staircases that narrow slightly from the outside to the inside.[8] The two main entrances, the *aditus maximi*, are preserved and on their vaults, there must have been two tribunes (*tribunalia*), perhaps accessible only from the *cavea*. Little remains of the *proscaenium*, the *pulpitum* and the *scaenae frons*. In the eighteenth century the whole area was much better preserved than it is today, so for its reconstruction we can rely on these data, and on geometrical studies based on contemporary structures (Fuchs 2020, 251-2, type C).

The structure is built using different building techniques, such as brick works, *opus reticulatum*, *opus vittatum*, and seems to have been conceived in a single moment, as already proposed by G. Montali (2015, 61). Small interventions are attested by an inscription (CIL IX 5426) dating back to the age of Claudius (Fig. 4). Here the words *faciendum curavit* must probably be attributed to the monumentalising of these entrances and not related the entire theatre, as previously hypothesized. In fact, the discovery during the excavation of the western *vomitorium* of an inscription with a dedication to Gaius Cesar (CIL IX 5425), dated by C. Delplace (1996, 119; Cancrini, Delplace and Marengo 2001, 27) to the year 5 BCE or 1 CE, suggests a most antique dating for the structure, contemporary with the foundation of the colony (Montali 2015, p. 78), as stated by the great majority of scholars.[9] This chronology seems also to be confirmed by a further epigraph (CIL IX 5449): a dedication to a certain Octavia who should probably be identified as Octavia minor, the sister of Augustus (Cogitore 2000; Marengo 2008). The construction of a theatre in this era is not surprising, since it is part of a series in the Regio V,[10] and it would also fit in a much wider phenomenon that affects, at least, the entire Italian peninsula (Bejor 1979; Sommella and Migliorati 1988). Some technical details of the structure also point towards foundation in the Augustan age (Montali 2015, 79; Maraldi 2002). The majestic simplicity of its architecture, and the rectilinear stage building (Small 1983, 58-60; Maraldi 2002, 40), equipped with three doors placed on the same line and with no exedras, seems to appear in the theatre of Marcellus in Rome and then was adopted in the immediately following years in many theatres. Afterwards it gave way to more spectacular architectural structures (Fuchs 2021, 382; Pensabene-De Nuccio 2010; Sear 2006, 84-87; Tosi 2003, 331). The

[8] Outside, the access was 2.40 wide, at its entrance into the structure 1.70 m, and it was characterized by 8 steps of 37 x 19 cm. Probably, as we will explain, one of them was decorated with an epigraph dating back to 43 CE.

[9] Bonvicini 1954, 40; Delplace 1996, 120; Luni 2003, 249; Maraldi 2002, 39; Montali 2015. A dedication to Gaius and Lucius Caesar was also found in the Cassino theatre (Pensabene-De Nuccio 2010, 74) and in Cartagena (Ramallo Asensio 1999).

[10] In this region we can list *Urbinum*, *Asculum*, *Firmum*, *Interamnia praetuttionum*, *Urbs Salvia* and probably *Helvia Ricina*; in the nearby *Regio VI*, *Ocriculum*, *Carsuale*, *Hispellum*, *Spoletium* and *Interamnia Nahars*. Luni (2003) writes that *Aesis*, *Ariminum*, *Bevagna* may also have been built in the Augustan age.

Figure 4. Inscription relating to an embellishment of the theatre dating back to the age of Claudius, on a slab shaped like an arch. Nineteenth-century drawing (Bonvicini 1971a, 100) and three-dimensional processing (elab. Studio111).

fact that the *scaenae frons* is almost of the same length as the *orchestra* is also considered an architectural peculiarity of this period (Small 1983, 57-60; Maraldi 2002, 40).

The first operation carried out on the field was to obtain a new topographical survey of the structure using a long-range 3D laser scanner (Fig.5), combined and integrated with photogrammetry and direct survey.[11] The laser-scanner provides much more precise data that are also being used to identify the restorations carried out in relatively recent years which were either not, or only poorly documented. The point clouds generated from 75 stations have become the reference digital model for the reconstruction, providing us with a solid base of data which literally grounds and supports the three-dimensional model.[12] The topographic survey was conducted by V. Castignani and F. Pizzimenti using a Laser Scanner Leica P30, a time-of-flight laser particularly suitable for the documentation of architectural contexts, and resulted in an accurate 3D model of the monument. The acquisition method involved the use of reflective target as control points for relative and reciprocal positioning of setups, in order to achieve a pre-alignment of scans at the acquisition stage and a more precise registration in post-processing. The sampling interval was selected as 6mm at 10 m, ensuring high resolution in point cloud restitution. Data processing resulted in a three-dimensional point

[11] A previous, high-quality survey by N. Masturzo in 2005 was used to integrate parts that are no longer visible today, since a modern wooden stage covers much of the *proscenium* and of the *scaenae frons*.

[12] This is generally considered to be the best operational protocol in 3D modeling, see Fuchs 2021, 387; Bianchini-Potestà 2018; Bilis *et al.* 2017; Mele-Maniglio 2015, Finat *et al.* 2005.

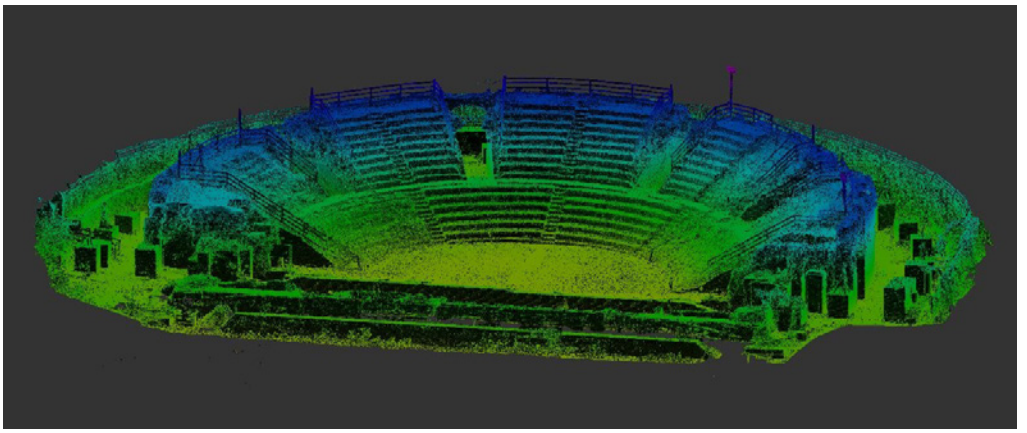

Figure 5. Laser scanner survey of the theatre in false colours (elab. V. Castignani). Courtesy of the Italian Ministry of Culture

cloud with sub-centimetre accuracy, clean of noise and visualized through different colour map parameters.

We then proceeded with the reconstruction of the theatre, studying the problems inherent in the building section by section, as well as the aesthetic and functional connections between the parts. The modelling operation was entrusted to the company Studio 111 run by L. Tampieri and G. Canuti, who took care of the technical part of the work; they used Autodesk 3ds Max for the elevation and for the details and the texturing phase Zbrush, Adobe Photoshop and Substance painter softwares were used. Lights and peculiar characteristics of the materials were given with a GPU-based graphic engine Fstorm.

In the following paragraphs a detailed explanation of the reconstructive process is provided, in order also to make available all the useful data to open a debate and a dialogue with the scientific community regarding these fascinating, but challenging reconstructions.

The *cavea* (Fig. 6)

The easiest part for us to reconstruct was the *cavea* because it is still largely preserved. It was divided into four wedged areas by five staircases. Today only the core of *opus coementicium* and pebbles can be seen, but originally it must have been covered with stone. Analysing the notes of the De Minicis brothers (Bonvicini 197 b, 375, n. 5), it seems that the *scalaria* were covered with marble, and the seats in local travertine. It was therefore decided to colour the seats in pale yellow and the stairs in white, a very elegant chromatic difference.[13] Wieseler (1851) is the only that indicates the presence of a double-width staircase in the centre, something that is no longer verifiable today, since this part of the theatre has been heavily restored. Yet, since this has never been underlined either in the notes of the eighteenth-century excavations or by the De Minicis brothers, it must be considered untrue. Moreover, this is a very rare

[13] In Verona also the seats were in local white stone, while the stairs were in red marble from S. Ambrosius (Tronchin-Bevilacqua 2022, 185).

Figure 6. 3D representation of the cavea *(elab Studio111).*

architectural solution, so we decided to model the central staircase in the same way as the other ones.

The *ima cavea* presents a footrest and 6 steps (58 x 30 cm for the steps and 30 x 26 for the footrests), followed by a wider upper limit, the *praecintio* (75 cm wide and 10 cm high), and then by the *media cavea*, which had 1 footrest and 9 steps; the steps have the same size as those of the *ima cavea*. Very little remains of the last two rows, but we can rely on the excavation data that were confirmed by the 3D model. Nothing remains of the third level, the *summa cavea*, and likewise only little was still standing at the time of the first excavations. We suggest that it had a width of 2.46 m as indicated by the space between the external pillars and the internal ambulatory wall. The third level of the structure, however, in contrast to what has been presumed up to now, probably did not host further rows of spectators, but rather a portico: the most recent studies on Roman theatrical architecture have drawn attention to the need for a solution of this type to operate the *velarium* that sheltered the spectators from the sun.[14] Therefore, to the hypothetical height of the building up to the *media cavea* (6.40 m), we must add about 3 m in height for the gallery in *summa gradatione*, as hypothesized for other theatres (e.g., the nearby Urbisaglia structure)[15] and, with a good approximation, also for the structure of Falerio by P. Bonvicini (Luni 2003), reaching an overall height for the theatre of about 9.40 m.

Until now, a capacity of 1,600 spectators has been proposed. The method used by the De Minicis brothers to arrive at this calculation is curious: they made the excavation workers sit in the stands (Bonvicini 1971a: 107). This method may not be one of the most refined (Fuchs

[14] An operation that needed a remarkable number of people (Gabellone *et al*. 2017). I am grateful to W. Fuchs for his advices especially about this aspect.
[15] Cingolani 2020; in Verona a lower ambulatory of about 2.3 m has been hypothesized (Trochin and Bevilacqua 2022, 185).

2021, 392-3), but it is certainly effective. However, the capacity was calculated by inserting five rows of tiers in the *summa cavea*. It is therefore probably necessary to reduce it to 1,100 seats, although to this number we can perhaps add a limited contingent of high-ranking spectators hosted in the *proedria* and in the *tribunalia*. This is, however, a capacity that is adequate for a small city like *Falerio Picenus*.

We have already mentioned the epigraph relating to an embellishment of the theatre dating back to the age of Claudius (Bonvicini 1971a, 100). It was discovered 'in front of the first western *vomitorium*' and was carved on an arch-shaped slab, of which only a fragment is still preserved today. It was located above one of the entrances, most likely the one near which it was found. We consequently decided to remodel it on the basis of the preserved fragment and its drawing in the nineteenth-century excavation diaries[16] (Fig.4).

We also know from the excavation diary of 1836 that two telamons holding large tragic theatrical masks were found close to the eastern *aditus* (Bonvicini 1971a, 101; Sear 2006, 156). It is not easy to hypothesize their precise original location. This type of couple-sculpture is most commonly found at the terminal point of the handrails at the base of the *analemmata*, as occurs in the theatre of Pietrabbondante (2-1 BCE) or in the small theatre of Pompeii (80-70 BCE) (Verzár Bass 1990, 415, Ortolani 2008; Di Napoli 2013, 144-6). Telamons without masks are also rather widespread: at *Iaitas*, *Tegianum Dianum* and *Aquileia* (Sear 2006,149, 175). Based on these considerations, we decided to place them at the base of the *annalemata* in our 3D reconstruction (Fig. 6 and 7), even if some difficulties still persist. First of all, all sculptures are lost and the nineteenth-century excavators do not provide us with the dimensions; furthermore, the other telamons known in this position in the theatres are all kneeling, while those in the Falerio theatre were standing, so other possible locations were considered. One possible location, would be along the front of the *pulpitum* wall, as occurs in the theatres of Syracuse (Caruso *et al*. 2015, 25-6) and Segesta (D'Andria 2017, 83, pl. 10), that were decorated with several standing telamons. However, the Sicilian structures are too distant in time and location to be considered as reliable comparisons. A very similar telamon in a standing position was found in Benevento (Adamo Mucettola 1991, 206). It was discovered in a medieval wall, reused together with another kneeling telamon. Scholars have hypothesised that these elements were both taken from the city theatre, one from the *analemma* and the other from the *proscenium*; a second hypothesis is that the standing one decorated a city gate (Adamo Mucettola 1991, 206). Taking into account the analogy with the city gates and the point of discovery of the statues, is it possible that the telamons decorated the internal arch of the entrance to the theatre? In theatres, to our knowledge, this position is never attested for these statues. It is not an impossible solution and surely fascinating, but for the moment it seems less likely than the handrail one.

The discovery of a herm that portrays a character with Dionysian features recalls similar sculptures from the theatres of *Alba Pompeia* and Verona, where it is assumed that they decorated the corners of the parapet of the *tribunalia*. We also hypothesize a similar location here (Bolla 2010).

[16] This interpretation was supported by the De Minicis Brothers, in Bonvicini 1971a 98-9; and recently also by Tosi 2003, 331. See also Cancrini, Delplace and Marengo 2001, 27.

Figure 7. The two fragments of telamons identified during the nineteenth-century excavations (Bonvicini 1971a, p.101), our reconstruction and the hypothesis of its original placement (elab. Studio 111).

The modelling of the *summa cavea* and the hypothesis of the temple

As already mentioned, nothing remains of the *summa cavea*. For its reconstructions, we took in consideration the rare theatres where this portion of the building has been preserved. Erratic architectonic materials that could have come from this part of the building are also very rare: only some marble columns of 30 cm in diameter have been found (Sear 2006). In our model, we have created a gallery of slender columns on the internal front and an external wall with fenestrations useful for lightening the structure.

It is well known that ancient theatres had a strong connection with worship and sacredness. Vitruvius in fact writes 'Apollini patrique Libero secundum theatrum' (Vitr. I, 7, 1) and again 'cum forum constitutum fuerit, tum deorum immortalium diebus festis eligendus est locus theatre' (Vitr. V, 3, 1). For Quintilian the theatre can be defined as 'a kind of temple' (III, 8, 28-9). The cases of the famous Republican sanctuaries that highlight with their structures the strong the connection between temples and theatres, are also well known.

However, these are not the only cases known. The most complete and still fundamental study on the phenomenon remains the one by J. A. Hanson (1959). The scholar analysed all the possible architectural relationships between theatres and temples, and among the 'imperial theatre buildings combined with temples', he listed also the case of Falerio (Hanson 1959, 59, 76, pl. 44). Recently L. Maraldi (2002, 37) has focused on the problem and G. Tosi (2003, 738) has positively re-evaluated the proposal of the presence of a temple in the Falerone theatre. In Italy solutions of this type have been hypothesized for Cassino, Ercolano, Sepino and Fiesole, to which we can add *Leptis Magna*, Dugga, Tipasa, Calama, Philippeville, Timgad and Cherchel in Africa; Vienne, Lillebonne, Tulle and Vaisoine-La-Romaine in France; Sagunto in Spain; *Nicopolis* in Epirus; *Apamea* in *Syria*; and *Heracleia* in *Bithynia*. To my knowledge, further examples can be added, such as, for example, Amman in Jordan. In more recent times, a similar solution has also been hypothesized in Teano, Taormina, Volterra, *Alba Fucens*, *Iuvanum*, Spello, Pompeii, Arezzo, Pietrabbondante, Verona, Trieste, Squillace and various other cases (Tosi 2003, 735). It must be underlined that the certainty of the real existence of temples in *summa cavea* of these theatres is highly uneven and ranges from *aediculae* and shrines that are well preserved and still visible, such as in Amman or *Leptis Magna* (Bomgardner 2016), to completely hypothetical examples, such as that of Volterra. As far as the case of Falerone is concerned, Hanson assumes the existence of the temple only on the basis of the presence of the base for an equestrian statue (see below) outside the structure, placed on the central axis of the *valva regia*. The temple would be located in line with these, tracing a sort of sacred axis. However, in our opinion, there are also other more concrete elements to take into consideration which make the hypothesis plausible. Before Hanson, something similar had been proposed by Wieseler: he drew a central staircase twice the size of the others (Wieseler 1851, 19-20; Hanson 1959, 44). Therefore, it had to lead to a particularly important place, probably the temple, similarly to what has been hypothesized for the theatre of Trieste (Verzar-Bass 1991, 164). However, these data are very uncertain, and moreover, in various cases where the summit temple was clearly present, the stairs are not particularly large, and in some cases, there is no direct access from the *cavea*. In any case, the theatre of Falerone seems to have many elements in common with that of Urbisaglia and the latter was certainly equipped with a chapel in *summa gradatione*. The theater of Urbisaglia was built above an ancient place of worship (Perna 2006; Cingolani 2018, 2020): the chapel could be interpreted as a sort of restitution to the divinities of the space. The same could have happened

Figure 8. The small pediment that was created in the summa cavea *to give the idea of the possible presence here of a temple (elab. Studio 111).*

in *Falerio Picenus*; in fact, in the area of the theatre a series of architectural terracottas for the decoration of a temple and some votive offerings from the Republican age were discovered in 1921 (Moretti 1921, 185-6), suggesting the presence of a temple in the same place, before the building of the theatre (Maraldi 2002, 103; Paci-Landolfi 2002, 313-322; Perna 2012, 383). This phaenomenon is not unknown for the region (Perna 2012; Giorgi 2014.). A further element can be added to the discussion: an inscription recently reviewed by C. Delplace was found inside the theatre and mentions the construction of an *aedes*: '*aede[m] / de sua [pecunia]*' (CIL IX 5423, Cancrini-Delplace- Marengo 2001, 24-25, 90). On the basis of these considerations, we have decided to model a small pediment in the *summa cavea* (Fig. 8) suggesting the presence of the temple in a deliberately vague way, without adding further elements in order to provide the visitor with this hypothetical structure, but without creating a totally false reconstruction.

The *orchestra*

The *orchestra*, the area that separated the spectators from the stage, was always paved with stone slabs in Roman theatres. The eighteenth-century excavations reports tell us about the discovery of fragments of cipollino marble slabs in this area, clearly part of the pavement of the *orchestra*. This seems to be contradicted by the excavation report of 1836 (Bonvicini 1971a), which reports the presence of travertine slabs, but in reality, it mentions the discovery of a single slab which was anchored to the ground because someone had tried to steal it during the excavations. Our conclusion is that there was a multi-material pavement, as in many other cases.[17] In the model we have therefore paved the orchestra with of slabs of two materials. This flooring, according to the excavation diaries of the time, was placed 60 cm below the

[17] Sear 2006, 81 states that the orchestras received marble flooring only from the Augustan age, perfectly confirming the chronology of the theatre. An interesting information is reported by Catani (1989, 217): at Villa Cecchi, in the nearby hamlet of Convento, she saw numerous limestone slabs in the walls, some of which were curved and bore traces of a drainage channel. They could actually be the slabs of the theatre orchestra.

Figure 9. 1962 postcard showing the state of preservation of the scene and the proscaenium *of the Theatre of Falerio Picenus before modern restoration.*

external walking surface,[18] and we took this into account during the modelling operations. We added a *balteum*, a parapet that separated the orchestra from the *cavea*, since a large marble slab vertically fixed was found during the nineteenth-century excavations (De Minicis 1839, 14). In front of the *balteum* we modelled the *proedria*, stone steps from where the most notable people of the town watched the performances. These are not archaeologically documented, because this part of the building was particularly poorly preserved already in the nineteenth century. Otherwise, we should imagine some *subsellia*, elegant wooden seats.

The *pulpitum* and the stage

Beyond the orchestra the *pulpitum* wall developed. It was largely rebuilt after the 1960s, as proved, for example, by a 1962 postcard (Fig. 9). Our 3D reconstruction relies in the fact that it is canonical for Roman theatres to have *pulpita* that alternate curvilinear with squared niches about 1.50 m wide. Originally the wall must have been ca. 1.45 m high (Montali 2015, 71), as stated by Vitruvius (Sear 1990) and as can be seen in other theatres of the region. It was equipped with 4 little stairs that allowed access to the stage. Small bronze statues were perhaps housed in the niches, and in the nineteenth-century excavations statuettes of a household's guardian and a lictor were found here (Bonvicini 1971a, 103), something that is not attested in other theatres. Generally, the statuary decoration of this portion of the

[18] This happens quite frequently in Roman theatres, for the case of Verona, see Bolla 2010 and Tronchin and Bevilacqua 2022.

building is never reproduced in models and, in fact, reliable hypotheses cannot be made even for Falerio (Maraldi 2002, 36; Bolla 2010).

Between the *pulpitum* wall and the *scaenae frons*, there was the *proscaenium*, the stage: it was a wooden deck (33.20 m x 4.60 m) where the actors performed, built over an underground chamber that functioned as a resounding chamber. Nothing remains but the joints for the boards. In the part closest to the *orchestra* there were 6 pits, measuring 30x30 cm, and 1.95 m deep (Maraldi 2002, 36), that housed the poles that were used to raise and lower the curtains (*auleum*), very well preserved in Falerio Picenus (Fincker -Moretti 2010).

The *Scaenae Frons* (Fig.10)

The *scaene frons* is one of the most difficult parts of the theatre to reconstruct since, as noted by other scholars (Limoncelli 2019, 19), it is frequently poorly preserved; therefore, not only actual archaeological data, but also comparisons are scarce. In our case, even the few remains are difficult to access due to the modern stage built to make the structure usable for shows, which covers the *scaenae frons* and the *proscenium*. We therefore rely mainly on previous surveys and attempted a difficult survey with a laser scanner. It can be deduced from previous document that the *frons scaene* should have been rectilinear, with three entrances, like those of *Herculaneum*, *Iguvium*, Arles, *Ostia*, Cassino, *Italica* and many others. All of these examples are inspired by the archetype constituted by the theatre of Marcellus in Rome (Pensabene, De Nuccio 2010, 59; Sear 2006, 83). In fact, the plan of the theatre drawn up by F. Dessi in the nineteenth century shows the presence of aligned plinths on which 14 columns were arranged.[19]

Figure 10. 3D reconstruction of the scaenae frons *of the theatre of Falerio Picenus (elab. Studio 111).*

[19] This drawing can be considered reliable, since this is the canonical number of columns for straight *frontes scaenae*, a fact not known at the time (Montali 2015).

Since the theatre of Falerio is very small in size (the structure is only about 9.40 m high), we must imagine a not very high *scaenae frons*, having only two levels. This type is frequently attested in the Augustan age (e.g., in *Augusta Bagiennorum*, Limoncelli 2019, 43) and described by Vitruvius. The plinths were seen in the eighteenth century and drawn by B. Agabiti (Fig.11), and were richly decorated. They were of two different types, consisting of precious marbles of various colours: porphyry, giallo antico marble and pavonazzetto, as described in detail in the eighteenth century (Bonvicini 1971b, 124). One of the two typologies was even still endowed with bronze decorations (Bonvicini 1971b, 124): metallic festoons and bucrania which can be compared with some similar fragmentary decorations discovered in Verona, and which are reproduced in the 3D model, inspired also by similar decorations in other monuments of the time, such as the *Ara Paics Augustae* in Rome. B. Agabiti only gives us the measurements of the plinth decorated with metal festoons which was 9 palms of the papal state (ca. 2 m), while the second type of plinth is shorter and less slender.[20] We could hypothesize that the central door was architecturally enhanced, as happens very frequently in theatrical *frontes*

Figure 11. Plinths of the theatre of Falerio Picenus. Above, as drawn in the eighteenth century (Bonvicini 1971, 124-5) and below our reconstruction (elab. Studio 111).

[20] Bonvicini 1971b; Montali 2015, 74-75. Peculiar plinths are attested for example in the theatre of *Augusta Bagiennorum*, Limoncelli 2019, 43.

scaenae (Pensabene-De Nuccio 2010, 62). This can be seen for example in the Cassino theatre, where the central plinth is lower, so that the columns on it were higher. We opted of a similar solution in *Falerio Picenus*, in order to give particular emphasis to the *valva regia* (Fig.11).

G. Montali (Paci-Montali 2011) focused on a lintel, recomposed from three fragments (Fig.12) and two other similar architectural elements not matching each other (one of them bears an inscription by the emperor Probus, obtained by erasing its decoration in a later phase). All these elements are decorated with a particularly elaborate botanical-design frieze, and Montali hypothesized that they could be part of the decoration of the *scaenae frons* due to the particularly exuberant decoration, the fact that the architrave is also decorated in the lower face, and because these elements, although not found inside the structure, do not adapt well to other types of buildings. Montali himself was very cautious in this proposal, thinking that the close rhythm of the columns of a *frons scaene* did not adapt well to this architectural element. Our model confirms that Montali was right. In fact, the architectural element could decorate the aedicules above the side doors of the *frons scaene* which are 2.1 m wide; the lintel is 3 m long and could fit perfectly, taking into account the space occupied by the columns. The central door is 3 m and would need a longer architrave (Maraldi 2002, 36; Tosi 2003, 330), maybe the one with the inscription of Probus which was originally longer and had to be in the centre for greater visibility. On the basis of the height of the lintel (46 cm high), we can assume columns with a base that was 15 cm high, a shaft of 2.47 m and a capital 34 cm high. The width of the column should be around 31 cm. This system, quite thin, could be part of the second level of the *frons scaene*. The first one can be reconstructed, according to the Vitruvian principles, with bases of 18.75 cm, shafts of 3.08 m, 42.5 cm-high capitals and a 57.5 cm architrave. The diameter of the column was 38.7 cm, similar to some examples in Ostia (Pensabene, De Nuccio

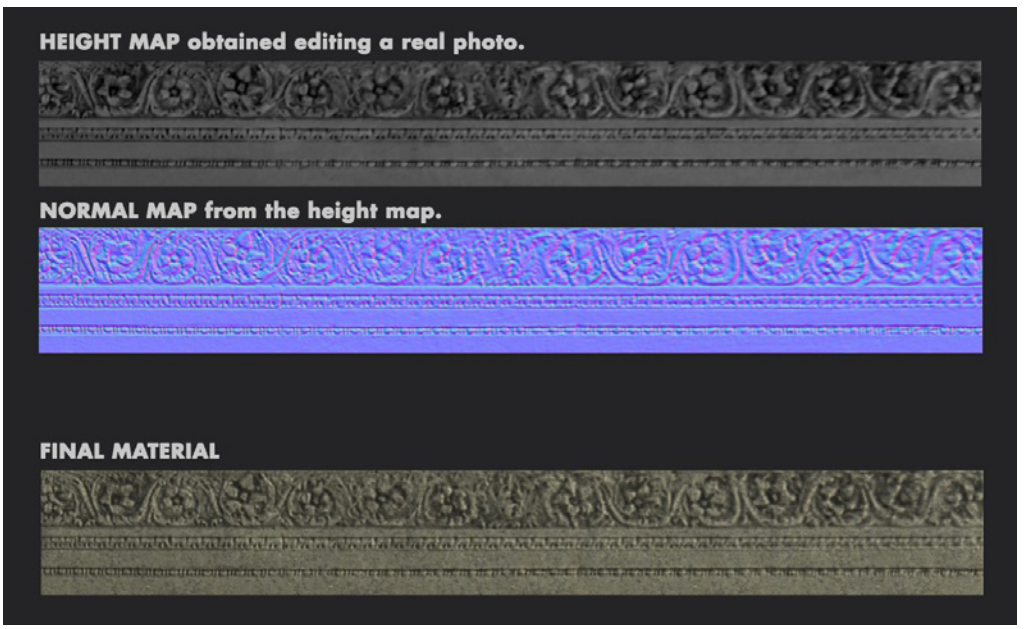

Figure 12. Architrave decorated with a particularly elaborate botanical-design frieze, probably belonging to the theatre. Here you can see the process to create the virtual element from merged photos (Studio 111).

2010, 72). We do not have any reliable data regarding the architectural order of the columns, but we suggest that they could have been Corinthian, based on the frequency of this type in these structures (Fuchs 2021, 381). We also have no example of a column left. From the reports of the nineteenth-century excavations of the scene area, however, we are informed of the discovery of fragments of white marble and limestone, 'breccione', giallo antico and other unspecified types of marble (Bonvicini 1971a, 105); therefore, it had to be a very elegant and multi-material stage backdrop. In the 3D reconstruction we proposed a first order in white marble and the upper one in coloured marbles, according to what was attested, for example, in Ostia, in that case, grey and cipollino marble (Pensabene, De Nuccio 2010, 72) and in *Augusta Bagiennorum* (white marble on the first level and giallo antico and bardiglio marble on the second) (Limoncelli 2019, p. 43).

On both sides of the stage building there must have been walls leaning against the one behind the scene; it was important to support a deck for the roof. However, no trace of these were found, so we modelled it on the basis of comparisons with other models (such as the ones of Lecce and Catania) or better-preserved structures, such as the theatre of Volterra (Fuchs 2021, 382).

Behind this architectural backdrop there was the *postscenium*, a narrow and elongated space (33 x 4 m), characterized by a peculiar V-shaped buttress which, to date, does not find good structural comparisons (Maraldi 2002, 37, n. 143).

The statues of the *scaenae frons*

The 14 columns of the two levels of the *scaenae frons* created 11 large niches (4 in the first level and 7 in the second one, Fig. 6) which, as in any ancient theatre, were originally occupied by statues (Ramallo Asensio, and Röring 2010). The reconstruction of the statuary groups is not simple: statues of different chronology coexisted on the *frons scaene* as proved by a mid-2nd century CE epigraph that mentions the donation of statues to complete its decoration by Antonia Picentina, priestess of the Diva Faustina (CIL 5428), and most of them are now lost. In the nineteenth-century excavations three magnificent marble statues were discovered in the vomitoria of the theatre, whose datation is problematic;[21] from the excavation diaries it is clear that they were about to be calcinated, since fragments of calcined marble were found with them. Their identification is uncertain, but they probably represented Demeter/Ceres (the best preserved, 2.07 m high, Fig.2), Venus (similar to the famous Aphrodite of Milos) and Jupiter Aigiochos (De Angeli 1987). We can add a head of Augustus of the type of Prima Porta discovered by P. Bonvicini in the 'scraps' of the De Minicis collection in Fermo. The statue of a man in a toga, traditionally associated with the theatre, seems instead to be linked to the amphitheatre (De Angeli 1987). In addition to these, we can postulate the presence of a statue of Commodus and that of Gaius Caesar, on the basis of the presence of epigraphs, probably attributable to the pedestals. It can be less certainly hypothesized that the epigraph dedicated to Octavia, mentioned above, also belonged to a statue and I consider it very likely that *Antonia Picentina* dedicated a statue to Faustina, as a priestess of her cult.

[21] M. Fuchs (1987, 62-66) traces them back to the Trajan age, while S. De Angeli (1987) and Delplace (1996,123) are vaguer.

We can therefore recognize two groups of statues: the first portrayed the imperial family (Gaius Caesar, Augustus and Commodus, perhaps Octavia and Faustina); the other, divinities (Demeter, Venus, Jupiter). We propose that the statue of Augustus of the type of Prima Porta was in the centre, as also assumed for the Roman theatre of Lecce. It would be a tangible tribute of the person who transformed Falerio into a colony and probably promoted the construction of the theatre itself.

As for the model, we were uncertain on how to reproduce the statues. Vague and unrecognizable representation would have clashed with perfect statues such as the ones preserved or the ones with e known know archetype. In order not to deceive the visitor, however, it would be necessary to find a way to make them understand what was there and what is only hypothesized. No solution seemed satisfactory to us, so we preferred, for the moment, to leave all the niches empty.

The external part of the theatre

For economic reasons, it was decided, for the moment, not to model the exterior of the structure, but, in order to acquire a better understanding of the theatre in all its complexity, it was necessary to study it in its entirety, so we also gathered all the data necessary for the future modelling of this part of the building.

The outer portico

For the general harmony of the structure, the scholars agree that, already in the first construction phase, there was a perimeter portico around the theatre. Its vault was covered in frescoes, as affirmed by the first excavators (Bonvicini 1971b, p. 390) e and two wider pillars on the sides of the *versurae*. The pillars were at a distance of 2.70 m from one-another. Today the distance varies between 2.60 and 2.90 m, most likely due to the modern-age restorations, except for the central one, which is 3.40 m wide. This was, in fact, the location of the base for the statue described in the next paragraph.[22] These semi-columns were probably covered with yellow mortar at an initial phase (Bonvicini 1971b), but definitely at a time when the town was prospering, these were covered with slabs of giallo antico marble, as indicated by the discovery in the nineteenth century of curvilinear thin fragments of this material.

The first excavators write of Doric columns (Bonvicini 1971b, 390); the De Minicis brothers hypothesize an Ionic or Corinthian order, while Bonvicini opted for the Ionic order (Bonvicini 1971a, 476; 1971b, pl.3). We agree with G. Montali that it is likely that the colonnade was of the Ionic or Corinthian architectural order, which would better adapt to the Ionic bases and given the frequency of these orders for these porticoes (for example, in the theatre of Verona, of the Augustan age), but also because P. Bonvicini mentions the discovery of carved brick elements 'with carved ovoli and another with acanthus leaf' (Montali 2015, 65-67; Bolla 2010).

The peculiarities of the larger central arch, having more refined molding of the bases, and more slender and more protruding columns, suggests the possibility, already supposed by Montali, that they differed in order and perhaps also in the material used to cover them, as

[22] Measures were verified personally. See also Maraldi 2002; Montali 2015 and the unpublished survey by Arch. Masturzo.

attested, in later leisure buildings such as the Colosseum. This would explain the discovery of thin elements to cover columns in pink marble and coral breccia reused in the area (Montali 2015, 66-67, n. 50). The *cavea* was surrounded by a paving in Istrian stone according to the eighteenth-century excavations (Bonvicini 1971a, p. 109), useful for providing better access to each entrance to the structure even in the case of rain.

The statue base

A platform was inserted inside the central archway of the external portico. It is a pebble and mortar arrangement, now mostly covered with soil. This structure measures 2.21 x 3 m at the base. Starting from the bottom, after 34 cm it has an 8 cm deep recess on all sides and rises for another 39 cm. At the top it is 205 cm wide and the possible length is 284 cm. The base was originally supposed to be higher, as evidenced by the nucleus of concrete projecting above it.

We agree with those who interpreted it as the base of an equestrian statue, given the elongated proportions and because of the fact that some fragments of a large, golden bronze statue were found here, with some fingers, a fragment of footwear, one of drapery (Bonvicini 1971a, p. 100-1).

An equestrian statue was placed in the theatre of Thugga, but it is attested only epigraphically (CIL VIII, 26622). A statue of this type was also housed in the theatre of *Herculaneum* and fragments of a statue on horseback have also been identified in that of Verona (Bolla 2010, 38). However, in these cases, the statues were located inside the structures and not outside.

It is difficult to establish who could be represented here. Such a prestigious position is perhaps more suited to an emperor than to a citizen, however wealthy. The fact that Domitian's edict was found right in front of the statue seems to suggest this emperor. However, we have seen that it is very likely that a portico, albeit a very simple one, with stuccoed columns, was present since the foundation of the structure, so it is possible that the equestrian statue can be attributed to Augustus, although only one young portrait of him on horseback was discovered.

Conclusions

The overall dimensions of the structure were obtained with an accurate 3D laser scanner survey and completed on the basis of comparisons with better-preserved buildings from the same period; for this we have tried to represent the real elements seen in ancient times, such as epigraphs, marble coatings, bronze decorations and statues.

We are aware of some limits related to what has actually been preserved, to the presence of some decorative elements found in the theatre whose location is unidentified, for example a small round relief of Hercules or two fragments decorated with an eagle (Bonvicini 1971a, 103) and because of the documentation of the first excavations which, at times, is not very accurate, with vague descriptions of the materials used, drawings without scale, walls found that were not fully understood and therefore were not adequately represented, all of which led, especially as regards the area around the scenic building (possible basilicas or stairs, *porticus post scaenam*, etc.), to some inconsistencies that it may only be possible to resolve with new research campaigns and excavations. In every three-dimensional reconstruction of an ancient building there is always a percentage of uncertainty, we could add that we are well

aware of some errors. The first question that comes to mind is 'is this the theatre the Romans saw?', 'What is the degree of 'authenticity' of this reconstruction?'; A question that implies also philosophical issues (Kynorgiopoulou 2000), although in this specific case there was an abundance of elements available.

The main problem is that we are forced to show just a building phase in our reconstruction, while the monument evolved in time, and its history, that a good archaeologist should be capable of 'reading' in masonry, constitutes part of its identity and of its authenticity (Thomson 2008). However, it seems to us an important work not only because it will attract new attention to the site and enable tourists to understand it better; also because it represents a true 'democratization' of cultural heritage, since the inhabitants of Falerone will be able to view the statues found here without being forced to go to the Louvre Museum or look at some decorations without going to the Vatican Museums; but above all, because the 3D reconstruction was used as a real research tool and it increased significantly our knowledge on the site.

The work is not finished yet: we have acquired the data, but still not modelled the exterior of the building and we are still wondering how to deal with the problem about the statues of the *scaenae frons*, and the way we will chose to operate will mean the model can easily be improved or changed in the future in the event of new findings or studies (Limoncelli 2019, 22-23).

Certainly, some difficult choices had to be made, and it is important that the scientific community is aware of them.

We informed the research community of this through this publication, but we are trying to identify intuitive methods to make the visitor understand which elements of the reconstruction are certain and still preserved, which are almost sure and not preserved, and which have been reconstructed on the basis of comparisons with structures or with similar decorations. In fact, even if a look through the smartphone allows us 'to deliver complex computations in a simple, appropriate way for a heterogeneous and generic audience' (Gabellone et alii 2017), we believe it is right that everybody should be aware of the so-called paradata, the hidden level of information behind a reconstruction.[23] As reported in paragraph 4.6 of the London Charter for the computer based visualisation of Cultural Heritage:

> *Documentation of the evaluative, analytical, deductive, interpretative and creative decisions made in the course of computer-based visualisation should be disseminated in such a way that the relationship between research sources, implicit knowledge, explicit reasoning, and visualisation-based outcomes can be understood.'* [24]

Indeed, we would like to stimulate even the tourist's curiosity about this approach, so that he can understand how much work and study goes into creating a three-dimensional reconstruction.

[23] As noted also by Viccei 2019, 85. In the glossary attached to the London Chart you can read the definition: Paradata Information about human processes of understanding and interpretation of data objects. Examples of paradata include descriptions stored within a structured dataset of how evidence was used to interpret an artefact, or a comment on methodological premises within a research publication. It is closely related, but somewhat different in emphasis, to 'contextual metadata', which tend to communicate interpretations of an artefact or collection, rather than the process through which one or more artefacts were processed or interpreted. See also the Pompey project, Beacham-Denard 2003

[24] http://www.londoncharter.org/fileadmin/templates/main/docs/london_charter_2_1_en.pdf

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Notes

Architectures and urban landscapes in Pompeii: the project of Sapienza University in the *Regio* VII

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Abstract

Pompeii is one of the most important archaeological sites in the whole Globe, visited by thousands of people every year. The image of the city preserved, astonishing for its monumentality, belongs to its final days: it's the city of 79 CE, freezed under the eruption of the Vesuvius. So far, though we know that the city had been living for centuries before its epilog, our knowledge about the previous Pompeii is lacking. To fill this gap, after an agreement between Sapienza University and the Archaeological Park of Pompeii, a project has been started, aimed towards the creation of a GIS capable to manage the whole documentation, in order to understand the sequence of phases which depicts the development of the city. *Regio* VII has been chosen as a test area.

Keywords

Pompeii, Regio VII, GIS, Ancient Architecture, Urban Landscapes

The *Regio* VII project

In May 2021, the Department of Science of Antiquities of Sapienza University subscribed a three years collaboration agreement with the Archaeological Park of Pompeii in order to carry on a project aimed to the creation of an Archaeological Information System able to manage historical and archaeological data.[1] The project is based on previous experiences gained by the Sapienza researchers with Archaeological Information Systems, formerly created for the collection, management and analysis of every element of ancient Rome and ancient *Latium* (*vetus* and *adiectum*) urban and rural landscapes.[2]

[1] The first idea of bringing this methodology in Pompeii was made with the endorsement of the previous Director of the Archaeological Park of Pompeii, prof. Massimo Osanna, who wished for the use of the Archaeological Information System already implemented for Rome, inviting its experimentation on the Pompeian context. The choice of the *Regio* VII as the area of inquiry was made together with M. Osanna, as well. My personal thanks to him for having supported the preliminary phase of the project and to the current Director, Dr. Gabriel Zuchtriegel, for having supported and allowed it.

[2] For an example of this kind of analysis, reconstruction and recontextualization of urban and architectural-monumental contexts we refer once again to the Archaeological Information System elaborated for Ancient Rome and the synthesis edited in Carandini and Carafa 2012; 2017. For the *Progetto Lazio Antico* see now https://lazioantico.it/.

The purpose was a research based on a systematic analysis of entire complexes, considered through the recontextualization of all available documentation and material. A purpose more interesting to achieve in Pompeii than elsewhere.

Actually, the project originates from the awareness that an articulated and in-depth knowledge of contexts and a scientific reconstruction purpose allows for a deep understanding of an ancient site and contributes to the design of cultural heritage conservation and communication with the public. Given this assumption, previous researches made by the Sapienza *équipe* in the Vesuvian city and the test-application made on ancient Rome let apply the same method in Pompeii too, implementing an approach based not on classes of objects or single architectural units but on entire building ensembles and on interrelated data (see below, section 2).

Within the city, the test-area has been identified in the context of the *Regio* VII: an important and complex part of the ancient city located in the central-western area and comprehending most of the so-called *Altstadt* – formerly thought to be the earliest part of the settlement – the public zone of the *Forum* and a lot of other private and public buildings (Fig. 1).

The choice of *Regio* VII as the selected context for the first phase of our project derives from various considerations based on our earlier personal experience in the same area — with the excavation in the *Casa delle Nozze di Ercole* (D'Alessio 2008; Carafa and D'Alessio 2016)(Fig. 2) — and the presence, in this sector of Pompeii, of some of the city's most interesting monuments, both public (the *Forum* Square, the temples of Apollo and Jupiter, the buildings used for imperial worship, the *Macellum*, the Stabian baths, etc.), private (as the *insula Occidentalis* and other rich *domus* such as the *Casa delle Nozze di Ercole*) and commercial (*pistrina*, *textrina*).

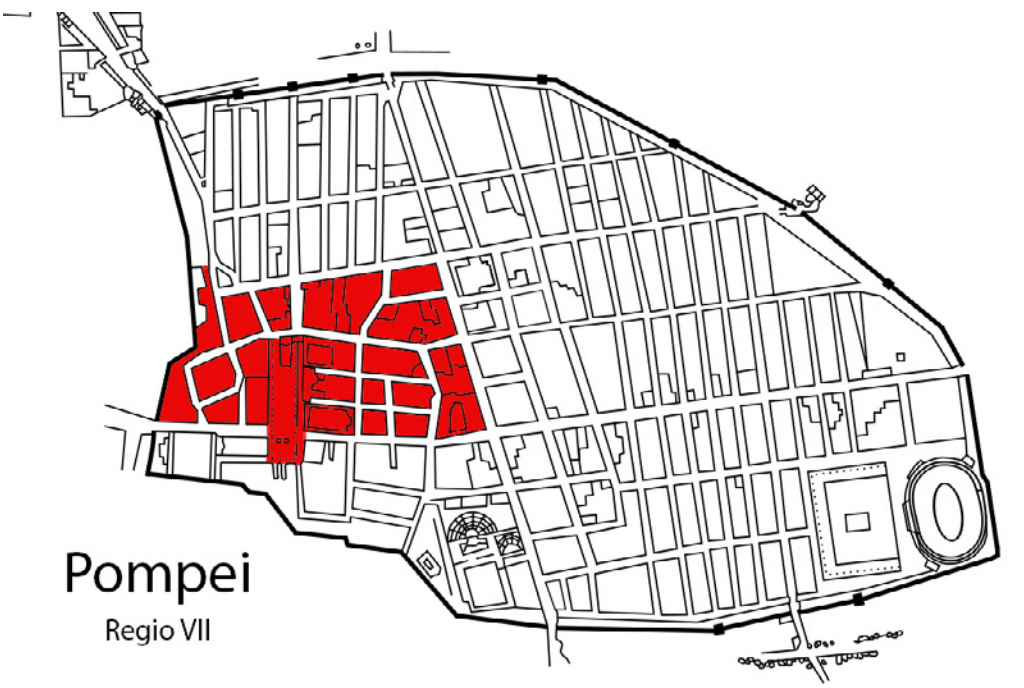

Figure 1. Pompeii, plan with the indication of Regio *VII (in red).*

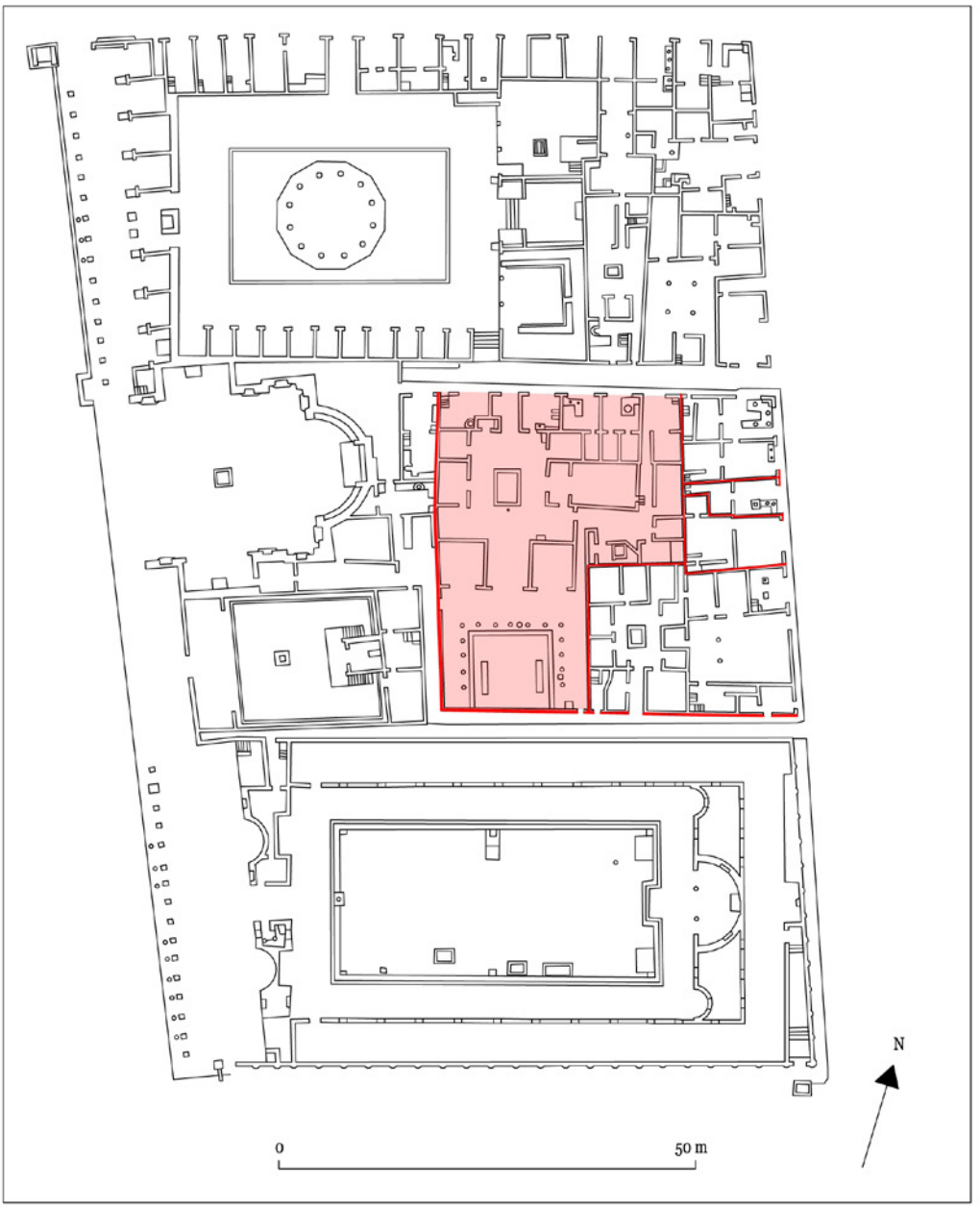

Figure 2. The localization of the Casa delle Nozze di Ercole in the insula *VII, 9 (D'Alessio 2008, p. 277, Fig. 2).*

The aim of the project is to create a database related to a GIS platform and to a Spatial Data Infrastructure that collects and manages all the available documentation of archaeological data (structures and objects by mid-6th century BCE to 79 CE) accumulated from the discovery of the city in 1748 up to today. The main goals are to embed digital archives with a specific numerical mapping; to manage data collected from analytical surveys and other assessments in order to create a model to extend all the processing possibly to a urban scale; to establish

an integrated reference system for material contexts associated with complex stratigraphic sequences; to elaborate different repertoires — today unavailable for the Vesuvian center — of the goods (ceramics, glass, metals, coins, etc.) circulating within the city during the different chronological time-horizons examined.

The first expected outcome is the creation of an Archaeological Map of the entire *Regio* and a series of thematic maps representing the different chronological phases of ancient presences. It will allow to reconstruct the succession of urban landscapes and the architecture of public and private buildings in this area through time. According to a procedure already applied to multi-layered archaeological sites, this involves the recomposing of stratigraphic, architectural and topographic contexts, a diachronic reading of them and the reconstruction of transformations over time. The capacity of the system will make it possible to handle large amounts of data and to elaborate a narrative of ancient urban history that can also be preliminary to an exhibition path. The material thus organized may eventually form the basis for further comparative research on the city and its material culture.

The proposed project is part of the cultural enhancement activities supported by the Ministry of Culture, in particular in the context of the renovation, enhancement and/or creation of facilities dedicated to the enjoyment, narration and understanding of archaeological contexts of different nature (urban sectors, archaeological areas, collections of objects, etc.).

Significant in this regard are the recent initiatives promoted by the former Archaeological Superintendency of Rome for the computerization and online management of its archives in agreement with Sapienza University.[3] Over the past few years, moreover, the Archaeological Park of Pompeii has been the subject of interest from the European community, through the program called 'Great Pompeii Project', which brought international attention to the need to carry out actions of awareness and protection within the archaeological area of the Vesuvian center.

Thanks to this project, the Archaeological Park holds and shares with the scientific community an up-to-date base of information about city (in particular a new vector-based urban survey of cognitive data related to ancient structures, orthorectified photographs and laser scans, as well as the collection of data related to different aspects of the archaeological structures, such as registry, conservation, etc.). This constitutes an optimal starting point for anyone today who wants to approach to the study and management of archaeological data in the Vesuvian center.[4]

It is now to be considered a shared standard the contribution of digital technologies to the knowledge and enhancement of cultural heritage. The application of the proposed strategies on the Pompeian punctual and diffuse contexts, from the single object to the entire archaeological site is however a complex operation that requires the participation of various

[3] I refer specifically to the Geographic Archaeological Information System of Rome (SITAR).

[4] I need again to thank the Director of the Park, Dr. G. Zuchtriegel for the permission to consult this amount of material and especially Arch. R. Martinelli, Dr. A. Russo and Dr. G. Scarpati for their continuous support. Thanks to their effort, we also had the possibility to consult all the available archives of Pompeii such as the photographic database *Tolomeo,* the Drawings Archive, the SIAV (Vesuvian Archaeology Information System).

experiences to collect and organize data, compare them with existing archives, and return the results to the scientific community as well as to the public.

It is evident that such a systematic and extensive intervention needs a unified and shared methodology. The best experiences of archaeological analysis of large portions of multi-layered and complex sites, developed in Rome, in other centers of ancient Italy and in the study of Pompeii's *insulae*, offer valuable support in identifying common line of intervention. A proposal for the application of this methodology to the study of an *insula* of Pompeii has already been developed and published (Carandini *et al*. 1996) and used in the edition of some research (Amoroso 2007).

The elements established as a necessary theoretical basis of this approach are: the stratigraphic analysis of structures; the analysis of material contexts associated with the known stratigraphies; the drafting of descriptive forms adopted by the Central Institute for Cataloguing and Documentation (ICCD) and stratigraphic diagram to order the architectural development of the building ensemble over time; the high quality standard and computerized editing of documentation; the elaboration of interpretive and reconstructive proposals, including possible hypotheses for recontextualization of any preserved remains of the original furnishings and decoration as well as furnishings related to the last phase of life.

The research has now reached a good stage of knowledge of the *Regio* VII evolution from the 6th century BCE, the first step of the urban settlement of Pompeii, to 79 CE, the moment of its ruin due to the Vesuvius' eruption. Many different chronological phases have been recognized, entered into the Archaeological Information System and geo-referenced in plan with the drawing of all the related Topographical Units (TU). In the following section Rosy Bianco, who organized the fieldwork and the related activities of the team,[5] will describe the method applied during the research and the various steps of the work, while Sara Bossi will explain the specific proceeding of the systematic stratigraphic analysis of the outstanding structures, which is still going on, with the care paid to the relationships between different Stratigraphical Units (SU) of every wall of the structures in order to obtain a relative chronology between them.

(M.T.D'A.)

Methodology

As explained above, the project follows the methodology and aims pursued in previous researches carried out for the city of Rome, its *suburbium*, and the ancient regions of *Latium vetus* and *adiectum*.

As in previous research, the main analysis tool used for the *Regio* VII of Pompeii is the Territorial Data Infrastructure. The TDI relies on the logical process, that is the base of the computing system responsible for collecting all the documentation pertaining to the findings made from the discovery of the city in 1748 until today. The systematic analysis of all available sources of information allows the creation of an updated archaeological map of this portion

[5] Members of the team are also Dr. Valerio Bruni and Dr. Elena Pavanello who are still working on *Regio* VII.

of the ancient city, aiming at the reconstruction of the stratigraphic, the architectural and the topographic contexts.

The analysis and reconstruction of the consecutive urban landscapes within the *Regio* is articulated in the following steps: 1) acquisition of the published and field documentation; 2) data processing and creation of the territorial information system; 3) drafting of a georeferenced archaeological map; 4) elaboration of thematic plans;[6] 5) reconstruction of contexts.

Data classification

The first part of the research is dedicated to the acquisition and subsequent classification of data, taking into account all of the available sources of information: published and unpublished archaeological data; epigraphic sources and, where available, ancient literary and iconographic sources; modern iconography and historical cartography. The sum of this information leads to the identification of the so-called Topographic Units (TU), i.e., the smallest constitutive element of an ancient landscape perceived as a unit.[7] The reconstruction of the framework of knowledge available for each context allows to systematically analyze the evidence and therefore to define the Topographic Units.[8]

As an example, the following elements can be considered TU: individual *domus*; temples; honorary bases in the Forum; *tabernae*; or, more broadly, all the buildings — or preserved parts of them — considered independent, regardless of their function, extent or monumentality.

Sets of TU can be gathered into larger groupings, such as **blocks** (i.e., the *insulae* in the Pompeian context), **complexes**, that are systems composed of more than one TU (as in the case of *Macellum* VII 9, 7-19), **areas** (see for example the porticoes

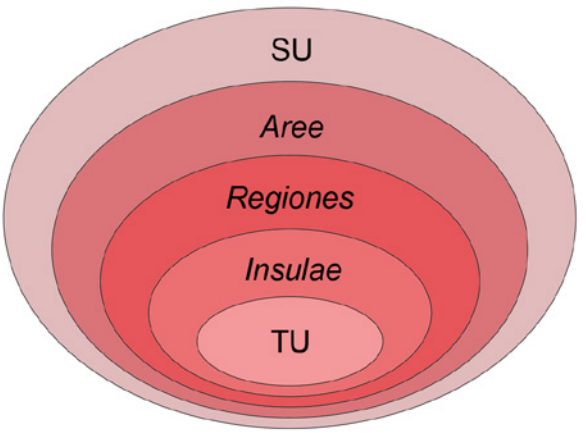

Figure 3. Archaeological information system: scheme of the logical structure.

[6] The data produced allows wide-ranging elaborations and analyses, e.g., the creation of: thematic plans relating to the different forms of occupation of *Regio* VII in a diachronic view (period and phase plans); reconstructive plates of both public and private monuments in their last phase of life and, where possible, in the most ancient phases.

[7] Capanna, and Carafa 2009; Capanna, and Carafa 2019; Carafa 2017; Ippoliti 2020, 25-30.

[8] Topographic Units can generally be grouped in four different types. **Context Units** are archaeological evidences — such as structures, infrastructures (roads, aqueducts, etc.), concentrations of ceramic sherds, etc.—, identifiable on the ground and having a certain geographical location. This is almost the totality of TU surveyed within the *Regio* VII. **Extracontext Units** have looser localization and a more uncertain interpretation than the previous ones; this type includes, for example, surface archaeological material identified through survey activities. This kind of TU has not yet been documented in our context of investigation. **Mobile Find Units** are objects having a very generic provenience from one context and/or building. This category includes, for example, the architectural elements repurposed in the foundations of the portico and the temple of the Sanctuary of Apollo (VII 7, 32). Finally, the **Anomaly Units**, are all the TU defined thanks to the interpretation of aerial and satellite photos or through non-destructive analysis, such as geophysical surveys (see e.g., Boschi, Rescigno 2020).

and the various buildings organized around the square of the Forum), **regions** (whether they are ancient, as in the case of the fourteen *Augustan regiones* of Rome, or conventional and modern, as in the case of Pompeii). Finally, the totality of these evidences makes up the **Site Units** (SU), which is the set of topographic units conceived in ancient times as unitary contexts. In the case of Pompeii, the only SU corresponds to the city within the walls (Fig. 3).

Identification and Dating: application of the method in the Regio *VII context*

The *Regio* VII has an extension of about 8 ha and is divided into 16 *insulae* of different sizes and functions. As is known, the central area is occupied by the Civil Forum, composed of public, commercial and cult buildings placed in close connection with the square. Two thermal complexes, the Stabian Baths and the Forum Baths, are known. In addition to the numerous *domus*, many buildings with commercial and productive functions (*tabernae*, *cauponae*, *thermopolia*, *pistrina*, etc.) have been documented (Fig. 4).

The rich Pompeian bibliography produced a conventional nomenclature for the TU that make up the *Regio* in its last phase of life, an aspect that needed to be taken into account. Therefore, during the analysis and classification of the available data, the civic numbers and previous denominations of the buildings have been preserved in the new information system.

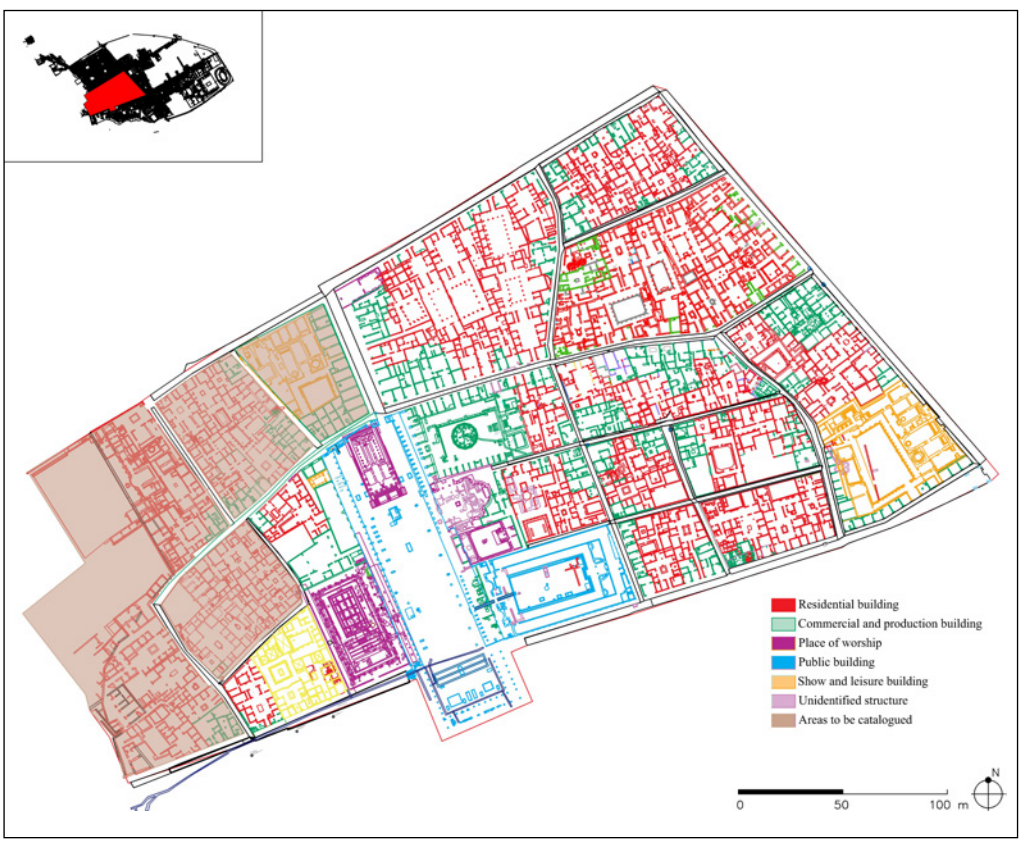

Figure 4. Pompeii, Regio *VII: the new plan in progress.*

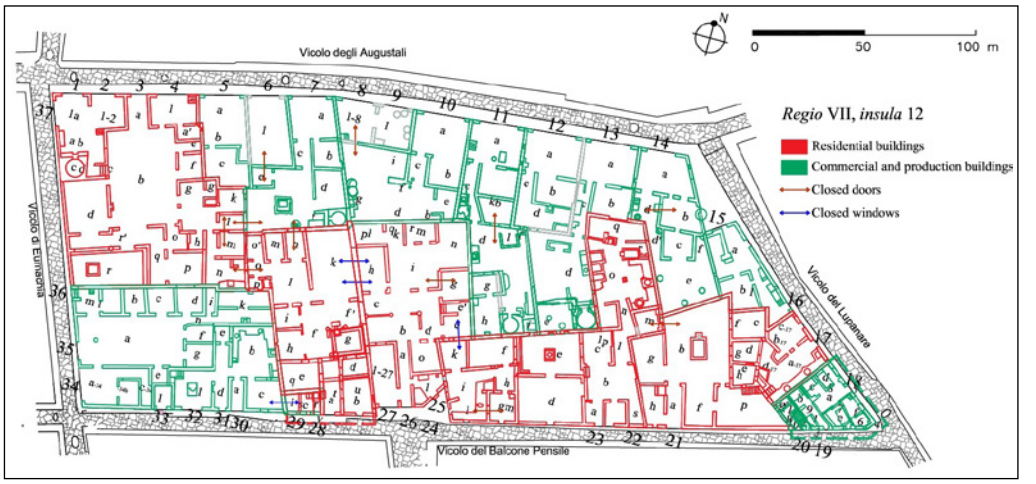

Figure 5. Pompeii, Regio *VII,* insula *12. Representation of the TUs documented in 79 C.E. with indication of the closed doors pertaining to the previous phases (Cartographic base: Morichi, Paone 2017).*

Wherever the available documentation and/or the autoptic examination (see section 3) of the structures permitted, it was possible to analyze the transformations undergone by each TU. They may consist in changes that do not alter the structure of the building, as for example: new wall and floor decorations, new architectural elements, new furnishing. Transformations might also involve more significant alterations, such as changes in the articulation and distribution of the rooms, the union or split of different residential units. An example of the former case is the *Casa di Sirico* (VII 1, 25-47), created by the union of two pre-existing houses, where recent excavations have highlighted planimetric transformations undergone in the service sector following the insertion of the *oecus* (Monteix *et al.* 2011, 308-311, fig. 95). Therefore, the rearrangement of the mosaic of information that makes up the data, allows to analytically observe all transformations undergone by the buildings and to propose a diachronic reconstruction of the different consecutive landscapes within the *Regio* VII.

This analysis results in a set of relative chronologies included between an initial dating determined by the oldest recognized element, and a final dating derived from the most recent one. The criteria used in dating may vary according to the available underlying information: stylistic dating, building technique, stratigraphic data, etc. Their explanation makes it possible to clarify the degree of reliability for the definition and dating of each TU. The examination of the stratifications that establish transformations occurred in the buildings involves sometimes the identification of further TU provided with autonomy at a time often only generically datable as prior to the last phase of life of the city.

In some cases, the absence of diagnostic elements, due to the lack of stratigraphic data or the lack of decorated surfaces, or due to datings based exclusively on the analysis of building techniques does not allow a reliable reconstruction of the chronology of certain contexts. We can cite for example the case of *insula* VII 12, for which we have only information from 19th century excavations and data from non-invasive surveys limited to some buildings.[9] In this

[9] Fiorelli 1875, 291-293; Bragantini, De Vos, and Parise Badoni 1986, 206-209; Bragantini 1997, 594-613; Hori 1992, 80-88; Hori 1993, 21; Nishida, Hori 1992; Muhlberger 2006.

Figure 6. Pompeii, Regio VII, insula 12: the facade of the Casa del Balcone Pensile (VII, 12, 28). On the left, the buffered doors of number 29 (Photogrammetry by 'Great Pompeii Project'. Topographic Referent: P VII 12 S3. Licensed by the Ministry of Culture - Archaeological Park of Pompeii: reprints or duplicates are forbidden).

portion of the city, 19 Topographic Units have been identified. They can be traced back to the last phase of the city's life (62-79 CE) (Fig. 5). For these TU it has been possible to hypothesize the presence of previous phases, but in no case the available documentation allowed us to propose a chronological partition, either absolute or relative. A significant example is the *Casa del Balcone Pensile* (VII 12, 28) linked to the building accessible from number 29. At some indefinite time that we are not able to establish, the latter loses its autonomy: the door-openings to the alley were walled and the passage connecting with the vestibule of the house was opened (Hori 1993, 21-22) (Fig. 6).

Interpretation of TUs, periodization and graphing

The step dedicated to the classification of data and identification of TU was followed by their interpretation and periodization. It should be underlined, however, that the variation in the overall quality of data makes it sometimes very difficult to define, interpret, and propose a chronological framework for the surveyed TUs.

The elaboration of a vocabulary that includes all the different types of buildings and rooms surveyed within the wide bibliographic repertoire of the city, was a fundamental step for the interpretation of the Topographic Unit. Each TU can thus be divided into functional classes (military building; administrative building; place of worship; commercial or productive building; entertainment and leisure building; dwelling; etc.) further divided according to the interpretation of each single. As an example, the class 'Commercial and Productive building' can be further specified as *caupona*, *cella*, *emporium*, *fullonica*, *hospitium*, *lupanar*, *macellum*, *mensa ponderaria*, *officina*, *pistrinum*, *taberna*, *thermopolium*, etc.[10]

[10] It is interesting to note that within the vast panorama of functional classes present in the city, a category that can be preliminarily defined as 'hybrid' stands out. This group includes buildings for which the available documentation sometimes crystallized in the definitions proposed at the time of discovery. It also includes structures with a dual commercial (and / or productive) and housing function. For such TUs, to lean towards classification (e.g., the housing rather than productive function, or vice versa) would lead to a forced interpretation. Therefore, they have been considered independently and will be subject of a specific analysis.

The association of the available data for each independent context within the urban landscape, allows to propose chronological subdivisions that correspond to transformations undergone over time, i.e., periods and phases.

TU can be divided into **periods**, i.e., the timeframe during which a building maintains its planimetric and functional system unchanged; any change to the articulation of the structure that substantially varies the planimetric organization (but not the function) implies a new period. Periods are made up of different phases. The **phases** are distinguished according to the presence of minor changes, compared to those occurred for the distinction between periods. They do not alter the planimetric system of the TU (e. g. opening / closing of doors and / or windows; changes to the decoration or the general equipment of a building). In some cases, the available documentation permits us to determine absolute chronologies for single phases.

Each information, thus recomposed, is inserted into a database created using Microsoft Access software, that consists in a series of related tables in which all the available information converges. The structure of the tables follows the cataloguing logical tree: 1) SU; 2) TU; 3) Periods; 4) Phases; 5) Rooms; 6) Data; 7) Material record; 8) Dating materials; 9) Spot-date; 10) SAS card; 11) Areas; 12) Complexes; 13) *Insulae*; 14) *Regiones*; 15) Objects (architectural elements; wall and floor decorations; sculptures and furnishings in general; inscriptions); 16) Sources (e.g., archives, bibliography, etc.).

At the same time, all the documented units are represented in a georeferenced archaeological map in a vectorial and non-symbolic way.

This activity is realized through the acquisition of every graphic representation available, from the historical plans of the buildings, to the most recently produced surveys, such as the ones representing excavation trenches positioned in the space by georeferencing the raster data. The cartographic base used is the plan made for the 'Great Pompeii Project'. Whenever TUs are made up of elements that are not visible in their entirety, the architectures have been integrated. This can be done, for example, thanks to the insertion of the missing elements represented on historical maps (Fig. 7). A good example of this phenomenon is the the NW sector of *insula* 4 damaged by the bombings during the World War II, and now partially occupied by modern buildings. The original articulation is still visible in historical plans such as the one annexed to CIL IV, vol. 1.

The integration of any existing gap in the buildings' plans can also be achieved through the specular projection of their structure (where the preserved plan suggests a symmetrical system) or through comparison with other ancient buildings that have typological and chronological affinities with the one in question (Fig. 8).

Within the database, every single layer that makes up the archaeological map (created with Autocad 2020) is provided with a unique identification code corresponding to the one used for the cataloguing of the Units surveyed within the database. The name of each layer contains all the information regarding the TU:

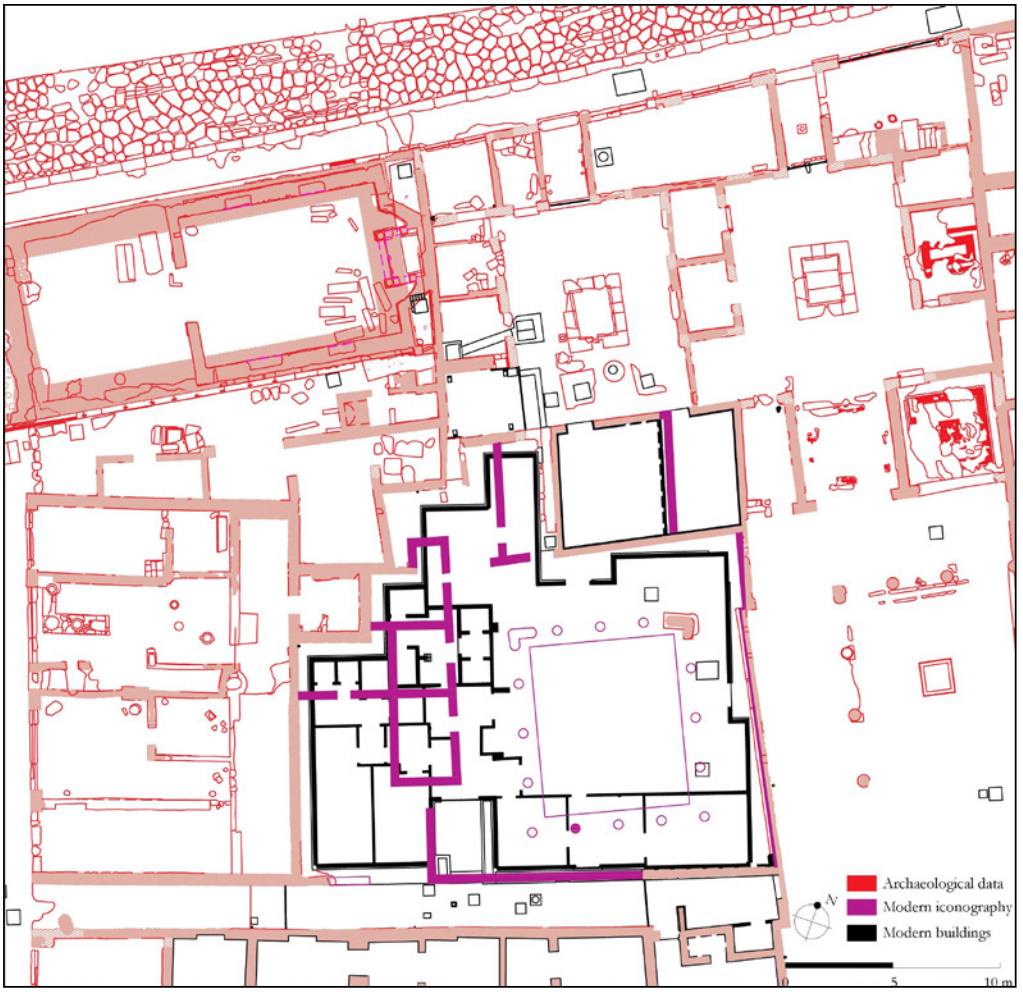

Figure 7. Pompeii, Regio *VII,* insula *4. In black the modern facilities; in purple the integration of architectures no longer visible (Cartographic base by 'Great Pompeii Project', licensed by the Ministry of Culture - Archaeological Park of Pompeii: reprints or duplicates are forbidden).*

- SU (**Pom1_**),
- *regio* and *insula* (Pom1_**VII10_**),
- street number (Pom1_VII10_**5_**),
- period or periods (Pom1_VII10_5_1_; Pom1_VII10_5_2_)
- phase or phases (Pom1_VII10_5_1_**1_**; Pom1_VII10_5_1_**2_**; Pom1_VII10_5_2_**1_**; Pom1_VII10_5_2_**2_**).

Wherever it was possible to recognize TUs different from those known in the official nomenclature, an identification code has been assigned in order to uniquely identify the building, monument or evidence (Pom1_VII10_**001_**). These cases include, for example, the fountains, the honorary bases of the *Forum* or the *tabernae* identified below the *Chalcidicum* of Eumachia.

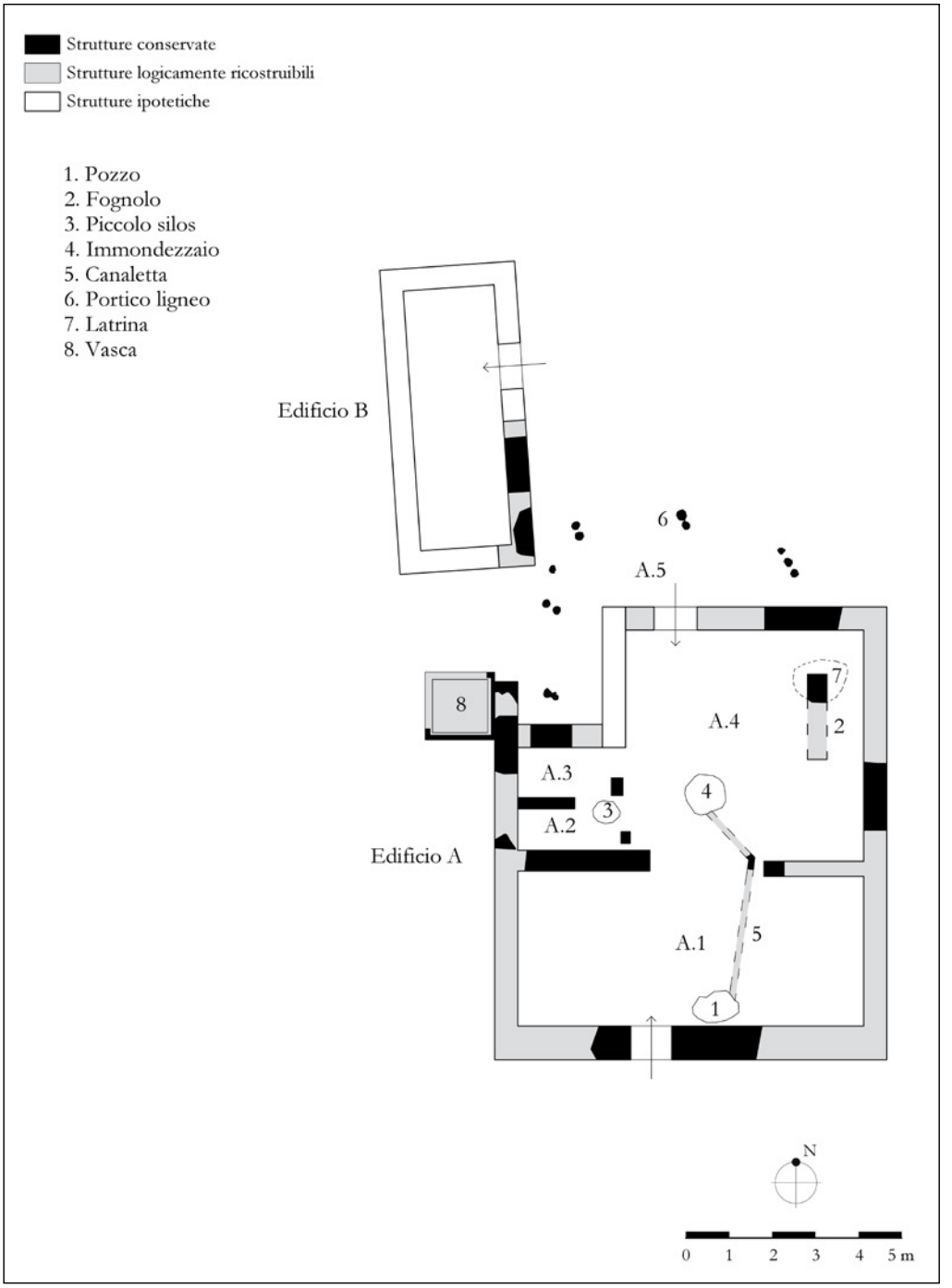

Figure 8. Pompeii, Regio *VII,* insula *9: proposal of reconstruction of the Samnite buildings found below the Casa delle Nozze di Ercole (VII, 9, 47). In black the documented structures; in gray the logically reconstructable environments; in white the hypothetical integrations (D'Alessio 2008, p. 278, Fig. 8)*

The second part of the code contains further information, such as: [11]

- current visibility[12] (Pom1_VII10_5_1_1_**NV_**; Pom1_VII10_5_2_2_**V_**);
- the state of conservation[13] (Pom1_VII10_5_2_2_V_**C_**);
- the localization[14] (Pom1_VII10_5_2_2_V_C_**c_**);
- the representation[15] (Pom1_VII10_5_2_2_V_C_c_**per_**);
- the data,[16] i.e., the information source Pom1_VII10_5_2_2_V_C_c_per_**arc**).

Figure 9. On field work: Elena Pavanello in the viridarium of the Casa delle Quadrighe (VII, 2, 26).

The same procedure is followed in the description of the various rooms that make up the TUs. In this case also, if it is possible to recognize in the internal articulation of the buildings the existence of features no longer visible or with a different extension than the one currently known, we proceed with the attribution of a new nomenclature. Finally, each layer is associated with a specific color according to the functional class to which it belongs and the type of building identified. A valid example of application of the exposed methodology to the Pompeian context can be considered the *insula* VII 10 for which there is an accurate stratigraphic analysis of the walls conducted by A. Amoroso (Amoroso 2007).[17]

The review of the documentation allowed to observe in a diachronic perspective the distribution of the eight TUs that characterize the shape of the *insula* at different time-frames, starting from the second century BCE (Fig. 9). The results obtained are summarized in the following table:

[11] Abbreviations are obtained from Italian terms.
[12] 'Visibility' is boolean value *Visible* or *Not Visible*. Building of the last phase of the city made up by still extant elements are *Visible*. *Not Visible* are, for example, the *tabernae* identified by A. Maiuri below the *Chalcidicum* of the Eumachia Building.
[13] 'State of conservation' includes three values: *Preserved*; *Destroyed*; *Unknown*. Destroyed elements or buildings that, regardless of their conservation, can be placed on a map by vectorizing data contained in historical plans.
[14] 'Localization' includes the following values: *Certain* for all TU that can be certainly positioned in space; *Uncertain* for units, whose plans do not preserve any spatial reference and cannot be georeferenced, or building that have no plan available. In the latter case, the representation is conventionally indicated by a circle, whose diameter changes according to its generic positioning (1 m) or a specific one (0.5 m).
[15] *Perimeter* is used for TU for which a georeferenced plan is available; *To be perimetered* refers to the TUs without a georeferenced plan; *Reconstructed* includes portions of a room, of a building or of an ancient context rendered through the integration of any existing gaps in the plans produced through projection or comparison with other ancient buildings.
[16] Data includes the following values: archaeological data; ancient iconography; modern iconography; literary sources, or reconstruction through comparison.
[17] The review of the documentation available for the *insula* was the subject of a recent Degree Thesis discussed by F.P. Inesi, entitled 'Le *Insulae* VII, 10 e VII, 13: due isolati di Pompei a confronto. Analisi e proposte di ricostruzione', a.y. 2020/2021.

TU	PERIOD	PHASE	DESCRIPTION	STARTING CHRONOLOGY	ENDING CHRONOLOGY
Pom1_VII10_001	1	1	*Castellum aquae*	Augustan Age	Last quarter of the 1st century CE
Pom1_VII10_1-2	1	1	*Caupona* (VII 10, 1-2)	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_3	1	1	Casa della Caccia Nuova (VII 10, 3). Hypothetical first plan of the atrium house	2nd century BCE	Sullan age
	2	1	Casa della Caccia Nuova (VII 10, 3). Atrium house with addition of peristyle and *caupona*	Sullan age	Third quarter of the 1st century CE
	3	1	Casa della Caccia Nuova (VII 10, 3). Atrium house deprived of the *caupona* and decorated with pictorial cycles in IV style.	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_4	1	1	Independent workshop (VII 10, 4)	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_5	1	1	Atrium house (VII 10, 5). Hypothetical first plan of the atrium house.	2nd century BCE	Last quarter of the 2nd century BCE
		2	Atrium house (VII 10, 5) with wall and floor in Ist style.	Last quarter of the 2nd century BCE	Sullan age
	2	1	Atrium house (VII 10, 5) with the addition of peristyle.	Sullan age	Augustan Age
		2	Atrium house (VII 10, 5) with new rooms SO of the peristyle and new wall in IIIrd style.	Augustan Age	Third quarter of the 1st century CE
	3	1	Atrium house (VII 10, 5) with displacement of the impluvium, downsizing of the atrium and addition of a *officina lanifricaria* on the back.	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_6	1	1	Independent workshop (VII 10, 6),	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_7	1	1	Unidentified building (VII 10, 7)	Augustan Age	Last quarter of the 1st century CE
	2	2	Unidentified building (VII 10, 7) with the addition of a small room and latrine	Third quarter of the 1st century CE	Last quarter of the 1st century CE
Pom1_VII10_9-12	1	1	*Hospitium* with production/ commercial and receptive area.	Augustan Age	Third quarter of the 1st century CE
	2	2	*Hospitium* with changes in the receptive part.	Third quarter of the 1st century CE	Last quarter of the 1st century CE

Hitherto, the examination of the published documentation brought to the identification of 364 TUs distributed in the *insulae* 1, 3, 7, 8, 9, 10, 11, 12, 13 and 14, included in a timeframe that goes from the Iron Age up to the post-eruption spoliation activities. The analysis of the remaining *insulae* is still ongoing.

(R.B.)

Field activities

Targets

Field activities are aimed at carrying out a systematic stratigraphic analysis relating to any archaeological evidence within the *Regio* VII of Pompeii. The acquired data are then integrated with the published data relating to the Stratigraphic Units that are no longer visible today.[18] These activities are focused on the identification of diachronic sequences, based not on the observation of similarities or discontinuities in the use of building materials or building techniques, but on the accurate reading of the stratigraphic relationships between different structures.
This will allow us to meet several targets:

1) in a synchronic context, the understanding of the development and the procedure of the construction sites, through the analysis of the stratigraphic relationships between structures referable to the same phase;
2) in terms of relative chronology, the identification of the periods and phases attested on a regional scale: more in detail, the identification of the constructive circumstances in which there has been a change in the morphology of the floor plan, elevations or decorations of a building, made through the correct recognition of the negative Stratigraphic Units (whether they are cuts, shaving of walls, obliterations);
3) the identification of any urban arrangement differing from the one preserved today, and previous to it, through the analysis on a regional scale; thus, proposing new hypotheses on the evolution of the urban shape of Pompeii;
4) the proposal of a hypothesis of absolute chronology for the phases and periods identified through the integration of the relative stratigraphic sequence with dating elements, based, wherever possible, on excavation's stratigraphic data, or on the style of the decorations, or on other elements of indirect dating;
5) finally, the identified stratigraphic sequences will make it possible to propose new absolute chronologies for the construction techniques attested in *Regio* VII of Pompeii.

On-field methodology

The methodology used is based on the identification of the individual Stratigraphic Unit (SU), whether they are masonry, decorative or negative units. A unique identification number is assigned to each SU, linked to the annotation in a digital register and a descriptive file. By analyzing the stratigraphic relationships, a unitary stratigraphic diagram is drawn up for each of the sixteen blocks that make up the *Regio* VII. The SU are then represented in a comprehensive georeferenced plan, in vector format obtained in a CAD software environment.

[18] See sections 2.2 – 2.3.

Figure 10: Pompeii, Regio *VII,* insula *4, plan: different colors refer to the identified relative chronology sequence (Cartographic base by 'Great Pompeii Project', licensed by the Ministry of Culture - Archaeological Park of Pompeii: reprints or duplicates are forbidden. Elaboration by V. Bruni).*

In the plan thus created, each SU has its own layer, whose name corresponds to the SU number: this allows an easy link between the digital register, the descriptive cards and the graphic data (Fig. 10).

In addition, a specific description is dedicated to the Masonry Stratigraphic Units (MSU): they are defined by each identifiable structural element, or, within each of them, by each different documented construction technique.[19] Through the use of a digital database,

[19] The structural elements are distinguished according to the following list: cavity, sub-foundation, foundation, wall, architrave, flat arch, arch, jamb, pillar, column, half-column, buttress, substructure, covering, roof, road.

each MSU is described in relation to the masonry equipment (material constituting the structure, distinguished, when possible, in material of the core and of the facing, indications on cutting, measurement and installation of the elements), according to the descriptive parameters provided by the Atlas of Roman Building Techniques 'ACoR' ;[20] the original and / or conservation measures of the monument (thickness, length, height); further descriptive details (for example, possible presence of ashlar, *anathyrosis*, chromatic effects, brick stamps, etc.).

Since the beginning of our activities, the field-work of data-collection and the following analysis procedures have been facilitated by the use of a large amount of graphic documentation made available by the Archaeological Park of Pompeii. In particular, this documentation consists of general plans and orthophotos (Fig. 6-7).

The general plans represent all the archaeological evidence visible today, on a 1:1 scale and georeferenced. The evidence is divided into layers that identify the elements based on the type of unit (ancient structures, either sectioned or projected; modern structures; plasters; other elements, such as floors, roads, objects). The plans are accompanied by a dense network of absolute altitudes, positioned on ancient and modern walking levels. Furthermore, the drawings of structures of the wall are filled with different hatches, which generically indicate the construction techniques documented at the height of the plan cut.

These plans allow to:

1. have an overall image, preliminary to the field work, of the existing MSU and of the building techniques;
2. have a punctual, updated, georeferenced survey of the archaeological evidence available, to operate on without the need for new measurements on our part;
3. have the possibility to integrate and convert our work into other projects of the scientific community, given the complete compatibility of the graphic data.

The orthophotos of the walls, in 1:1 scale, allow to:

1. quickly verify the data acquired in the field;
2. obtain precise measurements of single elements;
3. have high resolution graphic documentation available to illustrate stratigraphic relationships, building techniques, or any other detail of interest.

Accomplished outcome

To facilitate the procedure, the data collection work has been divided into the sixteen *insulae* that make up the *Regio* VII. Field operations started in blocks 2 and 4.[21] In particular, in *insula* 2, 1900 MSU have been identified and numbered, corresponding to the structures located at house numbers 1-53. The MSU were entered into the digital register and represented in

[20] https://acor.huma-num.fr/.

[21] In *insula* 2, field work has been conducted by Dr. Rosy Bianco and Dr. Elena Pavanello. The latter is entrusted with the computerization and management of the collected data. In *insula* 4, field work has been conducted by Dr. Sara Bossi and Dr. Valerio Bruni. The latter is entrusted with the computerization and management of the collected data.

plan, in vector format. For the part of the *insula* already analyzed, the preserved stratigraphic relationships were recognized and a partial stratigraphic diagram was compiled.

In *insula* 4, however, the work is at a more advanced stage (Fig. 10): all the existing MSU have been identified and numbered, for a total of 1239 MSU; they have been represented graphically in plan, each in its own vector layer. The MSU were then entered into the digital register, along with the description of the structural element of pertinence, the function and the original and / or current conservation measures. An analysis of the preserved and visible stratigraphic relationships was performed, and the general stratigraphic diagram relating to the structures of the *insula* was drawn up.

Next progress of the work

In the next fieldwork campaign, the acquisition of data relating to the MSU of *insula* 2 will be completed: consequently, the digital register will be compiled and the stratigraphic diagram of the structures will be accomplished. In *insula* 4, on the other hand, the data relating to the Stratigraphic Decorative Units and the Negative Stratigraphic Units will be acquired, which will be then included in the general stratigraphic sequence of the block already drawn up. At the end of this operation, it will be possible to recognize the periods and construction phases still visible: the relative sequence thus obtained will be linked to elements of absolute dating, also coming from the published data, which will allow to propose chronologies for the different recognized phases. Finally, these will be described graphically through the drafting of phase plans and analyzed from a constructive and urban planning point of view.

(S.B.)

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Preliminary zooarchaeological analysis of the Phoenice and Butrint excavations (2021 campaign)

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Abstract

The recent archaeological excavation of the Butrint and Phoenice sites in south Albania allows to restart the zooarchaeological analysis. In these samples, the faunal remains have a high level of identification, and their taphonomic conditions show many cut marks. This preliminary zooarchaeological analysis of the Chaonia region show two very similar economies, where the breeding of the main domestic species is followed by a reasonable hunting activity. These preliminary considerations could be useful to environmental study of Epirote area, but also to improve the recovery protocol of these remains together with collaboration of the archaeologists.

Keywords

Zooarchaeology, Phoenice, Butrint, faunal remains, environmental study.

Introduction

As part of the 2021 archaeological excavation campaign of Butrint and Phoenice (Southern Albania) conducted by the University of Bologna and the Institute of Archaeology in Tirana (Fig.1),[1] a new zooarchaeological analysis has been conducted on some of the excavated contexts.[2]

The faunal remains of the excavations in Phoenice from 2015 to 2019 have been found in sectors A5, A11, A20, A23, C4 and in few tombs in sector A5 too. Moreover, the faunal remains coming from the 2021 excavation in Butrint, from Areas 4, 5, 6, and 7, have been studied as well.[3]

At the site of Phoenice 1483 osteological remains have been studied in total, and in Butrint 781 remains were analysed. These faunal remains showed a high rate of identification possibly due to some sort of involuntary selection carried by operators while collecting or in some phases of the recovery strategy. For this reason, statistical and quantitative analysis have been limited at this preliminary stage.[4]

The taphonomic condition of all these faunal remains shows many marks on the surface of the bones, which could be referred both to butchery marks and to gnawing mostly associated to carnivores like dogs. Only very few remains show bite marks by rodents, whereas traces of exposure to burning are completely absent.

[1] Thanks to Professors Enrico Giorgi, Giuseppe Lepore, and Belisa Muka for this study opportunity, together with all the collaborators of the archaeological mission. Furthermore, thanks to Professor Antonio Curci for all his help and for teaching me many things on the field work and in the publication phases.

[2] For previous studies at the site see Curci 2005; 2005b; 2007.

[3] Osteological remains collected from Phoenice during campaigns carried from 2006 to 2014 and in 2021 and those from Butrint unearthed in 2019 have not been examined yet.

[4] These preliminary considerations could be useful to evaluate future strategies and the recovery protocol with the collaboration of archaeologists.

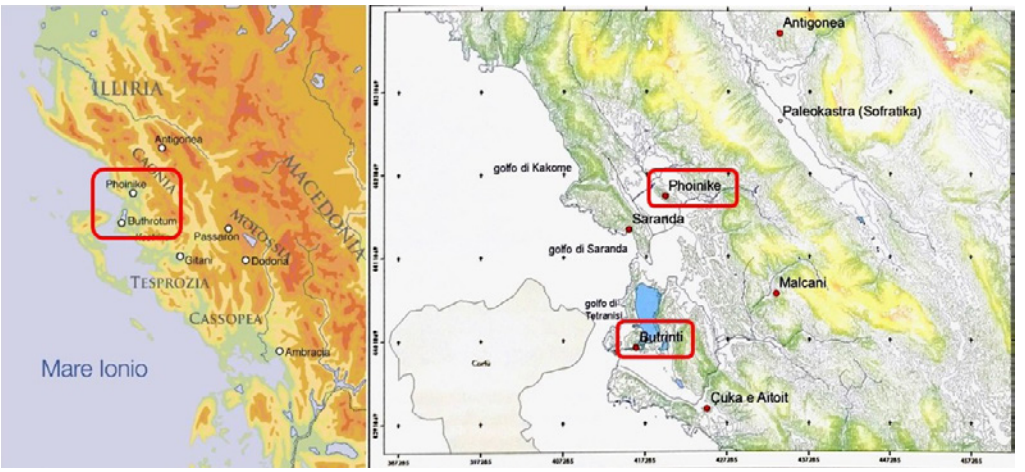

Figure 1. Location of the sites of Phoenice and Butrint. After Giorgi 2017, 2-3, Figure1-2.

Methodology

The zooarchaeological analysis involved a preliminary count of determined osteological remains as well as undetermined ones, filing the resulting data into a specific database file in MS Excel 2019©. When the identification of bones or species was not possible, only the animal size was taken into account. Therefore, these indeterminate remains have been divided into three groups, including vertebrae, ribs and various elements: large, medium and small sized, excessively fragmentary bones for which even original size was not possible to ascertain.

The number of identified species (NISP) has been uploaded on a specific database in MS Access 2019© with additional data, like laterality, preserved part, age of death and sex when available.

After data coming from all the excavated area will be combined on this database, it will allow to obtain results like minimum number of individuals (MNI), as in the case study of Phoenice, although larger samples are necessary to infer more properly on the kill-off patterns economy through every chronological phase of the contexts.

The case study of Butrint allowed to start the zooarchaeological analysis almost simultaneously with the archaeological excavation. As a consequence, the data were filed on the Excel form only, although it has already delivered some information during the excavation. In this case study the faunal remains have not been washed before the preliminary count, allowing to recover more fragments of bones and optimising activities and time during the excavation. Successively, all the determined remains will have to be washed carefully and filed in the Access database, where all data will be elaborated like previously mentioned.

At this initial stage, the anatomic identification of these remains has been carried out by adopting atlases only (Schmid 1972, Barone 1976, Wilkens 2002), since no reference collection was available for consultation at the time. Therefore, in the future some remains will have to be verified, for example through osteometry or biometrical indexes analysis.

Phoenice

The faunal sample of Phoenice shows the level of identification with 703 NISP equal at 47% (Tab. 1, Fig. 2). Many of the analysed remains come from the area of the upper town, A11, which is still under excavation (Fig. 3). For this reason, the NISP count here should be regarded as preliminary pending a more detailed analysis further on. At the moment, the zooarchaeological analysis brings attention on the other areas, which have been completely excavated and where the fauna has been already analysed.

In Area 23 a basilica belonging to an episcopal complex has been unearthed together with an acceptable amount of faunal remains. The chronological sequence of this area dates back to the 5th century CE when the basilica was built on the Hellenistic ruins, being at last abandoned around the 16th century following multiple construction activities.

Area 5 is the district of the Hellenistic *Stoà* and a small square church dating to the 7th century CE, which was abandoned in the 16th century CE. Few faunal remains have been found in this area, which can be added to the ones from the tombs in the same area and dating back to the Late Antique and Middle Ages (Cirelli, Podini 2018, 235-247).

Table 1. Table of NISP and MNI for

PHOENICE	A5				A23			
	NISP	NISP%	MNI	MNI%	NISP	NISP%	MNI	MNI%
Domestic								
Pig - *Sus domesticus*	15	32.6%	4	31%	39	24.8%	8	33%
Sheep/Goat - *Ovis vel Capra*	12	26.1%	4	31%	22	14.0%	5	21%
Cattle - *Bos taurus*	12	26.1%	1	8%	79	50.3%	4	17%
Dog - *Canis familiaris*	1	2.2%	1	8%	1	0.6%	1	4%
Equid - *Equus* sp.	0	0%			0	0%		
Donkey - *Equus asinus*	4	8.7%	1	8%	2	1.3%	1	4%
Wild								
Red deer - *Cervus elaphus*	0	0%			7	4.5%	1	4%
Fallow deer - *Dama dama*	0	0%			1	0.6%	1	4%
Roe deer - *Capreolus capreolus*	1	2.2%	1	8%	0	0%		
Wild boar - *Sus scrofa*	0	0%			3	1.9%	1	4%
Rabbit or Hare - *Leporidae*	0	0%			2	1.3%	1	4%
Fox - *Vulpes vulpes*	0	0%			0	0%		
Bird Ind. - *Aves*					1	6%	1	4%
Pond turtle - *Emys* sp.	0	0%			0	0%		
Tortoise - *Testudo* sp.	1	2.2%	1	8%	0	0%		
Determined Remains	**46**	100%	**13**	100%	**157**	100%	**24**	100%

Moreover, Area C4 contains a Hellenistic residence named the 'House of paintings' dating to 3rd-2nd centuries BCE. Many faunal remains have been found in this house, especially in rooms C2, A1 and D (Gorica 2015, 43-46). Finally, Area 20 represents a small trench excavated within the bath complex of the Late Antique phase, from where the quantity of faunal remains sampled is too small for the zooarchaeological analysis.

As usual, in these samples the domestic species are more abundant. Sheep and goats *(Ovis vel Capra)* with the pigs *(Sus domesticus)* are the more common species, followed by cattle *(Bos taurus)*, whereas there are few remains of equids *(Equus* sp.), dogs *(Canis familiaris)* and domestic fowls *(Gallus gallus)*. In the same sample, there are some wild species probably associated to hunting activities and high numbers of shells suggesting molluscs picking.

In the areas where the excavations were completed, it was possible to estimate the MNI for wild and domestic species. In area A23 the NISP shows a preference for cattle remains followed by pigs and then sheep and goats, while the MNI estimate shows that pigs are more frequent than sheep and goats, as well as cattle.

Pigs are attested by 8 individuals: 2 males older than 4 years old, 2 adults between 2-4 years, with one male and one female, 3 sub-adults between 1-2 years old and a juvenile individual

the analysed areas in PH15-PH19.

C4				A11		A20		Burials		TOTAL	
NISP	**NISP%**	**MNI**	**MNI%**	**NISP**	**NISP%**	**NISP**	**NISP%**	**NISP**	**NISP%**	**NISP**	**NISP%**
31	26.5%	5	25%	108	35.0%	3	43%	4	33.3%	**200**	30.9%
51	43.6%	7	35%	129	41.7%	2	29%	6	50.0%	**222**	34.3%
19	16.2%	3	15%	41	13.3%	0	0%	1	8.3%	**152**	23.5%
0	0%			2	0.6%	0	0%	0	0%	**4**	0.6%
0	0%			2	0.6%	0	0%	0	0%	**2**	0.3%
0	0%			0	0%	0	0%	0	0%	**6**	0.9%
11	9.4%	2	10%	5	1.6%	0	0%	1	8.3%	**24**	3.7%
1	0.9%	1	5%	0	0%	0	0%	0	0%	**2**	0.3%
0	0%			2	0.6%	0	0%	0	0%	**3**	0.5%
2	1.7%	1	5%	0	0%	0	0%	0	0%	**5**	0.8%
0	0%			4	1.3%	0	0%	0	0%	**6**	0.9%
0	0%			1	0.3%	0	0%	0	0%	**1**	0.2%
2	1.7%	1	5%	12	3.9%	2	29%	0	0%	**17**	2.6%
0	0%			1	0.3%	0	0%	0	0%	**1**	0.2%
0	0%			2	0.6%	0	0%	0	0%	**3**	0.5%
117	100%	**20**	100%	**309**	100%	**7**	100%	**12**	100%	**648**	100%

Table 1 continued. Table of NISP and

PHOENICE	A5				A23			
	NISP	**NISP%**	**MNI**	**MNI%**	**NISP**	**NISP%**	**MNI**	**MNI%**
INDETERMINATE REMAINS Small-Medium Sized								
vertebra	2	2.5%			2	1.3%		
rib	5	6.3%			16	10.5%		
various remains	21	26.6%			33	21.7%		
INDETERMINATE REMAINS Large Sized								
vertebra								
rib	3	3.8%			12	7.9%		
various remains	21	26.6%			57	37.5%		
INDETERMINATE REMAINS Undetermined Sized	27	34.2%			32	21.1%		
Indeterminate Remains	**79**	100%			**152**	100%		
Mollusc								
Shell Ind. - *Mollusca*								
Common cockle - *Cerastoderma* sp.					10	67%	10	67%
Saltwater clam - *Glycymeris* sp.								
Mussel - *Mytilus* sp.								
Flat oyster - *Ostrea edulis*								
Scallop - *Pecten jacobaeus*								
Thorny oyster - *Spondylus gaederopus*	1	13%	1	13%	3	20%	3	20%
Veneridae	1	13%	1	13%				
Spiny dye-murex - *Bolinus brandaris*					1	7%	1	7%
Murex trunculus - *Hexaplex trunculus*	4	50%	4	50%				
Spindle snails - *Tarantinaea lignaria*					1	7%	1	7%
Helicidae	1	13%	1	13%				
Pomatias elegans	1	13%	1	13%				
Mollusc	**8**	100%	**8**	100%	**15**	100%	**15**	**100%**
Total determined	54	41%			172	53%		
Total undetermined	79	59%			152	47%		
TOTAL	**133**	100%			**324**	100%		

MNI for the analysed areas in PH15-PH19.

C4				A11		A20		Burials		TOTAL	
NISP	**NISP%**	**MNI**	**MNI%**	**NISP**	**NISP%**	**NISP**	**NISP%**	**NISP**	**NISP%**	**NISP**	**NISP%**
2	1.5%			12	2.9%					**18**	2.3%
22	16.4%			103	25.2%			1	20%	**147**	18.8%
39	29.1%			88	21.5%					**181**	23.2%
3	2.2%			13	3.2%					**16**	2.1%
9	6.7%			32	7.8%	1	100%	1	20%	**58**	7.4%
33	24.6%			44	10.8%			2	40%	**157**	20.1%
26	19.4%			117	28.6%			1	20%	**203**	26.0%
134	100%			**409**	100%	**1**	100%	**5**	100%	**780**	100%
				1	5%					**1**	1.8%
1	17%	1	17%	9	43%					**20**	36.4%
				1	5%					**1**	1.8%
						2	50%			**2**	3.6%
				1	5%					**1**	1.8%
				1	5%					**1**	1.8%
				3	14%	1	25%			**8**	14.5%
1	17%	1	17%	1	5%					**3**	5.5%
										1	1.8%
4	67%	4	67%	3	14%	1	25%	1	100%	**13**	23.6%
										1	1.8%
				1	5%					**2**	3.6%
										1	1.8%
6	100%	**6**	100%	**21**	100%	**4%**	100%	**1**	100%	**55%**	100%
123	48%			330	45%	11	92%	13	72%	**703**	47%
134	52%			409	55%	1	8%	5	28%	**780**	53%
257	100%			**739**	100%	**12**	100%	**18**	100%	**1483**	100%

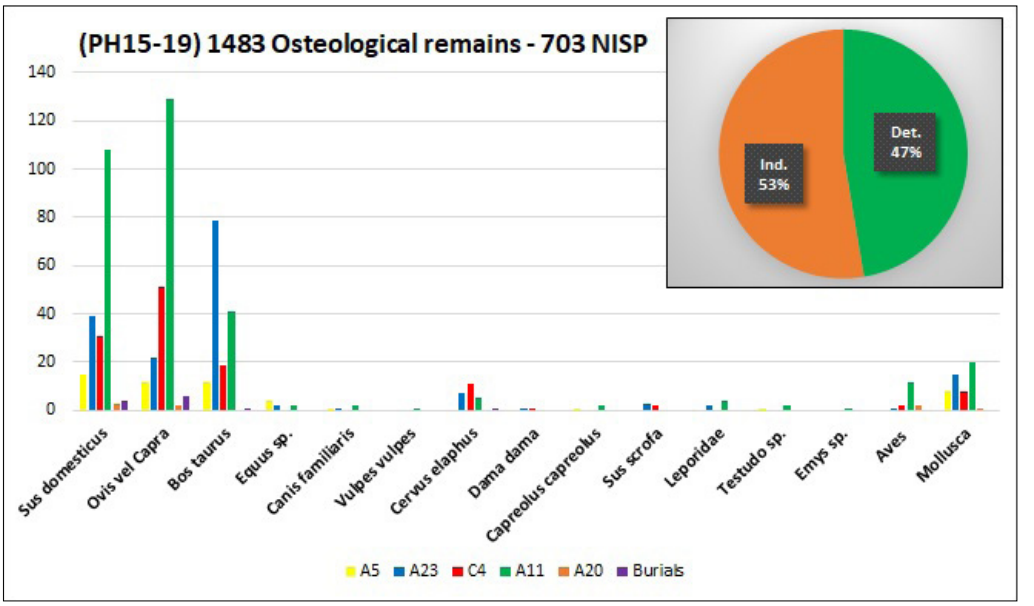

Figure 2. Pie chart with the rate of identification (%) of all the osteological remains, and bar chart of NISP sorted by excavated areas during 2015-2019 archaeological seasons (PH15-PH19)

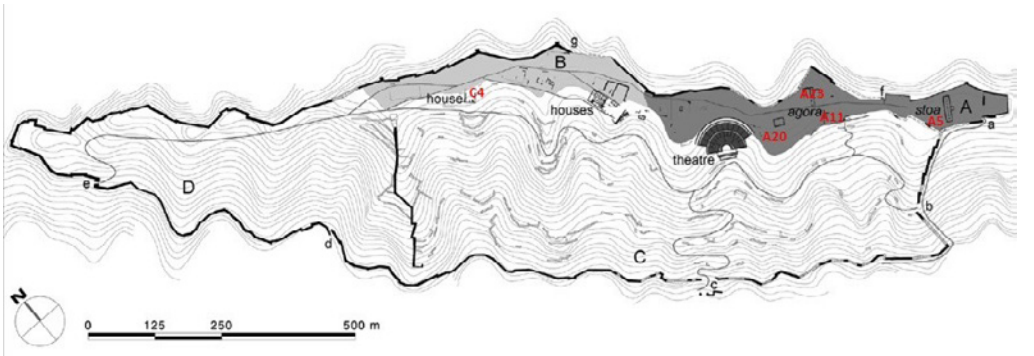

Figure 3. Map of Phoenice with analysed areas. After Giorgi, Lepore 2020, 155, Figure 2.

between 4-6 months old.[5] Five individuals of sheep and goats were estimated: an adult goat between 4-6 years old, another one between 3-4 years old, 2 sub-adult goats between 1-2 years old and one sub-adult sheep.[6] The criteria used to distinguish between sheep and

[5] The age of death of pigs was estimated following Barone 1976 and Silver 1969 for the fused epiphyses of long bones, whereas as for teeth by adopting Grant 1982 and Bull and Payne 1982. The age stages of pigs used here are: Newborn less of 4 months old, Juvenile between 4-7 months old, Young between 7-12 months old, Sub-adult between 12-16 months and 17-24 months old, Adult between 2-4 years old and Adult-Senile more of 4 years old.

[6] The age of death of sheep and goats was estimated following Silver 1969 for the fused epiphyses of long bones, whereas Payne's criteria were used for tooth wear (1973). The age stages of sheep and goat used here are: Newborn between 0-2 months old, Juvenile between 2-6 months old, Young between 6-12 months old, Sub-adult between 1-2 years old, Adult between 2-3 years old, Adult between 3-4 years old, Adult between 4-6 years old, Adult-Senile between 6-8 years and Senile between 8-10 years old.

goats follow those suggested in literature.[7] Cattle are attested by only 4 individuals: an adult between 4-8 years old, another adult between 3-4 years old and 2 sub-adults between 18-30 months old.[8]

In area A5 the NISP amounted to a few pieces for each species, while the MNI estimated 4 individuals for pigs, sheep and goats too, and only one cattle. Pigs include: an adult of more than 4 years old, an adult between 2-4 years old, a sub-adult between 12-24 months old and a young between 7-12 months old. The sheep and goats are: a young between 6-12 months old, a sub-adult between 1-2 years old, an adult between 4-6 years old and an adult between 3-4 years old, which could also be a sheep. The identified cattle was an adult between 4-8 years old. This count of MNI stays unaltered, even adding the few remains from the tombs of area A5. These faunal remains are not food offering to the dead, but they are intrusive elements in the soil of the burial, which came from some destruction or reworked contexts.

The estimate of NISP and MNI in area C4 of the Hellenistic house shows more sheep and goats than pigs and cattle. The sheep and goats are 7 individuals: a juvenile goat between 2-6 months old, a sub-adult sheep and a sub-adult goat between 1-2 years old, 2 adult sheep and 2 adult goats, which one between 3-4 years old and another between 2-3 years old. The identified pigs are 5: an adult of more than 4 years old, a female adult between 2-4 years old, 2 sub-adults between 12-24 months old, and a young between 7-12 months old. On the other hand, cattle are 3 individuals: an adult of more than 4 years old, a sub-adult between 18-30 months old and a juvenile between 5-6 months old.

Some preliminary osteometry information allow to have a first estimate of the height at withers:[9] sheep is tall 65 cm circa based a metacarpal bone, whereas the goat is tall 62 cm approximately on other metacarpal[10] (Tab. 3). Moreover, goats show two types of horns, the first linear and the second twisted, whereas only one horn of sheep was found. The withers height of pigs was estimated between the 66 and 78 cm, based on two metapodials.[11] These ones look significantly smaller in size than two others from which it has been estimated a wither's height between 97 and 104 cm, reasonably associable to wild boars. In addition, the lower canine teeth show a dimensional gap between two species, for example the breadth of root is 2,5 cm in the wild boar and 1,6-1,8 cm in the pigs (Fig. 4). Although a proper distinction between wild boar and pig is possible only in adult individuals, whereas it is hard to accomplish as for young individuals or for crossbreeding.

There is not much information for the cattle, because their remains were very fragmented due to butchery. Nevertheless, the measured overall length of an almost complete radio would suggest an individual with withers height of more than 113 cm.[12] Moreover, there was a very

[7] Bossneck et al. 1964, Bossneck 1969 Prummel, Frisch 1986 and Halstead et al. 2002.
[8] The age of death of cattle was estimated following Silver (1969) for the fused epiphyses of long bones, whereas Grant's criteria were used for tooth wear (1982). The age stages of cattle used here are: Newborn with less of 5 months old, Juvenile between 5-6 months old, Young between 6-18 months, Sub-Adult between 18-24 months and 24-30 months old, Adult between 3-4 years old, Adult between 4-8 years old and Senile more of 8 years old.
[9] The element's measurements follow the Von der Driesch 's criteria (1976).
[10] The coefficients used for goats come after Schramm 1967, while the ones for sheep come after Teichert 1973.
[11] The coefficients used come after Teichert 1966-69.
[12] The coefficients used come after Matolcsi 1970.

Figure 4. Difference in Lower male canine teeth of wild boar and pigs.

Figure 5. Smoothed cattle astragalus.

interesting astragalus with a smooth edge found in room C2 of the 'House of paintings' in area C4 (Fig. 5).

These objects are quite known in literature and they may have been employed for playing or as payment, but also as religious symbols (Curci 2005,63-65; 2007, 110-117; De Grossi, Minniti 2013; Holmgren 2004). This smoothy astragalus is important because it is the only exemplar found in a residential area, whereas other known astragalus came from the necropolis.

Dog remains are few in the sample and we cannot estimate their physical features or the MNI. Although, there is no trace of these remains inside the 'House of paintings' those would be the first ones identified within the residential area of the upper town, because in the previous study they were only attested in the necropolis (Curci 2007, 112-113).

The equid remains are few and always identified as an adult individual, probably a donkey, because the osteometrical data are very similar to the donkey of the tomb no. 27 of the necropolis (Curci 2005, 109-112).

In the archaeological sample, NISP count shows that between the wild species more frequently occur are the red deer (*Cervus elaphus*) then the wild boar (*Sus scrofa*). The deer prefers living in woods with clearings, whereas the wild boar can live in the bush very well. About the deer remains, there are no fragments of antlers but only metapodials and a few fragments of radius, scapula, tibia and femur. All these remains show a lot of butchery marks: the occurrence of a metapodial and phalanges can prove the existence of a butchery area nearby, because these remains have little alimentary relevance (Fig. 6). The estimate of the MNI of these wild species of area A23 shows an adult deer individual older than 3 and half years old, based on the fused

epiphysis of distal radius,[13] and a wild boar of more than 4 years old, estimated by lower canine tooth. In area C4 the presence of two deer have been estimated on the basis of two left astragali, whereas the remains of wild boar belonging to an adult individual of more than 2 years old was estimated on two metacarpals.[14]

Figure 6. the second phalanx of a red deer with cut-marks.

The few remains of the fallow deer (*Dama dama*) and the roe deer (*Capreolus capreolus*) have also been preliminarily identified: to the former would belong a phalange and one fragment of metacarpal, whereas the roe deer was identified by a fragment of distal tibia and two scapulas. The fallow deer lives in an environment of woods with clearing, whereas the roe deer can adapt to live in the bush very well and near areas occupied by humans.

The distal radius of the fox (*Vulpes vulpes*) will require a further check with a reference collection, because it is the first time the species has been identified at the site of Phoenice. In addition, some fragments of radius, scapula, and tibia have been attributed to an indistinguishable rabbit or hare (Leporidae). Moreover, fragments of badger (*Meles meles*) found in the 'House of two peristyle' will need too more verification. A few elements belonging to reptiles have also been determined, assigned in particular to few remains of pond (*Emys* sp.) and land tortoise (*Testudo* sp.).[15]

As regards birds, many remains have been attributed to domestic fowls. Though a small coracoid was provisionally attributed to a wild species of the galliformes order, by morphology and size would look compatible with a rock partridge (*Alectoris graeca*). Instead, a large-sized wing phalange has furthermore been collected but not yet determined.

The archaeomalacology analysis has been important for this case study, because at the moment it is the only information available about the marine resources.[16] The identified species and family are as follows:[17]

Marine Bivalve

- *Cerastoderma* sp.*
- *Glycymeris* sp.
- *Mytilus* sp.
- *Ostrea edulis**

[13] The age stages used here for fused epiphyses of long bones were estimated following Mariezkurrena 1983.
[14] These metacarpals were mentioned above to estimate the withers height.
[15] The pond tortoise was attested in the 'House of two peristyle'.
[16] Molluscs can describe the environment and depth of sea, lagoon, and river, but they can also deliver information about people's food habits.
[17] Taxa in the list marked with the asterisk were identified also in previous analyses; in our sample, though, there are lacking at all elements assigned to Naticidae and Patellidae, unearthed instead in the 'House of two Peristyles'; See Curci 2005, 63-64.

Figure 7. Specimen of Spondylus gaederopus found in the site of Phoenice.

- *Pecten jacobaeus*
- *Spondylus gaederopus*
- Veneridae*

Marine Gastropod
- *Bolinus brandaris*
- *Hexaplex trunculus**
- *Tarantinaea lignaria*

Terrestrial Gastropod
- Helicidae*
- *Pomatias elegans*

The main species found in the site used as food is the common cockle (*Cerastoderma* sp.) followed by the thorny oysters (*Spondylus gaederopus*), which has a big relevance for the alimentation, since it tastes like oysters[18] (Fig. 7) There were not worked pieces of these shells on the site, therefore this shell was not used as ornament but only as food. Moreover, these molluscs were picked by diving down to a depth between 2-30 meters on the rocky seabed.

Belonging to the Muricidae family are attested the murex trunculus (*Hexaplex trunculus*) and the spiny dye-murex (*Bolinus brandaris*), both commonly associated to the dyeing process. The murexes were consumed also for food, so its presence does not automatically suggest purple

[18] Today this mollusc is no more attested in the sea of Albania, because its population has been decreasing in all the Mediterranean area during the last 80 years for unknown reasons. However, the populations of spiny oysters were attested in the Lower Adriatic, Aegean and around Tunisia (Micheli 2015, 198-210).

dye extraction. Moreover, the structures for smashing and macerate these molluscs have not been found in Phoenice yet. Another marine gastropod found in the site was a spindle snail (*Tarantinaea lignaria*), whereas among the marine bivalves there were some species of the Veneridae family, flat oysters (*Ostrea edulis*), mussels (*Mytilus* sp.), a fragment of saltwater clam (*Glycymeris* sp.) and other fragment of scallop (*Pecten jacobaeus*).[19]

The few terrestrial gastropods found in the excavated layers were supposed to be intrusive during the process of natural accumulation. Nevertheless, these types of snails of the Helicidae family are edible, whereas the specie *Pomatias elegans* is not edible and describe an arid environment with dry leaves on the ground (Wilkens 2002, Girod 2015).

Butrint

The faunal sample of the Butrint shows the level of identification with 452 NISP equal at 57% (Tab. 2, Fig. 8). These remains come from the layers excavated during 2021, located on the central plateau of the Acropolis area near the western perimetral wall, which has different phases of construction, going from the Archaic to the Medieval period. The Italian-Albanian mission has excavated in this area since 2019. During the last campaign, two trenches have been opened in the filling (*emplekton*) of the polygonal Archaic wall and two other few meters to the North, where some medieval structures built above a Roman complex were found (Giorgi 2018; 2022; Giorgi, Lepore 2020; Giorgi, Lepore, Gamberini 2020). The analysed faunal remains come from these four investigated areas. The first two areas to the North are dated to the Medieval and to the Roman-Hellenistic period, while those ones near the polygonal wall are dated to the Archaic period (Fig. 9).

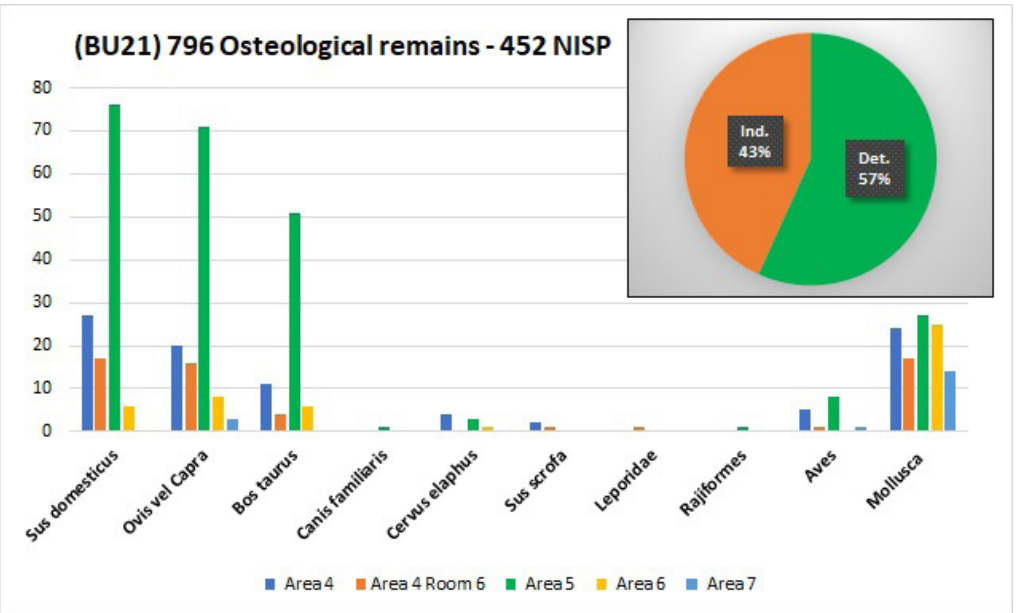

Figure 8. Pie chart with the rate of identification (%) of all the osteological remains, and bar chart of NISP for excavated areas during 2021 archaeological season (BU21).

[19] In the medieval age this shell had a symbolic role too, because it was a distinctive pilgrim's object (Girod 2015, 56-57).

At a first glance these faunal remains seem to come from layers of collapse or abandonment containing heterogeneous materials. In this sample, the highest NISP came from Areas 4 and 5. On the other hand, only few faunal remains were found in Areas 6 and 7, since previous excavations had exposed the upper layers of this stratigraphic sequence.

A preliminary chronological framework of faunal remains within Area 4 has been dated to the Roman period. In the so-called Room VI[20] located in this same area, many faunal remains come from the Roman layers, while a small quantity was found in SU 434 dating to the Hellenistic period provisionally. In Area 5 the faunal remains come from the Medieval layers, except for a few ones, which have been excluded since they have been collected in upper and rather unreliable contexts. While a lot of shells have been found within preserved Archaic layers of Areas 6 and 7 mainly.[21] This sample shows that the NISP of pig is the most attested, followed

Table 2. Table of NISP and MNI

BUTRINT	**Area 4**		**Area 4 Room 6**	
	Roman Phase		Ellenistic and Roman Phases	
	NISP	**NISP%**	**NISP**	**NISP%**
Domestic				
Pig - *Sus domesticus*	27	39.1%	17	42.5%
Sheep/Goat - *Ovis vel Capra*	20	29.0%	16	40.0%
Cattle - *Bos taurus*	11	15.9%	4	10.0%
Dog - *Canis familiaris*	0	0%	0	0%
Wild				
Red deer - *Cervus elaphus*	4	5.8%	0	0%
Wild boar - *Sus scrofa*	2	2.9%	1	2.5%
Rabbit or Hare - *Leporidae*	0	0%	1	2.5%
Bird Ind. - *Aves*	4	5.8%	1	2.5%
Passerine - *Passeriformes*				
Domestic fowl - *Gallus gallus*	1	1.4%		
Ray - *Rajiformes*				
Determined Remains	**69**	100%	**40**	100%
INDETERMINATE REMAINS Small-Midium Sized				
vertebra	3	3.7%	3	4.5%
rib	11	13.4%	20	30.3%
various remains	28	34.1%	20	30.3%
INDETERMINATE REMAINS Large Sized				
vertebra			1	1.5%
rib	7	8.5%	1	1.5%
various remains	8	9.8%	8	12.1%

[20] See the Butrint's Foundation plan in Greenslade, Leppard, Logue 2013, 55, tab. 4.6.

[21] Thanks to Federica Carbotti for her help and the elaboration of these stratigraphy data, which allowed this preliminary zooarchaeological analysis.

by sheep and goats, and then cattle. Regarding other domestic species just one element could be assigned to dog, whereas the equid remains were not found yet.

At Butrint there were wild animals like red deer, wild boar, and hare. In the sample no traces of deer antlers have been recognized, but only its osteological remains. On the other hand the remains of wild boar were found in stratigraphy of Area 4 and Room VI. In the latter, it was also found a fragment of pelvis belonging to a lagomorph, but its poor condition does not allow to distinguish if it belonged to a rabbit or a hare. Among the birds found in the sample, there are some remains of domestic fowls, but in the Archaic stratigraphy of perimetral wall a small humerus was found also, which has been tentatively attributed to a no specified passerine (*Passeriformes*). Currently, as for the previous case study of Phoenice, information about fishing is not available yet due to the difficulty in recovering these small and fragile

for the analysed areas in BU21.

Area 5			**Area 6**		**Area 7**		**TOTAL**	
Medieval Phase		Upper Layers	Archaic Phase	Upper Layers	Archaic Phase	Upper Layers		
NISP	**NISP%**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP%**
65	39.9%	11	1	5	0	0	**126**	36.5%
50	30.7%	21	1	7	3	0	**118**	34.2%
38	23.3%	13	0	6	0	0	**72**	20.9%
1	0.6%	0	0	0	0	0	**1**	0.3%
3	1.8%	0	1	0	0	0	**8**	2.3%
0	0%	0	0	0	0	0	**3**	0.9%
0	0%	0	0	0	0	0	**1**	0.3%
3	1.8%	1	0	0	0	0	**9**	2.6%
0	0%	0%	0	0	1	0	**1**	0.3%
3	1.8%	1	0	0	0	0	**5**	1.4%
0	0%	1	0	0	0	0	**1**	0.3%
163	100%	**45**	**3**	**18**	**4**	**0**	**345**	100%
19	14.0%	3	2				**30**	8.7%
13	9.6%	7		4		1	**56**	16.3%
42	30.9%	10	1	4			**105**	30.5%
2	1.5%						**3**	0.9%
14	10.3%	2					**24**	7.0%
21	15.4%	7		3		2	**49**	14.2%

Table 2. Table of NISP and MNI

BUTRINT	Area 4		Area 4 Room 6	
	Roman Phase		Ellenistic and Roman Phases	
	NISP	**NISP%**	**NISP**	**NISP%**
INDETERMINATE REMAINS Undetermined Sized	25	30.5%	13	19.7%
Indeterminate Remains	**82**	100%	**66**	100%
Others				
Shell Ind. - *Mollusca*	1	4.2%		
Thorny oyster - *Spondylus gaederopus*	2	8.3%		
Flat oyster - *Ostrea edulis*			1	5.9%
Mussel - *Mytilus* sp.	2	8.3%		
Common cockle - *Cerastoderma* sp.	10	41.7%	4	23.5%
Veneridae	1	4.2%	1	5.9%
Spiny dye-murex - *Bolinus brandaris*	1	4.2%	1	5.9%
Murex trunculus - *Hexaplex trunculus*	7	29.2%	6	35.3%
Ceriths snail - *Cerithium* sp.			1	5.9%
Limpet - *Patella* sp.				
Toothed topshell - *Trochidae*			1	5.9%
Helicidae				
Poiretia sp.			2	11.8%
Freshwater mussel - *Unio sp.*				
Total Mollusc	**24**	100%	**17**	100%
Total determined	93	53%	57	46%
Total undetermined	82	47%	66	54%
TOTAL	175	100%	123	100%

remains. However, a sample of soil collected in Room VI located in Area 4, even though not studied yet, has showed the presence of some fish and micromammal remains.[22] In addition, in the superficial layer of Area 5 the caudal spine of a ray-like species (*Rajiformes*) has been preliminarily identified.

To sum up, all these preliminary data still have to be checked against through MNI and others analyses. Moreover, the sample needs a bigger quantitative of faunal remains to submit reliable statistical data about the chronological sequence of the site.

In this case study, the archaeomalacology analysis allowed to gather important data on the exploitation of water sources (Fig. 10). A lot of these shells have been unearthed in a dumping fill disposed inside room VI in area 4 during the abandonment process. The great number of shells found among the stone-rich infill of the *emplekton* are the main source of faunal information

[22] New procedures for the recovery of such remains are going to be implemented for future analysis.

for the analysed areas in BU21.

	Area 5			Area 6		Area 7		TOTAL	
	Medieval Phase		Upper Layers	Archaic Phase	Upper Layers	Archaic Phase	Upper Layers		
	NISP	**NISP%**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP%**
	25	18.4%	7	2		5		**77**	22.4%
	136	100%	**36**	**5**	**11**	**5**	**3**	**344**	100%
	1	4.3%				2		**4**	3.7%
			1					**3**	2.8%
								1	0.9%
	4	17.4%		5		8		**19**	17.8%
	4	17.4%		2	6	1		**27**	25.2%
								2	1.9%
			1					**3**	2.8%
	6	26.1%		3	2		1	**25**	23.4%
	4	17.4%	1		1			**7**	6.5%
			1					**1**	0.9%
	3	13.0%						**4**	3.7%
	1	4.3%		2	1			**4**	3.7%
				1		2		**5**	4.7%
					2			**2**	1.9%
	23	100%	**4**	**13**	**12**	**13**	**1**	**107**	**100%**
	186	58%	49	16	30	17	1	**452**	57%
	136	42%	36	5	11	5	3	**344**	43%
	322	100%	85	21	41	22	4	**796**	100%

for the Archaic period, since their structure composed by calcium carbonate allows a better preservation than other organic remains. The identified species and family are:

Marine Bivalve

- *Cerastoderma* sp.*
- Veneridae*
- *Ostrea edulis*
- *Mytilus* sp.*
- *Spondylus gaederopus**

Marine Gastropod

- *Bolinus brandaris*
- *Hexaplex trunculus**
- *Patella* sp.
- *Cerithium* sp.*
- *Monodonta* sp.*

Table 3. Table of measurements and height at withers at Phoenice site.

Species	Area	Osteologic element	Side	GL	Measures	Coeffi-cient	Height at withers
Capra hircus	A11	Metacarpal	dx	109,3	Bp:23,7 Dp:16,6 SD:17,4 Bd:27,1	5.75	62,8 cm
Ovis aries	A11	Metacarpal	dx	133	Bp:20,8 Dp:19,7 SD:11,5 Bd:23,9	4.89	65 cm
Sus domesticus	A11	Metatarsal 3rd	sx	71,6	Bd:14,6	9.34	66,8 cm
Sus domesticus	A5	Metacarpal 4th	sx	74,9	Bp:14,3 Bd:15,6 SD:11,5	10.53	78,8 cm
Sus scrofa	C4	Metacarpal 3rd	dx	92,9	Bp:22,2 Bd:21,6 SD:17,6	10.72	99,5 cm
Sus scrofa	C4	Metacarpal 4th	sx	99,2	Bp:21,8 Bd:21,8 SD:16,8	10.53	104,4 cm
Sus scrofa	A23	Calcaneum	sx	104,1	GB:27,3	9.34	97,2 cm
Bos taurus	A23	Radius	sx	(265)		4.3	(113) cm

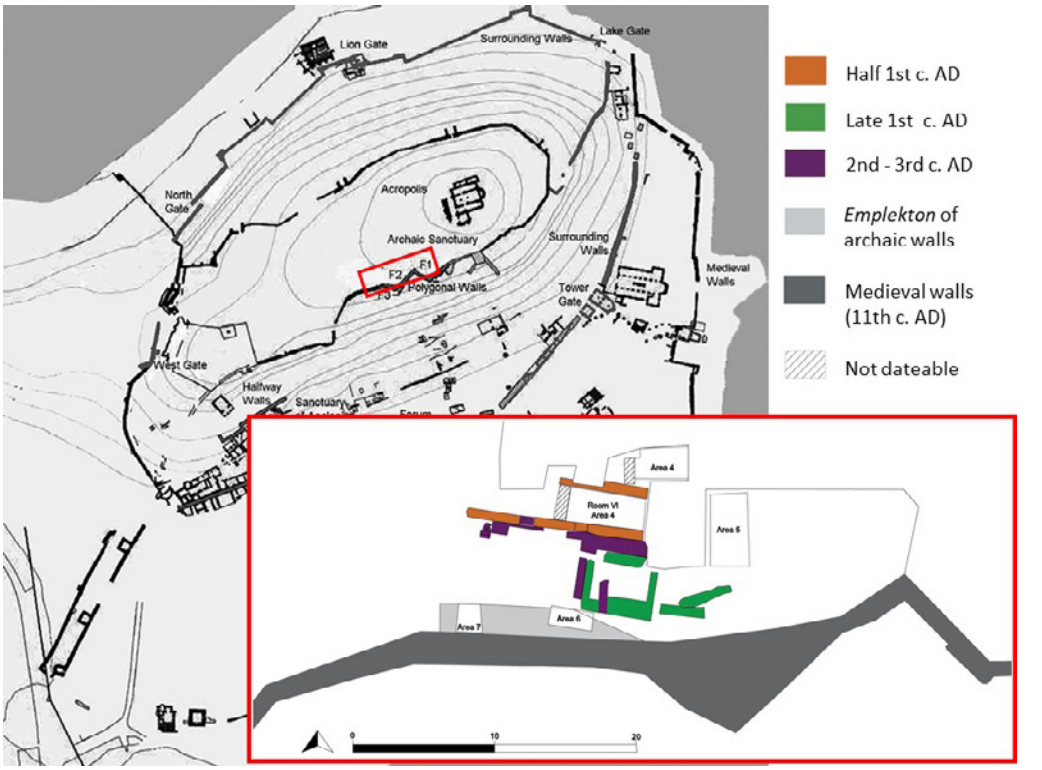

Figure 9. Map of Butrint with analysed areas, elaborated by Federica Carbotti. The colors are same used at the map by Butrint Foundation (Greenslade Greenslade, Leppard, Logue 2013).

Figure 10. Some sea shells from Butrint.

Terrestrial Gastropod
- Helicidae
- *Pioretia* sp.

Freshwater Bivalve
- *Unio* sp.

The presence of the same species found at Phoenice would suggest a similar activity of marine shell picking taking place at both sites, where their supply areas had the same environmental features. The exception are the ceriths snail (*Cerithium* sp.) and the toothed topshell (*Monodonta* sp.), which have not been found at Phoenice, but they had already been found during the Forum excavation (Hernandez 2017, 223-224). The toothed topshell prefers rocky seashore, where it can hide among the meadows of *Posidonia oceanica*. Instead, the ceriths snail prefers low rocky seashore or sandy seabed with a lot of detritus. Their spiral shape can suggest an ornamental use, but these molluscs have also a small alimentary purpose.

For what concerns land snails, some individuals of the Helicidae family, which prefer wet and shaded habitats, were identified in the site. These terrestrial gastropods are edible, but their occurrence at the site could also be due to a natural intrusion during the accumulation phases of the layer. On the other hand, other land snail species (*Poiretia* sp.)[23] are not edible,

[23] In the Epirus area, the genus *Poiretia* of family Spiraxidae is attested with three species: *Poiretia compressa, Poiretia*

hinting at the surrounding environmental features during the accumulation phases of the layer, consisting of wooded environment with dead leaves on the ground. However, this snail has also been collected in the oldest phases near the perimetral wall and in Area 4. Finally, in the upper layer of Area 6 a freshwater mussel (*Unio* sp.)[24] was found for the first time. This mollusc lives in ponds or weak flowing rivers with muddy riverbed. In antiquity they were used for alimentary purpose and for craftworks exploiting its internal mother-of-pearl surface (Wilkens 2002; Girod 2015).

Final considerations

This zooarchaeological analysis relative to the 2021 archaeological campaign intends to offer a preliminary glance to the animal exploitation in the investigated Epirote area: more detailed analysis and larger samples will be of course necessary to piece together a more accurate picture on its role in the local economy.

These two sites of Chaonia region have relied on apparently very similar economies, where the breeding of animals, like pigs, cattle, sheep and goats, seems to have been the chief practice to obtain animal-based resources. Moreover, according to the MNI estimated from the site of Phoinike, it is possible to suppose that pig represented the more frequently exploited domestic species during Late Antiquity. On the contrary, in the older periods sheep and goats were preferred than other domestic species.

Beside breeding, hunting had also a substantial importance at these sites, being practiced on large and small extensive woodlands and clearings. For what concerns the birds, domestic fowls were the most common, while few wild species were hunted infrequently. Such frequencies look pretty consistent with those collected in the Thesprotia district (Niskanen 2009, 145-154; Deckwirth 2011, 297-309).

On the other hand, we do not have any information about fishing, which was probably very influential at the Butrint site thanks to its strategic position at close range to sea, river and lagoon. However, some preliminary information came from the archaeomalacological analysis. These shells describe two different kind of water sources and environments, and also two different modalities of mollusc picking practice:

- The former is a marine environment represented by a rocky intertidal zone between low and medium depth, featuring meadows of *Posidonia oceanica*, where target of shells collection might have been species like: *Hexaplex trunculus*, *Spondylus gaederopus, Cerithium* genus *Poiretia, Monodonta* genus *Poiretia* and *Patella* genus *Poiretia.*
- The second type is a lagoon environment, with sandy or muddy seabed, in such context the mainly picked species is *Cerastoderma Posidonia oceanica*, which might have been the primary mollusc for food purpose. This species populates the lagoon environment abundantly and they can be picked up during low tide, as well as with trawling nets. In this habitat it might occur also the *Mytilus* sp. and the *Ostrea edulis*, which prefer water with low salinity. Since there is no trace indicating they might have been the result of

cornea, Poiretia delesserti (Welter-Schultes 2012).

[24] Cfr. *Unio elongatulus*

farming, they seem to have been picked up fortuitously, even if it depends largely on the quantitative samples studied.[25]

Finally, some rare attestation of species like: *Bolinus brandaris, Pecten jacobaeus, Glycymeris* sp. and Veneridae family, which prefer a sandy and soft seabed, therefore they can come from a small environment of Epirus or a different seashore.

In conclusion, the amount of osteological remains investigated at the two sites is rather different, making an accurate comparison between the two faunal samples difficult. However, data appear encouraging and, in the future, they will be integrated by useful information gathered from soil samples, which will increase the quality of the data and improve the statistical power of the survey.

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Geomatics and Ancient Architecture: the study of Villa San Marco and the Baths of *Stabiae*

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Abstract

In recent decades, archaeological research has increasingly made use of geomatic techniques to document ancient spaces and sites. The topographical research carried out in 2018 by the University of Bologna at Villa San Marco and the adjacent thermal complex in Castellammare di Stabia adopted the terrestrial laser scanner technology. It allowed the restitution of a three-dimensional model for an in-depth study of the architectural structure of the building and its construction phases, as well as the production of an updated planimetry of both complexes and wall elevation orthophotos useful for understanding the conservation status of the monument. This study is part of the 'Piano della Conoscenza di *Stabiae*', a project for the recovery and enhancement of Stabia's archaeological heritage coordinated by the Archaeological Park of Pompeii in collaboration with various Italian and foreign university institutes, based on the model of the Great Pompeii Project.

Keywords

Stabia, laser scanner, vesuvian archaeology, topographical survey, legacy data

Introduction

Villa San Marco (Fig. 1) is situated on the north-western ridge of the Varano hill in the town of Castellammare di Stabia (NA), where, from the second quarter of the 1st century BCE until the beginning of the 1st century CE, five other villas were built. All these buildings belong to the architectural typology of the *otium* villas, which allowed the owners to enjoy a privileged and breath-taking view of the Gulf of Naples (Guidobaldi 2018, 436).

The first explorations of the villa, which takes its name from a nearby chapel present there in the 18th century (Bonifacio, Sodo 2001, 31), can be attributed to the excavations of the Bourbon period, ca. 1750-1754. The excavation journals and news about these explorations, as well as drawings of the objects and plans of the structures, were published by M. Ruggiero (1881). After, it was buried in 1762 and it was brought to light again in the 1950s by Libero d'Orsi (1997).

In 1980, the Villa was severely damaged by a massive earthquake in Campania. A major restoration project was carried out by a French-Italian team led by Alix Barbet and Paola Miniero (Barbet 1999, 13).

The restorations allowed the team of scholars to deepen their knowledge on the architectural history of the building and to identify the main construction techniques, as well as a relative chronology of the interventions that modified the original architectural layout.

Figure 1. Castellammare di Stabia, Villa San Marco. Aerial view of the ancient complexes (from Google Earth)

The Villa and Baths

Architecturally, it is possible to divide the villa into six large sectors having different functions (Bonifacio, Sodo 2001, 32) (Fig. 2), for a total extension of about 11.900 m^2:

1. an atrium [44], around which a series of rooms developed, including kitchens;
2. a thermal facility, the central focus of which is a large *calidarium* [29] and a small tetrastyle atrium [25];
3. two large peristyles [1-2; 3-5-20] one of which with a large garden (9), *nymphaeum* and *natatio* [15-64];
4. a series of rooms distributed around the peristyle with *natatio* [3-5-20];
5. a porticoed courtyard[1] situated on the north of the atrium [44] around which various service areas developed, including two latrines and spaces generally identified as servants' quarters (Ruffo 2009).
6. three recently discovered rooms [83-84-85] located on the south of the perimeter wall of the upper peristyle [1-2] facing a portico with cratic columns [90], still to be fully excavated.[2]

[1] The sector, already excavated in the Bourbon epoch, was only brought to light in 2008 thanks to a stratigraphic excavation carried out by the Soprintendenza Archeologica di Pompei and further investigated by a team from Columbia University in New York between 2011 and 2016.

[2] The rooms were identified in 2002 using geophysical techniques carried out by the University of Birmingham in collaboration with the RAS and the Soprintendenza Archeologica di Pompei. The first excavation operations, which took place during spring 2006, brought to light the previously unidentified southern arm of the upper portico and the upper part of the walls of these rooms. In September 2020, a team from the University of Campania 'Luigi Vanvitelli', coordinated by Prof. Carlo Rescigno, resumed excavations in the area, bringing to light the entire battery of rooms and the portico; for the 2006 excavations see Bonifacio 2007, for the more recent ones the preliminary results are in press; Rescigno, Silani forthcoming.

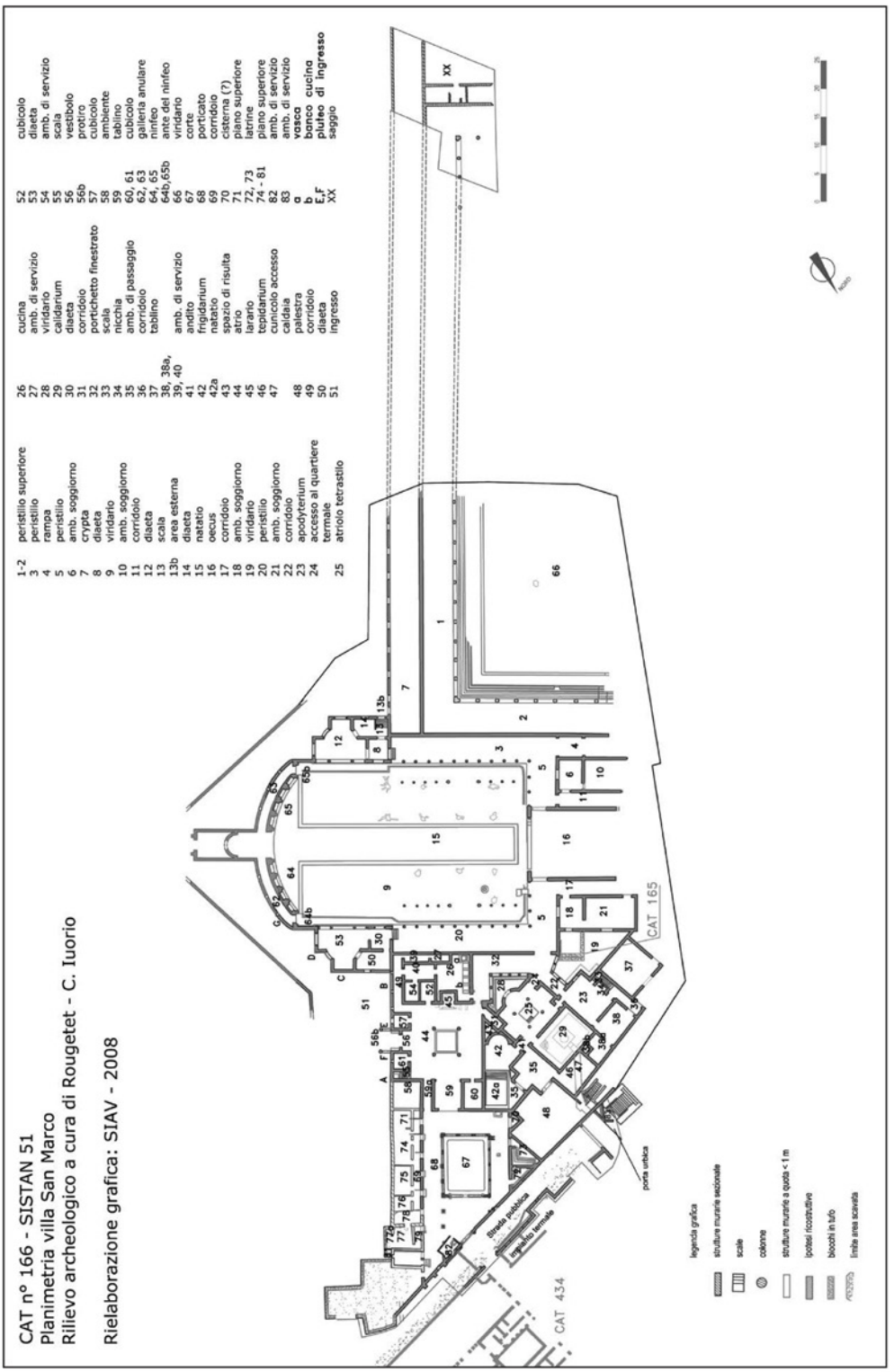

Figure 2. Castellammare di Stabia, Villa San Marco. Arrangement of the rooms (Guidobaldi 2018, 450).

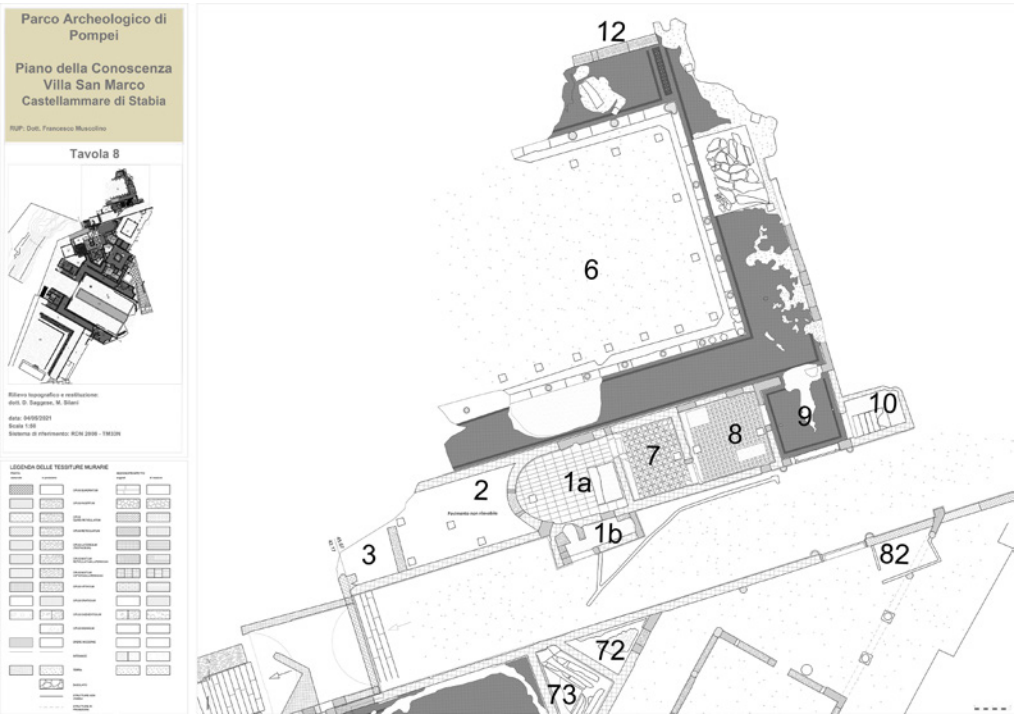

Figure 3. Castellammare di Stabia. The thermal complex (author's elaboration).

Near Villa San Marco, on the north of the so-called 'strada di breccia', there is a thermal complex (Fig. 3) already explored in the 18th century, but partially uncovered in 2009 as part of a project to reorganise the sea-front entrance to the Villa, which was strongly supported by the Soprintendenza (Ruffo 2010; Saggese forthcoming).

The excavation concerned only the south-western sector of the building, corresponding to a small thermal complex, articulated in the classical succession of *apodyterium-frigidarium*, *tepidarium*, *calidarium*, and a rhodium-type (Ruffo 2010, 224-225, for the hypothesis of a U-shaped portico see Esposito 2012, 151) peristyle-gymnasium (Fig. 4). Its eastern arm communicated through openings with a part of the complex still buried but whose planimetric configuration is known thanks to the drawings of Karl Weber (Fig. 5), responsible for the graphic documentation of the 18th century excavation campaigns.

Both buildings were entirely decorated with frescoes in the IV style, except for the rooms 39 and 27 of the kitchens of the Villa San Marco, which present pictorial fragments in the III style, evidence of a building phase antecedent to the one covered by the complex at the time of the 79 AD eruption and seem to share the same chronology in the definition of the building interventions.[3]

[3] For new hypotheses on the relationships between the two buildings, see Esposito 2012, 151-160 and Saggese forthcoming.

Figure 4. Castellammare di Stabia, thermal complex. View from the south corner of the peristyle-gymnasium (from Esposito 2012, 150).

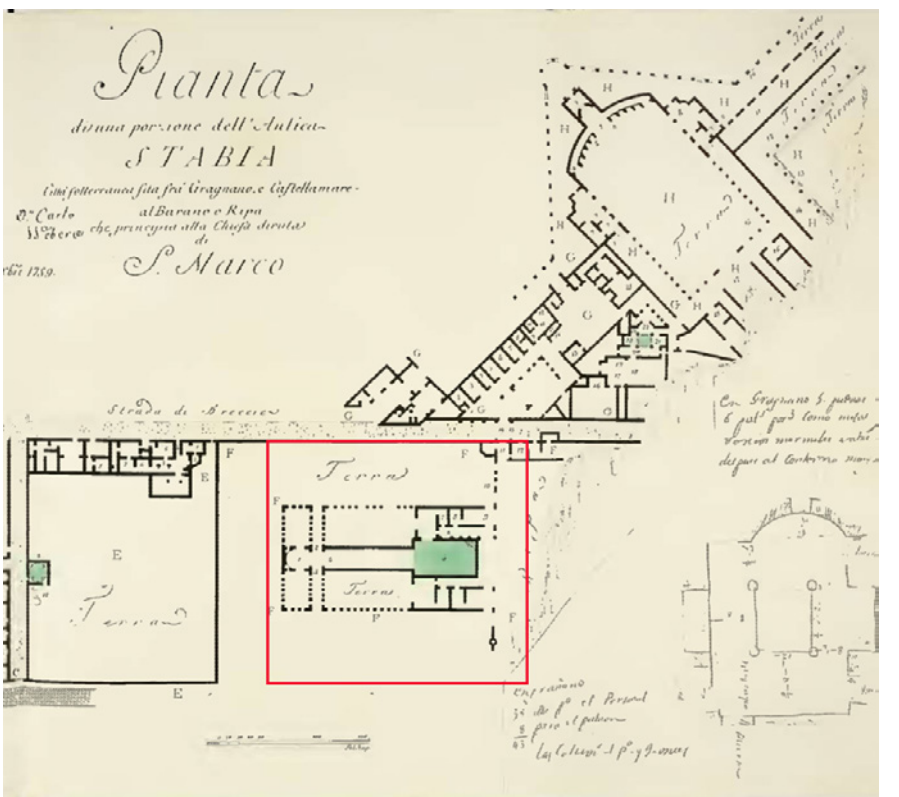

Figure 5. Stabiae. *Excerpt from Karl Weber's plan. In red the building investigated in the 18th century (author's re-elaboration from Ruggiero 1881, Tav. I, 184).*

The presence of paintings on almost all the masonry of the buildings, despite the fact that in several cases the state of conservation of the frescoes is not well preserved, concurred to complicate and to partially interpret the construction techniques used to build the wall textures of the two complexes.

The stratigraphic analysis of the walls carried out in the 1980s on the Villa San Marco revealed the use of three different (Rougetet 1999, 44) building techniques:

1. *Opus reticulatum*;
2. *Opus vittatum:* this was used exclusively for the framing of the columns of the atria and peristyles, which were then covered with stucco;
3. *Opus mixtum: opus mixtum* is, together with *opus reticulatum*, the most commonly used technique for walling. In his analysis, Jacques Rougetet distinguished three different techniques of *opus mixtum*, based on the different sizes of the tufa. The first typology, with regularly arranged 9x9 cm tufa tiles, can be seen in the atrium [44] and in the wall [25/22]; the second, with regularly arranged 7x9 cm tufa tiles, was found in the gymnasium [48] and in the wall [35/48]. The third, with regular 9x11 and 12x12 cm tufa tiles associated in verticals with irregularly arranged tufa tiles varying between 10 and 25 cm in width, is found in the masonry that had greater load-bearing capacities, as in the case of the walls of the hall 16 and those of the portico [3-5-20].

In addition to these three techniques, *opus craticium* was used exclusively in the masonry of the *cella hostiaria* [82], discovered during the 2008 excavations (Ruffo 2009, 253), in the columns of the portico [90] and in the partitions of the rooms [83-84-85].

In the thermal sector, beyond the 'strada di breccia', irregular *opus reticulatum* with tufa slabs of dimension between 8 and 11 cm is prevalently used for the entrance and the stairwell, while for the thermal rooms a *opus mixtum* consisting of yellow and grey tufa pillars of around 20x10 cm alternating with irregular reticulation of 8x10 cm (Ruffo 2010, 200).

The survey of buildings

The survey of the building was carried out in three phases, using different and integrated techniques: topographical and architectural survey using laser scanners; photographic and photogrammetric documentation; acquisition of information on possible buried evidence using georadar (Ground Penetrating Radar) surveys.[4]

The topographic survey of the complexes was carried out with the aid of a Leica P30 Laser Scanner (Fig. 6), a 'time-of-flight' laser scanner particularly suitable for the archaeological survey of buildings with complex architecture, which makes it possible to maintain a high quality point cloud in density, precision, and resolution over a range of distances from 0.3 to 120 m thanks to the hybrid technology known as Wave Form Digitizer (WFD), which combines 'time-of-flight' technology with the advantages of 'phase difference' technology.[5] In order to

[4] Thanks to prof. Enrico Giorgi and dr. Michele Silani for the opportunity given to the author to be able to take part in this project, which merged into the Specialization thesis discussed in 2019, for the precious advice given to me during the drafting of the text and for the trust placed in me in over the years.

[5] https://abtech.cc/wp-content/uploads/2017/04/Leica_ScanStation_P-Series_details_that_matter_wp_en.pdf. For a detail on Wave Form Digitezer technology see https://leica-geosystems.com/about-us/content-features/wave-

Figure 6. Csatellammare di Stabia. Villa San Marco. Leica P30 laser scanner being acquired (photo by the author).

Figure 7. Castellammare di Stabia, Villa San Marco. Data acquisition in autoresection mode (photo by the author).

create an overall point cloud for both monuments, 394 scans had to be made, with an average scan step set at 6.3 mm x 10 m (Saggese 2021, 17). The data was acquired using two different methods. The first, autoresection (Fig. 7), applies the topographic principle of forward intersection, which identifies of the position of the gripping station knowing the planimetric disposition of two other points, by measuring the horizontal angles formed by the conjunction of the known points with the directions going to the unknown point (Capra, Dubbini 2009, 83-84). In this specific case, the known points were measured by positioning two targets within a local framing network and subsequently georeferenced with Leica GS18 GPS. The method described allows the pre-registration of point clouds already in the phase of data acquisition and is widely used in the archaeological and engineering fields for outdoor environments and areas. This method was used in most of the environments of Villa San Marco (Saggese 2021, 18). The second method, on the other hand, consists in the free acquisition of the scans without the use of reference targets (Fig. 8). In this case, the point clouds are aligned at a later stage, during the data processing phase.

For the photographic and photogrammetric documentation it was decided to use an external support to the laser scanner, although the Leica P30 is equipped with an internal camera with HDR technology with three acquisition steps per shot,[6] in order to obtain a photographic result of higher resolution. These photographs would not be affected by the chromatic distortions caused by the different lighting conditions and relative exposure of the object to be surveyed at the time of data acquisition and which could be calibrated manually in colorimetric terms. For the occasion, a 42 mpx Sony Alpha 7R *full-frame* mirrorless digital camera was chosen, mounted on a panoramic tripod, Nodal Ninja, which allows the centre of the external camera to be positioned in the same instrumental centre as the laser scanner; the support, which can rotate 360° on the horizontal axis around its pivot, allowed the acquisition of a spherical image that can be perfectly superimposed on the point cloud acquired from each scan. Depending on the focal length used (16 mm) and the size of each single frame (10,000x5,000 px), holding the sensor in a vertical position, sixteen shots in RAW format were taken on the horizontal axis with two different degrees of inclination on the vertical axis (eight shots at +50° and eight shots at -15°) for the composition of the final spherical image.[7]

For the mapping of the buried evidence, the georadar instrumentation of the DiSCi Geophysics and Remote Sensing Laboratory was used, i.e. an IDS RIS Hi-Mod 1 georadar equipped with a 600-200 MHz dual frequency antenna.[8] The investigations focused on the ground area on the north-east of the Villa and on the upper peristyle [1-2] with its adjoining *viridarium* [66]. Regular grids were prepared for both areas as a basis for the measurements acquisition, which were then topographically surveyed with a total station.

Data processing

In the post-production phase, the point clouds acquired with the P30 Laser Scanner were first recorded using the Leica Cyclone 9.1.4 software, which uses a 'Cloud-to-Cloud' recognition

form-digitizer-technology-white-paper.

[6] https://leica-geosystems.com/products/laser-scanners/scanners/p-series-hdr-white-paper.

[7] For the darker rooms, spotlights were used to illuminate the darker areas and surfaces in order to achieve the most even illumination possible; Saggese 2021, 18.

[8] For a theoretical summary of how GPR systems work and the radargrams that can be obtained, see Boschi 2020, 95-113 and Goodman 2009, 234-236.

Figure 8. Castellammare di Stabia, Villa San Marco. Data acquisition in free mode (photo by the Alessandro Mauro).

algorithm. For the alignment of the scans, the folders containing the point cloud files were inserted into the software, which were sorted on a daily basis and subdivided into subfolders by type (scans and photos) and day of acquisition. Following this operation, the scans acquired in the field were manually aligned in free mode.[9] Leica Cyclone 9.1.4 handles this operation in two different ways. The first exploits the potential of the 'Cloud-to-Cloud' algorithm, which allows point clouds to be aligned by having the software recognise homologous points—mostly geometries—between them, giving them manual docking constraints. In general, for the recognition to be successful, at least three points should be constrained, preferably on the three x-y-z axes and well distributed in space.

The second involves a manual point-clouds visual alignment, known as 'visual alignment'. In this case the two point-clouds to be bound are displayed in false red and blue colours in the plan and in the elevation perspective. In this case the anchoring operation is carried out by roto-translating one of the two clouds over the other, so that they are perfectly superimposed. Once the alignment of the scans was completed, the overall cloud was recorded by applying the ICP algorithm,[10] where the errors were evaluated both on the individual pairs of scans and on the entire group. For a correct registration, the error for Cloud-to-Cloud constraints must be less than the nominal instrumental error, which for this topographic instrument is 0.009 m. and therefore must be below 0.027 m. on the overall group error.[11] The evaluation of the errors on a single pair of scans and on the whole group was below the values shown here (Fig. 9).

[9] The scans acquired in autoresection mode are not subjected to this operation, as they are already automatically aligned in the field. For easier management of the processing project, it was decided to create subgroups with the recorded stations.

[10] The ICP (*Iterative Closet Point*) algorithm allows point clouds to be aligned through iterative processes that minimise metric errors each alignment step (Franzini et *alii* 2021, 208).

[11] It is necessary to point out that the grouped scans are close to each other and the link to which they are bound is topographical in nature.

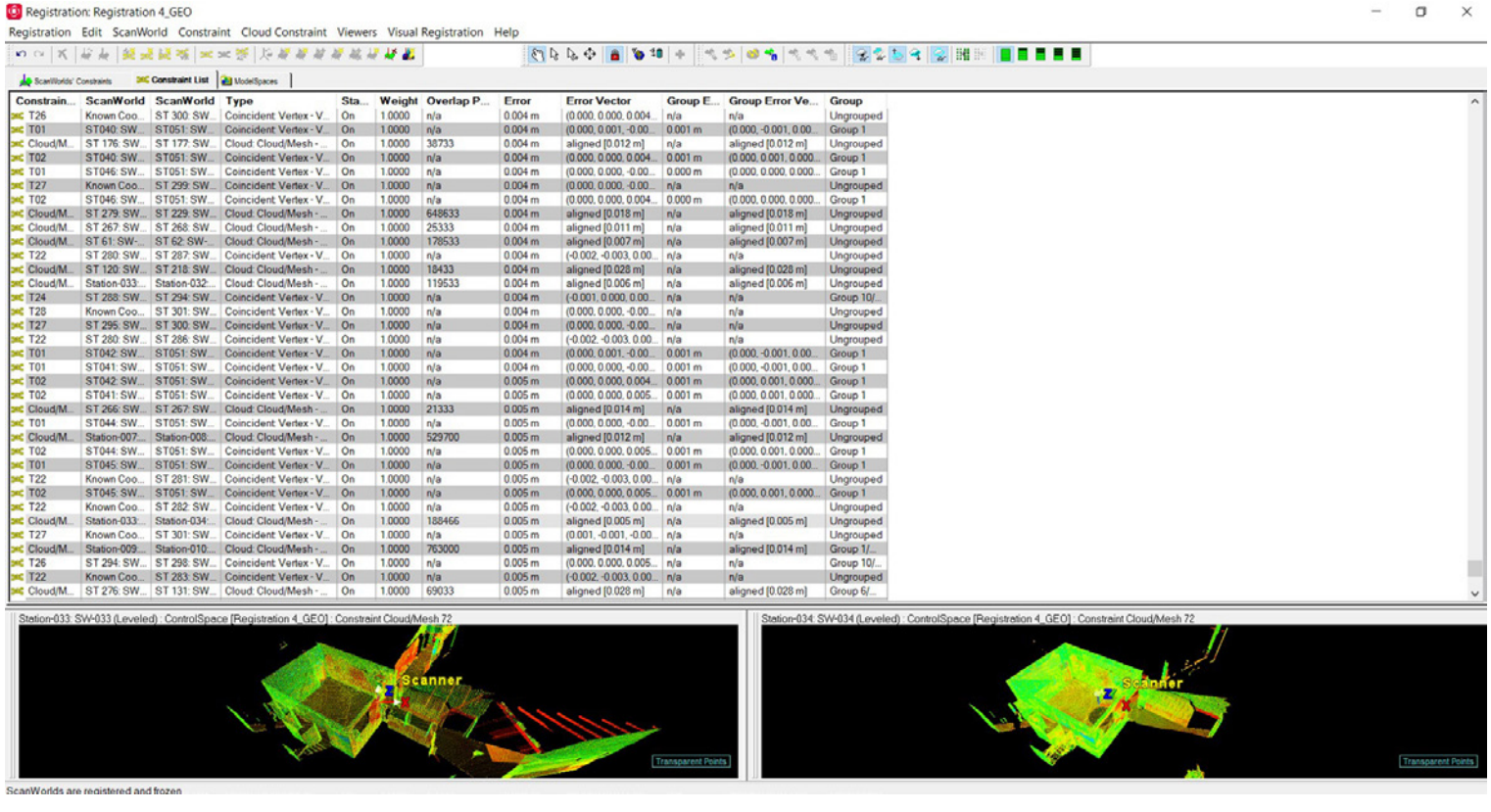

Figure 9. Error assessment after point cloud recording (author's elaboration)

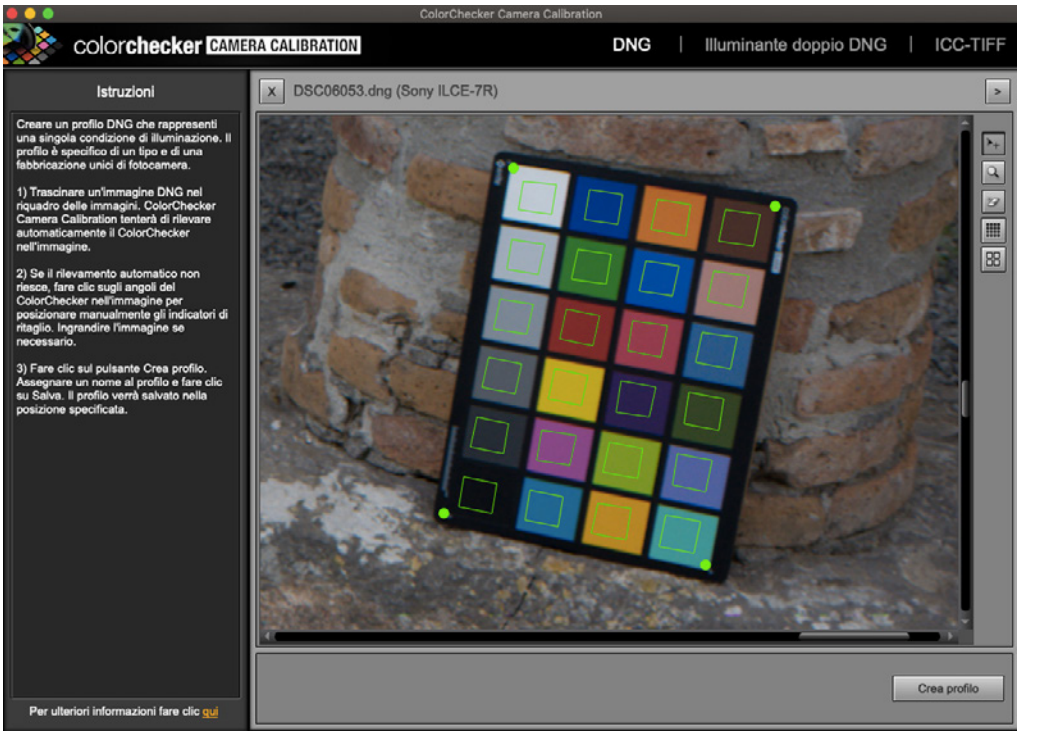

Figure 10. Creation of profiles within ColorChecker Passport (author's elaboration).

The photographic images, in RAW format, useful for colouring the point cloud and extracting detailed orthophotos of every single vertical surface, were optimised using the Adobe Photoshop CameraRaw software, from which an initial Digital Negative (*.dng) file was extracted. Subsequently, the file was imported into the ColorChecker Passport software (Fig. 10), where profiles (*.dcp) were created, useful for applying, during the colorimetric retouching, the exact profile of the light captured by the camera at the moment of the shot. This retouching is applied to RAW files within Adobe Photoshop CameraRaw and consists in the white balance by controlling the exposure through the colorimetric parameters defined by the profiles extracted by the color-checker (Fig. 11). The parameters that were changed according to the information from the profiles are exposure, light, contrast, shadows, whites and blacks, leaving temperature and hue unchanged. After this procedure, the individual shots were entered into the PTGui software,[12] where it was possible to compose the spherical images perfectly superimposed on the scans. After this procedure, the produced panoramas were named with the same name as the scan they were associated with and were imported into Cyclone 9.1.4 software to colour the point clouds. Each scan was exported to a file (*.e57), which contained the textured point cloud and the RGB value information referring to the associated spherical images. For the creation of the orthophotos of all vertical surfaces, the files (.*e57) extracted by Cyclone were imported into Cyclone 3DR 19.1 software. This software allows the creation of high resolution meshes and the translation of the information present in the files (*.e57), recomposing the spherical images, for their texturing (Fig.12).[13]

[12] https://ptgui.com.

[13] In this specific case, the reading of the information is facilitated by the working environment: in fact, the software

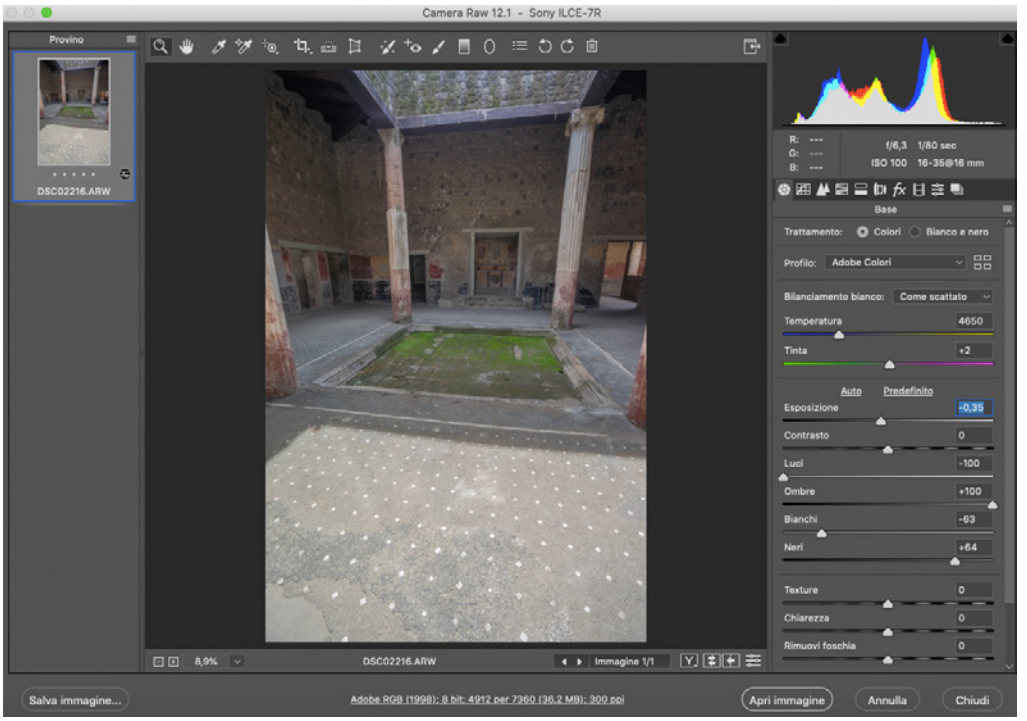

Figure 11. Calibration of spherical images in Adobe Photoshop CameraRaw (author's elaboration)

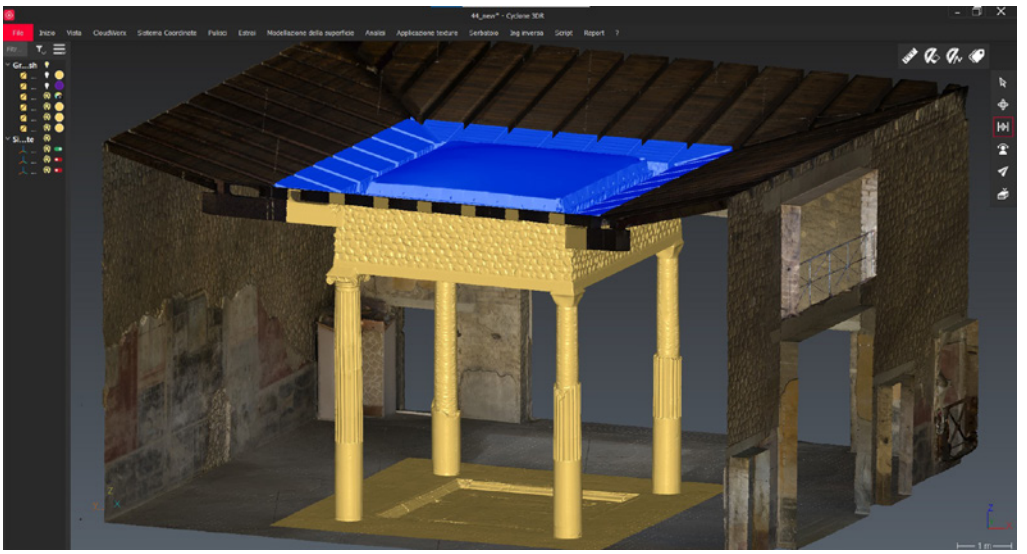

Figure 12. Recomposition of the spherical image in Cyclone 3DR.

Achievements and preliminary considerations

The work carried out at Villa San Marco by the team from the University of Bologna is part of an important project for the rehabilitation of the ancient monuments of *Stabiae* promoted by the Archaeological Park of Pompeii and involving several Italian and foreign[14] university institutes, using a protocol similar to the one already tested in the 'Piano della Conoscenza' of the Great Pompeii Project (Fichera et al. 2015; Giorgi, Sassatelli 2017). The aim was to carry out a topographical survey almost forty years after the last systematic study carried out on the monument, which laid the foundations for the chronological serialisation of the Villa's development phases, as well as its architectural study (Barbet and Miniero 1999). The data elaborated will be analysed and studied in order to further deepen the understanding on the architectural history of the building and to be compared with the previous research.[15] However, this is complicated by the fact that the analysis of the stratigraphies of the walls of the building appears difficult due to the various events that have affected the Villa San Marco monument since its rediscovery in 1749: for instance, the extensive and invasive restoration work carried out by d'Orsi from 1951 onwards, a time when the precarious static condition of the ancient masonry, heavily damaged by the destructive power of the pumice and lapilli produced by eruption of Vesuvius in 79 AD was perceived; the countless breaches opened in the masonry by the Bourbon excavators; the overall reconstruction that the monument underwent due to the significant damage caused by the earthquake that struck Campania in 1980.

The first result produced by this work was the elaboration of a georeferenced and updated plan of the two buildings in a CAD environment. This was produced by drawing directly on the point cloud in the Autodesk AutoCad Map 3D software using the Cyclone CloudWorx application tool. This tool allows the overall point cloud to be viewed within the CAD environment by calling it up from the project's Model Space within Cyclone. It was created on a scale of 1:1 adopting the graphic standards of the Great Pompeii Project 'Piano della Conoscenza' protocol, for a final restitution on a scale of 1:50 (Fig. 13).

The orthophotos of the elevations of all the vertical surfaces of the buildings were returned in scale 1:20 with extension *.jpg/*.tiff (Fig. 14). These drawings are very useful for the analysis of the walls and necessary for the mapping of the deterioration, as well as for a general survey of the state of conservation of the monument and for the planning of possible restoration works.

As far as the survey aspect is concerned, the method of acquiring photographic and photogrammetric documentation is innovative, especially in terms of performance, since with the use of the Nodal Ninja support, it was possible to acquire a single datum useful both for the colouring of the point cloud and for the production of high-resolution orthophotos of the vertical surfaces without having to carry out a photogrammetric survey dedicated to each wall.

packages for composing and recomposing the spheres belong to the same production company, namely Leica.

[14] The research project is regulated by a research agreement promoted by Prof. Massimo Osanna, who is its scientific director, with the collaboration of Dr. Francesco Muscolino, then director of the Stabia excavations. The research units participating in the agreement are coordinated by Prof. Enrico Giorgi (University of Bologna), Prof.ssa Carmela Capaldi (University of Naples 'Federico II'), Prof. Carlo Rescigno (University of Campania 'Luigi Vanvitelli'), Prof. Marco Maiuro (University of Rome 'La Sapienza'), Prof. Luca Cerchiai (University of Salerno) and Prof. Francesco De Angelis (Columbia University, New York).

[15] The study of the monument, and in particular of the bath complexes, is currently the subject of doctoral research conducted by the author of this contribution.

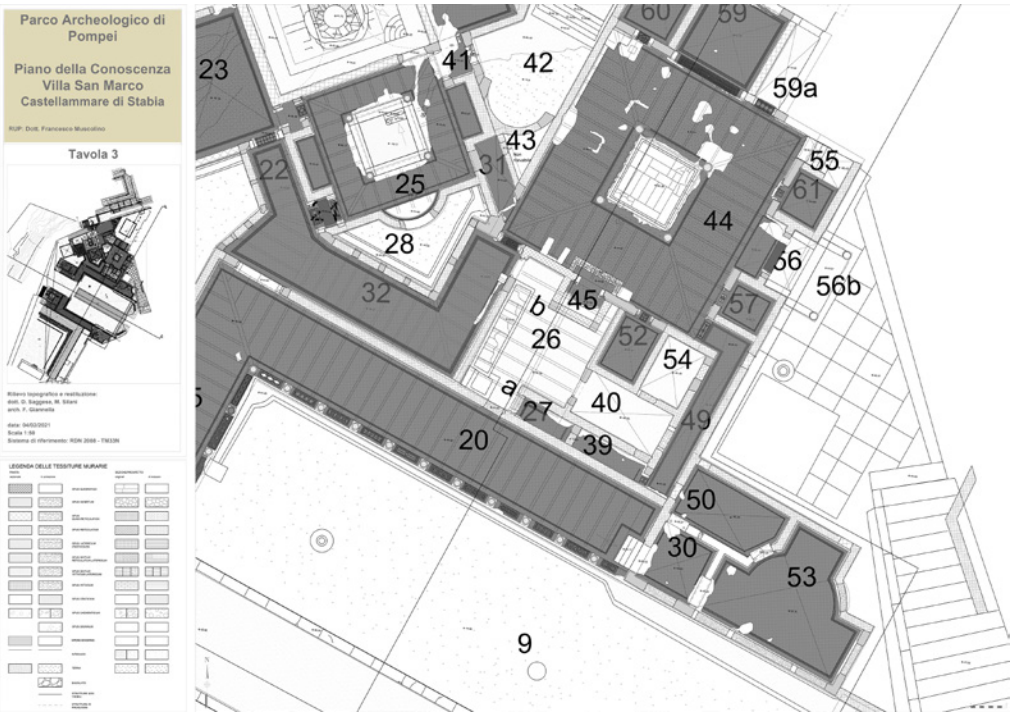

Figure 13. Castellammare di Stabia, Varano plateau. Planimetric restitution of Villa San Marco from laser scanner survey 2018; scale 1.50 (author's elaboration).

From an archaeological point of view, the new survey enabled us to document in detail all the surfaces of the villa, from which it is possible to restore the monuments to their original appearance.

From an initial analysis of the three-dimensional model produced, some sectors of the Villa, such as the thermal complex and the new rooms brought to light in 2008 and 2009, in which the restoration interventions appear less invasive, reveal various minor interventions that allow us to understand how the building often underwent renovations and adaptations of the spaces and furnishings according to the different needs of the owners or its own use.

It is therefore possible to state that the historical evolution of the monument is very complex and, although the chronology established by the Italo-French team is correct and acceptable, some gaps still remain unresolved and, in most cases, they can be contextualised during the transition between the Claudian-Neronian period and the last phase of use before the pyroclastic layers of Vesuvius marked the abandonment of the building.

Here, therefore, it is suggested that the terminology associated with the chronologies of the monument need to be revised, where the term 'phase', by which it is meant the moment of planimetric modifications of the building with a consequent change of use of the entire neighbourhoods, could be replaced by the term 'period'; instead, minor interventions may be associated with the term 'phase', and thus framing 'phases' within 'periods'.

Figure 14. Villa San Marco. Orthophoto of the elevation of the room 25 (author's elaboration).

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Reviews

Julian Bogdani, Riccardo Montalbano, Paolo Rosati (eds), *Archeo.FOSS XIV 2020: Open software, hardware, processes, data and formats in archeological research: Proceedings of the 14th International Conference (15-17 October 2020)*, Archaeopress Archaeology, Oxford 2021 | Book review

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Bogdani J., Montalbano R., Rosati P. (eds.), *Archeo.FOSS XIV 2020: Open software, hardware, processes, data and formats in archeological research: Proceedings of the 14th International Conference (15-17 October 2020)*, Archaeopress Archaeology, Oxford 2021.

The volume Archeo.FOSS XIV 2020, edited by Julian Bogdani, Riccardo Montalbano and Paolo Rosati, was published by Archaeopress Archaeology in 2021 and it collects the proceedings of the 14th international conference held on 15-17 October 2020 on the World Wide Web. Since 2006 the Archeo.FOSS annual convention has been an important moment of argumentation and updates regarding the most modern approaches and applications of free and open-source software solutions related to archaeology and more generally to the Cultural Heritage, establishing itself as a unique pioneering event. What stands out within this volume is undoubtedly the presence of an important space dedicated to open data and open standards solutions in archaeology and the ever-increasing difficulties of all those scholars who strongly believe in the possibilities offered by this type of approach but who are still too few to consider it an urgent necessity of the entire academic community. Data sharing with reusable information in open platforms, published on the World Wide Web and distributed under open licences, is the main theme of the conference. The book strongly emphasises these needs, and it has been released in an open-access format using a CC BY-NC-ND 4.0 International Licence, in keeping with the spirit of the 14th Archaeo.FOSS conference, responding to the new stimuli of discussion, data access and information sharing needed by today's scholars, researchers and beyond.

The need for an open methodology comes to light in the methodological approach of many of the papers presented: today's archaeological subject needs to deal with a lot of information from multidisciplinary research, collected with various tools that need to be organised but also well managed to be understandable. In fact, in many of the contributions, historical or archaeological knowledge is a starting point for the promotion of open systems and formats. The book begins with a general overview of the conference by the editors Julian Bogdani, Riccardo Montalbano and Paolo Rosati, who offer a perspective on the objectives, achievements and future plans for the Archaeo.FOSS community from the changes imposed by the situation in which the 14th conference took place. The 17 papers presented are organised in two sections with an appendix. The first section, entitled "Use, Application and Development of Free/Libre and Open-Source (FLOS) Tools in Archaeology", collects contributions based on case studies

and the development of tools and workflows. The second section, entitled "Creation, Use and Promotion of Open Data and Open Formats in Archaeology", is dedicated, in more detail, to the issue of open data.

Use, Application and Development of Free/Libre and Open-Source (FLOS) Tools in Archaeology

The first part of the volume is characterized by the presence of case studies that exemplify different digital solutions of data interchange in archaeology. As mentioned in the general foreword, multidisciplinary integration is the common thread of the contributions in the volume, underscored by the examples that will be mentioned, each one different in purposes but all sharing similar needs. Nowadays it is no longer enough to speak about multipurpose databases ready to catalogue and document cultural heritage or of GIS systems and WebGIS as if they were only storage units. In the papers presented it is concretely manifested that now the definition of innovative (an adjective more often than ever overused unjustifiably) and interdisciplinary approaches passes through a comparison of technologies and well-thought-out integrations that culminate in a defined, shared and declared workflow. It is in this perspective that the papers presented wanted to go and they can be divided in turn into thematic areas starting from the most up-to-date techniques of image acquisition and processing such as the integration of RTI (Reflectance Transformation Imaging) technique for the documentation of palaeo-mesolithic visual culture with a case study experimented by Michele Pellegrino and Donato Coppola in the site of Grotta di Santa Maria in Agnano (Ostuni, Italy). The non-invasive analysis through multi-lightning tests of RTI has led the scholars toward multidisciplinary methodological considerations and reflections that meet the needs of graphic documentation on prehistoric visual culture. Other remarks arise from remote sensing acquisitions for monitoring threats related to soil erosion to generate risk maps from an integrated assessment that considers the presence of archaeological deposits. The study, led by Stefano De Angeli, Fabiana Battistin, Federico Valerio Moresi, Philip Fayad and Matteo Serpetti, presents the results achieved by the methodology proposed by the RESEARCH project (REmote SEnsing techniques for ARCHaeology) in Falerii Novi (Viterbo, Italy) with an integrated and effective workflow that considers archaeological and geological/environmental data through analysis conducted with open-source software and scenario simulations by testing plug-in specifically designated to process data from GPR prospections. The work by Emanuele Brienza, Giovanni Caratelli, Lorenzo Fornaciari and Cecilia Giorgi on Rome – NE Palatine slopes goes instead into depth on the theme of the relationship between the archaeological fieldwork and the sharing of the complex set of information that fed the interpretative process of hypothesis of the everyday work. The data of the work team are shared with citizens, according to a WebGIS form of Cultural Heritage management, in line with the idea of an accessible archaeology and beyond. They manage data from long archaeological research and they experienced the possibility of renewing methods for collecting and sharing information focusing on 3D survey and on GIS systems for building archaeology data released with an open licence. In the same vein as the previous two examples on visual documentation, it is possible to set an interchange of technologies for processing 3D models and orthophotos from thermographic images taken by drone presented by Gabriele Ciccone. The paper interestingly deals with the replicability of the technology, something that is never secondary when it comes to methodologies and workflows documented. After all, the archaeological research has the great need to represent the data in space as an integral part of the research

itself, without which it is not even possible to formulate reconstructive hypotheses of settlements, mobility, structures, materials. In this, GIS systems represent the backbone of the digital humanities applied to archaeology, continually endowed with plug-ins that increase their exploitation possibilities for the purposes of the topographic research. In this light, the paper of Renata Ago and Domizia D'Erasmo about the urban mobility in 18th-century Rome sets a further example. If GIS is commonly used to analyse big data of urban mobility in modern cities, it's very interesting to see how it can be useful to examine kinds of movements in historical times. Thanks to an integrated workflow made up of historical georeferenced cartography and written sources of ceremonial and private paths, the results of the analysis of the vectorization in the GIS platform are different heatmaps of the most trafficked zones in the 18th-century Rome. A similar need for the representation and the comprehensibility of data is what emerges in the research that sees the extension software's potential applied to cases concerning archaeology of architecture as set out in the paper presented by Filippo Diara and Fulvio Rinaudo. The case study of the refectory of the Cistercian abbey of Staffarda (Saluzzo, Italy) is the protagonist of a project focused on experimentations and adaptations of FreeCAD FOS software, released with a GNU GPL v2 licence, as an HBIM platform for the documentation and analysis of building archaeology. The work by Paolo Rosati, instead, introduces the debate and the still open reflections on the Faro Convention, with a special care for the impact its adoption has on small museums by presenting case studies of institutions and cultural events held between 2018 and 2021 in Central Italy. Further evolutions of GIS technologies are explored by the geospatial investigations presented by Augusto Palombini in which the georelational model of data organisation becomes the basis for analysis processes. The paper outlines a case study of landscape archaeology applied to the middle Tiber Valley with the aim of identifying the areas with the highest potential in terms of agricultural use related to Roman settlements of the middle and late Imperial era through the creation of a new GRASS-GIS tool. Finally, a very interesting approach is the inclusion of Linked Open Data (LOD) within GIS projects to enrich geospatial data sets with semantic information. Examples are provided by Timo Homburg and Florian Thiery using two different archaeological contexts showing how spatial LOD can be published: the Limes data set with forts and watchtower along the Germanic Limes and the public road network in Roman Britain.

Creation, Use and Promotion of Open Data and Open Formats in Archaeology

As already mentioned, specific attention in the conference was placed on the ongoing matter of the use of open data in archaeology. The second part of the volume is dedicated to the creation and promotion of open data and open formats in archaeological research. The need for data exposure and sharing emerges clearly in eight papers presented. From large European projects and initiatives such as ArchAIDE, SITAR and PAThs to museum institutions, the specific focus of the session goes beyond the concept of open software solutions to proposals for the creation of distributed platforms with free licences, designed to be digital archaeological archives open to all. The paper presented by Francesca Anichini and Gabriele Gattiglia focuses on the open-data policy and the management of material covered by copyright of the ArchAIDE project. The consideration is almost obliged by the fact that there are stringent European directives on copyright and database protection: the project thus aimed at creating outputs that take copyright into account and do not alter the open nature of the output. Then in the direction of an archaeology that is open to a wider public, thus increasing education in the knowledge of cultural heritage, its protection and its

valorisation, moves the SITAR project, presented here by Mirella Serlorenzi, Ascanio D'Andrea and Riccardo Montalbano. SITAR is a long-term project that in the last few years has released a new open data platform for a public archaeology in Rome. Data are provided under a CC-BY-SA 4.0 licence with an open approach to external users according to a hierarchy of different types of interactions with the institution of the Soprintendenza Speciale Archeologia Belle Arti e Paesaggio di Roma. Two contributions are dedicated to the issue of Linked Open Data (LOD), used to interlink data within the World Wide Web semantically. On the one hand, the work of Florian Thiery, Sophie C. Schmidt and Timo Homburg leads directly to the technical core of the creation and publication of archaeological data in the Semantic Web providing two ways to model data using the example of Irish Ogham Stones in Wikidata as LOD with descriptions of protocols and workflows. On the other hand, the team based in the Catania University and composed by Nicola Lanieri, Rodolfo Brancato, Salvatore Cristofaro, Marianna Figuera, Marianna Nicolosi Asmundo, Daniele Francesco Santamaria, Daria Spampinato presents a paper with the results of the digitisation of the Libertini Collection of the Museum of Archaeology of the University of Catania (MAUC) where digital data are associated with sites and objects. The focus is based on the exploitation of the Web Ontology Language (OWL) looking forward for a long-term preservation of digital data that still an important aspect to consider when projects are intended to be durable and inclusive, especially in the case of a museum created to be experienced. The paper presented by Julian Bogdani, instead, deals with the problem of the digitisation and vectorisation of archaeological and/or architectonic graphical legacy documentation. This contribution focuses on the Simple Vectorisation Protocol (SVP), a GIS-based protocol for acquiring in the digital domain sketches and maps by following a syntax for reverse engineering and archive data, born in the context of PAThs, an ERC Advanced project directed by P. Buzi at Sapienza University of Rome. In the end the result shows a multidimensional dataset, publishable on online repositories, re-usable and remixable depending on strategies and necessities of every single archaeological project. The attempting of an overview on the management of spatial information of archaeological data available online but in a non-open format is the main theme of the contribution presented by Andrea D'Andrea and Francesca Forte. The analysis and comparison of open and non-open spatial formats for archaeological research deal with the matter of how non-open data can be re-used in different platforms to extend the dissemination of projects. The paper stresses the importance of the use of open standards with a practical test on a dataset for archaeological areas in the Lazio territory downloaded by the Open Data portal of Lazio Region in the section Piano Territoriale Paesistico Regionale (PTPR), made of points, lines, and polygons in shapefile format, demonstrating concretely the advantages of using formats, such as GeoJSON. The work by Alessandra Caravale, Alessandra Piergrossi and Irene Rossi presents the Open Data, Open Knowledge, Open Science research group at the CNR-ISPC. The team includes archaeologists, philologists, mathematicians, and computer scientists who share editorial work around the open-access journal *Archeologia e Calcolatori* showing FAIR guiding principles and the aims of the use of LOD in this case study. One of the most important aims achieved by the research group is the experimentation of protocols and strategies useful to share scientific resources, publications, or datasets, with a focus on the area of the Heritage Science. In the same light it is possible to set the contribution by Mario Ciurcina and Piergiovanna Grossi that deals with an overview on the recent evolution of technologies that contributed to the process of data opening in the domain of Cultural Heritage. Starting from a brief introduction about Italian laws concerning data related to Cultural Heritage, examples of main projects have been presented and discussed.

The volume closes with an appendix, by Julian Bogdani and Federico Sciacca, which takes the form of an introspective analysis of the activity of the Archeo.FOSS community since its inception, conducted on a statistical basis of the reports of the proceedings of the annual conferences with special reference to the vitality, or otherwise, of the projects presented over the years and to the way in which the conference proceedings were published.

Undoubtedly, once again, what characterises the proceedings of the 14th edition of Archeo. FOSS is the philosophy of the open approach, which is well underlined by this volume's focus on the aspects of communication and data sharing that are fully in line with the goals that the Archeo.FOSS community has set itself. All contributions develop themes that over time the group of scholars and researchers revolving around the Archeo.FOSS conferences has openly committed to spread, such as the culture of sharing protocols, data and software reuse for archaeology and Cultural Heritage.

Davide Gangale Risoleo, Ippolita Raimondo (eds), *Landscape: una sintesi di elementi diacronici. Metodologie a confronto per l'analisi del territorio*, BAR International Series 3047, Oxford, 2021 | Book review

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D. Gangale Risoleo, I. Raimondo (eds) 2021. *Landscape: una sintesi di elementi diacronici. Metodologie a confronto per l'analisi del territorio,* BAR International Series 3047, Oxford: B.A.R.

The book contains the proceedings of the conference on the new methodological issues applied to the study of the archaeological landscape, promoted by the PhD candidates of Tuscany's Doctoral Programme in 'Antiquity and Archaeological Sciences', with the support of 'Consulta di Topografia Antica' held in 2019 in Pisa.

Since its early beginning, the ancient topography has improved itself with the application of new inquiring methods: from the classic studies promoted by the positivistic science in the second half of eighteen century, focusing on epigraphy (build of corpora and indexes) and classic authors, to nowadays satellite images and geophysical methods, through the massive archaeological data integration following the 1st World War and the aerial photography in the post-2nd World War. However, P. Liverani in the Introduction (p. V) to the book stresses out how technological advances do not always correspond to improvements to the discipline itself but rather a speedup of methodological approaches already in use. On the other hand, as the use of archaeologists in photointerpretation and the deployment of geognostic analyses to a territorial scale have testified, the good application of new methodological approaches can bring big improvements in documenting the ancient landscape. The aim of the conference is then to display the latest researches lend by PhD candidates in order to have a benchmark set up by other researchers and well-known academics in ancient topography and landscape archaeology, that could offer hints and inspiration exposing research projects already built and well established. In the two-day conference four sessions were scheduled that became the four sections of this book: *I. Urbanistica e gestione delle risorse, II. Vie di comunicazione nel mondo antico, III. Nuove tecnologie per lo studio del territorio, IV. Paesaggi antichi: Metodologie a confronto*. Each session of the conference was guided by a member of the scientific board and introduced by a key speaker's presentation displaying a well-known project matching the session's topic.

The first one (*Sezione I. Urbanistica e gestione delle risorse*), introduced by A. Claridge (Royal Holloway, University of London) and P. Liverani (*Università degli Studi di Firenze*), is about urbanistic studies and resources management and focuses on aspects, such as the functional relations between urban spaces, that are usually neglected if compared to the close attention of studies on the urban planning. The first essay by B. Fochetti (*Note preliminari sul rapporto tra* tabernae *e impianti termali pubblici a Ostia imperiale*, p. 5) examines the city of Ostia, in particular the relation between *tabernae* and public thermal buildings. The author takes into account not

only planimetric issues but extends the study to the architectural and topographical aspects, including the volumetric analysis of the buildings.

The following papers, by D. Gangale Risoleo and E. Tamburrino, share the topic of water supply and management in urban contexts. The first one (*Urbanistica dell'acqua: i casi di Brescia e Verona*) pays attention to the hydric system of Brescia and Verona, and by using different types of sources (archaeological, remote sensing, written records) outlines a global reconstruction of the hydric systems of these cities. By taking into account dating, construction costs, type of commission and distribution issues it underlines out how private hydric purchase is way more documented than the written sources do. The second paper (*The Impact of Water Management in the Urbanisation and Urban Planning Processes. Some Preliminary Insights from the Roman Eastern Alps*, p. 27) deals with the issues linked to urban planning and water management, in particular the wastewater disposal, in towns built on slopes or in the foothills. The paper provides some relevant examples of wastewater handling of Roman settlements located between the *Regio X – Venetia et Histria* and the Province of *Noricum.*

The following section (*Sezione II. Vie di comunicazione nel mondo antico*) is introduced by G. Ceraudo (Università del Salento), and is focused on the routes of communication in the ancient world with the papers spanning through the Mediterranean, from Sardinia to Aegean islands, across the Southern Italy (Irpinia and Puglia). Most of the essays point attention to the Roman road network, except the one by A. Querci (*Θάλαττα, θάλαττα: the way the sea and the wind drew the trade routes in the Aegean Sea during the Bronze Age*) that focuses on the sea routes between Aegean islands during the Bronze Age trying to point out how the current climate conditions can be considered valid also for the Bronze Age and how these conditions could have affected the drawing of the sea-routes.

The other papers underline how latest methodological improvements can be used along with the traditional ones to achieve best results in the reconstruction of ancient routes of communication and ancient settlements. Pretty significant are the contributions by I. Raimondo (*Retracing an Ancient Roman Road: Aerial Photography and Topographical Survey of the Aecas-Siponto Road in Northern Apulia, Italy*) in which aerial photography and remote sensing are used along with historical and written sources (*itineraria*) to rebuild the route of the road between *Aecae* and *Sipontum* and the one by R. Montanaro e P. Guacci (*Vero o falso? Integrazione di strumenti remote sensing per la comprensione del territorio antico lungo la via Herculia*), where the use of remote sensing (LiDAR), topographical surveys and aerial orthophotos brought to the identification of a medieval fortified settlement along the *Herculia* road.

The third section, introduced by M. Millet (University of Cambridge) and S. Campana (Università degli Studi di Siena), considers the contribution of new technologies in the research (*Sezione III. Nuove tecnologie per lo studio del territorio*) and has a methodological profile. The section collects papers that focus on aspects that in recent years are becoming essential to reach a correct understanding and contextualization of the archaeological data, from the data collection to its disclosure to the public. In this perspective, F. Coschino's paper (*Il GIS come mezzo di analisi e divulgazione di contesti archeologici e bioarcheologici su scala variabile*) offers, through two case studies, some insights into how a GIS can be used both to have a multiscale analysis of the archaeological records and to disseminate the results to the outside. The following contributions, on the other hand, are based on the application of

archaeometric methodologies for the study and reconstruction of landscapes. The paper by L. Russo (*Produzione e circolazione di ceramiche acrome medievali nella Toscana sud-occidentale: studi morfologici ed archeometrici*) combines petrographic analyses on ceramic samples with those on clay samples to reconstruct the supply basins and the circulation of pottery between 7th and 9th centuries CE in the south-west of Tuscany; the other by C. Sciuto (*Racconti di pietre: l'applicazione di metodi archeometrici portatili allo studio dei paesaggi*), aims at the reconstruction of the landscape, through the use of portable tools for the geochemical characterization of stones, in particular at the localization of the mining sites of the building stones.

The fourth section (*Sezione IV. Paesaggi antichi: Metodologie a confronto*) is dedicated to the comparison of the different methodologies applied to the study of the ancient landscape, and is introduced by F. Vermeulen (Ghent University) who briefly traces the history of landscape archaeology to underline the progress made, with a particular focus on those of the last two decades that allow, in many cases, an updated and more accurate reconsideration of legacy data.

Following this line of research, the paper of R. Brancato (*Ricognizioni archeologiche e legacy data in Sicilia orientale: l'integrazione tra metodi per la ricerca sui paesaggi rurali in età romana*) displays the possibilities of integration between archaeological, topographical and legacy data through the use of geodatabase and how this can lead to the reconstruction of the rural Roman landscape in Catania's plain. Integration between different data and sources is also the common thread of the other essays and, as clarified by V. Limina *(Methodological Issues for the Integrated Analysis of Landscapes of Power: the Case Study of Volterra. Centuries 1st BC–5th AD*), it's an approach that can give good results even in areas often considered marginal.

The same diachronic approach, aimed to seize landscape modifications, supports the work by S. Berrica (*Paesaggio minerario nella zona nord di Madrid (Spagna) tra VII e VIII secolo*) that focuses on changes in the mining landscape of northern Madrid territory.

The three remaining papers show how it can be possible to bring together research, protection and preservation activities, acting in close synergy with local authorities and the ones responsible for the protection of the Culturale Heritage. The contribution of G. Forte, M. La Trofa, A. Piergentili Margani and G. Savino (*Ricerche topografiche tra tradizione e innovazione: dalla carta archeologica d'Italia all'esperienza del Progetto Ager Lucerinus*) follows the path traced by the experience of 'Carta archeologica d'Italia' and investigates, combining traditional methods to innovative ones, the western territory of *Luceria* working side-by-side with the town municipality; the same effort can be seen in the work of F. Matteoni (*Conoscere un territorio attraverso il costruito storico: il censimento dell'edilizia medievale nelle valli bergamasche*) on the medieval architectonic heritage of the northern Bergamo territory. The data collected during surveys and documentation of rural medieval buildings are shared with local authorities in order to be properly considered when drafting urban and territorial tools. A good example of this new approach is the case of upper Val d'Agri exposed by S. Montonato and F. Tarlano (*Ager Grumentinus: ricerche topografiche e tutela del paesaggio archeologico in Alta Val d'Agri, Basilicata*) where the multidisciplinary survey was conducted by including, in addition to traditional topographical research techniques, geomorphological and paleoenvironmental analysis. This brought to the recognition for this area of the 'Area of Archaeological interest' title, with consequent protection under the 'Codice dei Beni Culturali e del Paesaggio'.

In conclusion, the book offers a good display of the latest methodological trends in the study of the ancient landscape, combining the point of view of specialists in ancient topography, archaeologists and experts in archeometric methodologies. An addition of extreme interest, in particular for those who could not attend the conference, could have been the inclusion of brief essays of the speech exposed during the days of the convention from the key speakers, hopefully this could be done in the next issues.

Custode Silvio Fioriello, Francis Tassaux (eds), *I paesaggi costieri dell'Adriatico tra Antichita e Altomedioevo: Atti della Tavola Rotonda di Bari, 22–23 maggio 2017*, Ausonius Editions, Bordeaux, 2019 | Book review

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Custode Silvio Fioriello and Francis Tassaux (eds) 2019. I paesaggi costieri dell'Adriatico tra Antichita e Altomedioevo: Atti della Tavola Rotonda di Bari, 22–23 maggio 2017, Scripta Antiqua, 119; Serie AdriAtlas, 2; Bordeaux 2019; Ausonius Editions.

This conference volume collects the proceedings of a round table held at the University of Bari in 2017, organized by different European universities and research institutions that collaborate in the 'AdriAtlas Project' (www.adriaticummare.org). This international project coordinated by the École française de Rome and the Ausonius Institute of the University of Bordeaux Montaigne, and supported by institutes from Albania, Croatia, France, Italy and Slovenia, develops since 2007 an open source web-GIS based atlas of historical-archaeological evidence relating to the whole Adriatic coast and its wider hinterland, and defined according to the chronological arc that runs between Protohistory and the Early Middle Ages. The collaboration with many institutes and researchers aims at facilitating and soliciting knowledge of the archaeological heritage of both Adriatic sides, thus promoting not only forms of specialized study among the scientific community, but also dynamics of widespread understanding, identity awareness and sustainable management among local communities.

The present volume, the second in the AdriAtlas Series, contains a variety of scholarly contributions from current research projects on the Adriatic coastal regions presented at the Bari conference under the title 'I paesaggi costieri dell'Adriatico tra Antichita e Altomedioevo'. They include the discussion of archaeological finds and features, epigraphic and written sources as well as geomorphological and palaeo-ecological analyses, often studied on an interdisciplinary basis. The volume is subdivided in four sections, focusing respectively on landscape change, research history and archaeological research management, settlement dynamics and exploitation of the landscape, and finally connections and communication.

The first section on landscape change contains only one contribution, namely on sea-level changes. The research group around M.-B. CARRE (pp. 15-24) uses *piscinae* and *vivaria* found on the Istrian coastline near *Parentium* to sharpen the discussion around sea level change since Roman times. They show that the linking of archaeological data to geomorphological conditions and biological characteristics is of crucial importance for refining existing interpretations about these important phenomena.

With three contributions the second section, public presentation of and involvement in historical landscapes, is somewhat heterogeneous. R. PERNA (pp. 27-53) discusses, on the

basis of his work on the archaeological sites of *Vrbs Salvia* (Marche) and *Hadrianopolis* and *Antigonea* (Albania), the crucial integration of cultural and archaeological heritage in modern urban and spatial planning. L. PERZHITA (pp. 55–66) provides a useful overview of the history of archaeological research in Albania, on sites from the Bronze Age to the Middle Ages. While P. PERFIDO and G. CUCCI (pp. 67-73) provide insights into a more user friendly application currently under development by the AdriAtlas team.

The third section, covering the main focus of the conference proceedings, consists of nine contributions to the settlement history and use of resources in the coastal regions of the Adriatic. Here the geographic and chronological diversity of the presented studies demonstrate well the palimpsest of regional diversity and diachronic evolutions the complex landscapes of the Adriatic have undergone before, during and shortly after Classical Antiquity.

Three papers focus on areas in the north of the Adriatic. J. HORVAT (pp. 77-95) examines the distribution and great variety of Roman and other settlement sites in the mountainous terrain between the Gulf of Trieste, eastern Istria and the Danube basin, linked by two main communication routes between *Aquileia*, *Emona* and *Tarsatia*. The very intensive historical-archaeological investigation by M.S. BUSANA (pp. 97-114) of a rural area outside ancient *Altinum* and the laguna of Venice allows us to better understand the strategies employed by the inhabitants of the peri-coastal area over time to use and transform the environment in function of the changing political and economic conditions between the Iron Age and Late Antiquity. In a southern area of this Po-delta, between Ravenna and Rimini, D. RIGATO and M. VITELLI CASELLA (pp. 115-34) analyse a series of Roman epigraphic finds, reflecting on the geomorphological processes at work in these areas and on the economic activities (e.g. production of wine and ceramic building materials) connected with the different landscape units.

The next five articles deal with the Apulian coastal regions. M. L. MARCHI (pp. 135–48) zooms in on the crucial 4th and 3rd centuries BC, when major transformations in settlement centres and new urban forms take shape in the northern part of that region. Striking is the observation about the many different trajectories taken by Daunian centralized sites shortly before and during the phases of Roman colonisation of the coastal area and the inland territories. C.S.FIORIELLO and A. MANGIATORDI (pp. 149-81), on the other hand, present a well-documented synthesis on 31 settlements, integrating literary, epigraphic, archaeological and palaeo-ecological data to highlight agro-silvo-pastoral production processes (including olive oil and wool production) in coastal Roman Apulia. The recent discovery of settlement sites from the Bronze and Iron Age, as well Classical Antiquity, on the coast and inland of southern Salento are the focus of the article by G. MASTRONUZZI and R. CALDAROLA (pp. 183-207). This includes stratigraphic investigations of controlling tower-like buildings from the 4th-3rd century BC in the Messapian hinterland. M. L. DAMBROSIO and G. SCHIAVARIELLO (pp. 209-18) outline the chronological development of the settlement site and territory of *Teanum Apulum* (near the Gargano) providing new insights into ancient agricultural processes in the region. M. PELLEGRINO (pp. 219-29) looks at the processes of sea ingression in the Trani coastal area, north of Bari, and deals with burial sites from the 3rd – 1st millennium BC. Finally, the coastal area near Monopoli and Fasano, north-west of Brindisi, is the subject of the paper by R. ROTONDO (pp. 231-42), who synthesises knowledge about rupestrian settlements between Late Antiquity and the later Middle Ages.

The fourth section of this volume is dedicated to communication and the relationship between roads, rivers and ports on and near the eastern Adriatic coast. In the first contribution, P. BASSO (pp. 245-60) uses the example of her work in Gazzo Veronese to discuss land and river connections between the coast and the inland territories of the Po plain. This fine topographic study includes recent research results on the course of the via Claudia Augusta and the very large necropolis areas along the transport arteries. M. C. MANCINI (pp. 261-79) presents a short synthesis of work by different entities in the coastal region of Abruzzo, focusing on archaeological discoveries of a series of ancient port facilities and epigraphic evidence about connections via sea routes. This is further deepened in the contribution by M. M. S. NUOVO (pp. 277-99) who focuses on several estuaries between Apulia and the Marches, giving insight into the diversity of different port facilities. The diversity of these facilities is much conditioned by the natural environment and certain solutions for landing boats are being compared with post-medieval and modern solutions elsewhere in Europe. The landscape between Bari and Otranto is the focus of M.MASCOLO's paper (pp. 301-20) which deals with the spread of Jewish motifs and symbols in Late Antiquity as proof of economic and cultural travel, but also of certain migration movements. In the last contribution, D. SAGGSE (pp. 321-32) discusses the ancient wool production in the coastal regions of Apulia, especially in Roman Imperial times. This paper includes information about a *fullonica* from the 1st century AD in Canosa and potential tanneries at *Lucera*, Gravina di Puglia and Salapia.

The 18 contributions by 30 authors are written predominantly in Italian, with two papers using French or English. The volume is very well illustrated, with a good number of drawings, distribution maps and photos presented in colour. At the back of the volume indexes of ancient authors, epigraphic findings and geographic locations facilitate consultation. There is sadly a clear geographical unbalance between the majority of papers dealing with the underrepresented eastern coast of the Adriatic and the well-covered Italian side, although archaeological institutes active since many years with excellent research on and near the Italian coast (e.g. universities of Bologna, Ghent, Pisa...) are not present in the volume. Some work could have been achieved by the editors in enhancing the scientific value of the volume, such as inserting an abstract in the presented papers, and most of all, in presenting some major conclusions to the volume as a whole.

Overall, the present conference volume represents a valuable step in current interdisciplinary research projects along the Adriatic coasts. It contributes in a significant way to scholarly debate on the complex developments, conditions and peculiarities of coastal and near-coastal sites and exploitations in the Adriatic, and stresses the importance of communications with the hinterland. The latter is much influenced by the geomorphological conditions and changes over time of the coastal area, such as can be noticed in the difference between the access to the hinterland in the flat and open Po area with its many waterways, and the central and some southern parts of Adriatic Italy where the Apennine mountains and watershed forms a significant barrier for communication and transport connections with the Tyrrhenian part of the peninsula.