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Note:

Application Programming Interfaces (APIs) in Cultural Heritage Information Systems (Giacomo Mancuso), p. 505; *Indexing science* (Andrea Di Renzoni), p. 509

NON-INVASIVE PROCEDURES FOR THE EVALUATION OF PRE-ROMAN BURIAL SITES: NEW CASE STUDIES FROM THE MID-ADRIATIC AREA

1. INTRODUCTION

The outcomes and observations presented in this paper originate from a recently launched project, named SEARCH-Sensing Archaeology, which perpetuates with new modalities, and a focus on non-invasive methods, the longstanding tradition of research by the University of Bologna in the northern Marche Region, in the valleys of the Cesano, Misa and Nevola rivers (see for example DALL'AGLIO *et al.* 1991; GIORGI, LEPORE 2010)¹.

The project stems from the experience of the excavation of the Picenian and Roman necropolis of Contrada Nevola in Corinaldo (AN), for the discovery of which the contribution of non-invasive surveys was fundamental (BOSCHI 2018, 2019, 2020a, 2020b), since they allowed for the recognition of three circular traces preliminarily interpreted as circular ditches related to pre-Roman funerary monuments. The excavation, still ongoing, has confirmed this hypothesis (BOSCHI *et al.* 2020), as well as having naturally uncovered further evidence that was not initially recognisable, such as a fourth circle and a substantial number of Roman tombs (BOSCHI *et al.* 2022). A virtuous cycle has therefore been created, in which stratigraphic investigation allows the initial results of the non-invasive investigations to be reviewed with greater awareness (especially geophysics: BOSCHI 2020b, 150-159), a process allowing in the long run to develop the most precise and articulated understanding of the archaeological record available, functional to the creation of interpretative models applicable to different contexts.

This is one of the main objectives of the SEARCH Project, which aims to apply the same integrated analysis strategy (based on cartographic study, remote and proximal sensing, geophysics, field surveys) in order to obtain a non-invasive characterization as accurate as possible of some recently

¹ The project, whose full name is 'SEARCH - SEnsing ARCHaeology. Non-invasive mapping and tracking technologies for evaluating and protecting buried archaeology', has been funded thanks to AlmaIdea Grant 2022, a competitive programme of the University of Bologna aimed at supporting innovative basic research ideas with long-term potential. The SEARCH Project (PI: Federica Boschi; Co-PI: Marco Dubbini) won first place for the Department of History and Cultures in the 2022 call (<https://cris.unibo.it/handle/11585/893823>). The research carried out by the University of Bologna between Cesano, Nevola and Misa rivers are always concerted with the municipal administrations of the areas involved. The excavations and research in Corinaldo (ArcheoNevola project, direction F. Boschi) and in the territory between Nevola and Misa rivers discussed here were carried out under MIC concession and in agreement with Superintendence for the provinces of Ancona and Pesaro Urbino (archaeological officer I. Venanzoni).

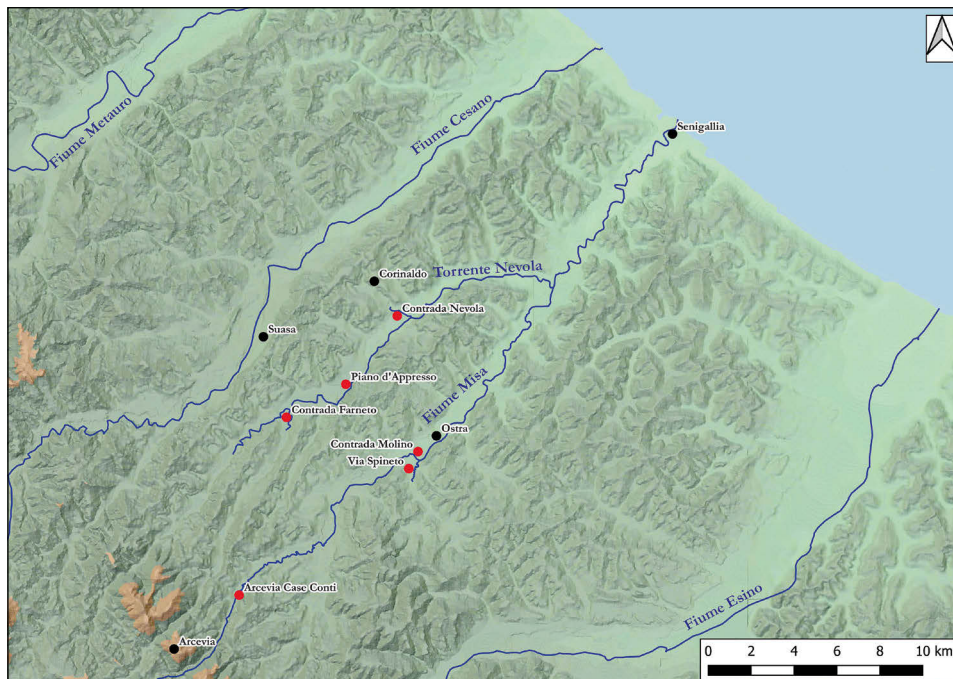


Fig. 1 – Localisation of the sites included in the SEARCH project (red dots).

recognised contexts in the same territorial compartment through aircraft flights or satellite remote sensing (BOSCHI 2018, 2022). The sites on which the project focuses are essentially five (Fig. 1): 1) Contrada Nevola (municipality of Corinaldo, Nevola valley), excavated area since 2018; 2) Contrada Piano d'Appresso (municipality of Ostra Vetere, Nevola valley), cluster of circular traces located approximately 4 km SW from Contrada Nevola along the same road axis; 3) Contrada Farneto (municipality of Arcevia, Nevola valley), large agglomeration of circular traces located approximately 3 km SW from the previous site; 4) site formerly known as 'Serra de' Conti Site 1 and 2', i.e. two groups of circular traces located on opposite banks of the river Misa in Contrada Molino (municipality of Ostra Vetere) and via Spineto (municipality of Serra De' Conti); 5) Contrada Case Conti (municipality of Arcevia, Misa valley), cluster of circular traces located a short distance from the well-known prehistoric settlement of Conelle in the upper Misa Valley.

On-field investigations are being carried out since 2023 (BOSCHI *et al.* 2024) within the framework of a ministerial concession for non-invasive surveys, which includes monitoring activities using UAVs and field surveys

over a vast area, with the aim of analysing the ancient landscape of the middle Nevola and Misa valleys in a diachronic perspective. Based on this broader mapping, on sites recognised as most archaeologically promising, non-invasive characterisation is systematically integrated by employing geophysical prospecting, and particularly magnetometry.

The following pages will focus on the integrated analysis of pre-Roman burial contexts (whether proven or suspected): following a brief overview of what is known with respect to this particular archaeological target, i.e. the so-called ‘Picenian burial circles’, the non-invasive investigations carried out at these sites in the northern Marche region will be discussed, with the aim of highlighting the contribution of geophysics in the characterisation of the buried deposit, but also and above all of the integration between magnetometry and more traditional techniques, such as aerial photography and field surveys. Lastly, some considerations will be made on the future research perspectives and on the possibility of theorising operational protocols for the non-destructive analysis and preservation of these sites, all of which are strongly compromised by modern human activity (especially agricultural exploitation); this procedure seems necessary also considering the logistical difficulty of excavation in these contexts.

2. BURIAL CIRCLES IN THE *PICENUM*: A BRIEF OVERVIEW

The matter of the ‘Picenian Circles’ is rather well-known but not exempt from oversimplifications. It is therefore worth making a few methodological and terminological clarifications: the term ‘circle’ is used here to refer to a structure consisting of an annular ditch delimiting an area reserved for one or more burials. This is a characteristic funerary manifestation that, with local variations and morphological evolutions in the diachrony, can be found from the 8th to the 5th century BCE throughout the area belonging to the Picenian culture; an area that in the history of studies, albeit with a good amount of simplification and some conflicting opinions, is generally included between the basins of the rivers Foglia to the N and Tronto to the S (LOLLINI 1976; NASO 2000, 11-38), finding a good overlap with the current administrative boundaries of the Marche region. As we shall see shortly, the specific type of circles discussed here is better documented in a more restricted area between the Metauro and Chienti rivers (Fig. 2).

In order not to deal with the complex issue of ethnic identity, which would deviate too much from the subject of this paper, it is appropriate to inscribe this brief overview of circles within these territorial limits, thus excluding the numerous known contexts in Abruzzo, which nevertheless remain a fundamental term of comparison for attempting to reconstruct the morphology of these monuments (D’ERCOLE 2023, 152-165). However,

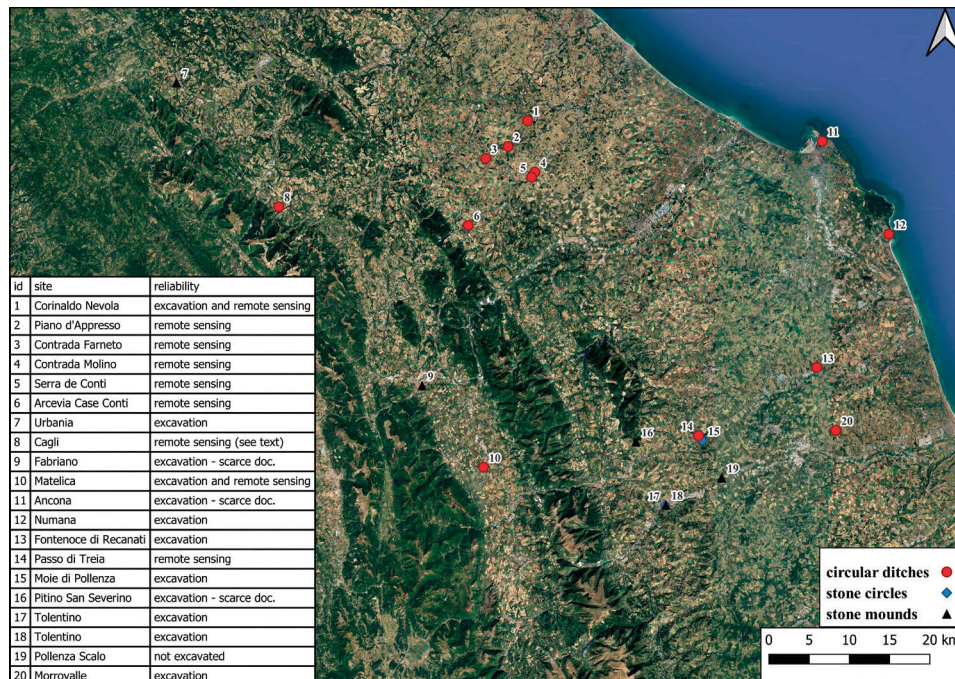


Fig. 2 – Sites mentioned in the text.

it should be reminded that the best attested typology in Abruzzo is that of stone circles that are not generally associated with a ditch; this typology is characterised by smaller dimensions (often between 8 and 10 m) than other circles discussed here, and can also be found in the present-day southern Marche, the northernmost attestation being the necropolis of Moie di Pollenza (PERCOSSI SERENELLI 2003, 619-622).

When we speak of circles in the Marche, we are usually referring to circular ditches with a diameter of between 10 and 40 m, the most common being around 20 m. The site that has provided the greatest number of this type of evidence is undoubtedly Matelica (SILVESTRINI, SABBATTINI 2008), where several dozen have been documented, distributed in various sectors and dated between the 8th and 6th centuries BCE; the best-documented phase is the Orientalising period, from contexts that have notable points of contact with those of Corinaldo. The other context that has returned a substantial number of circles is Numana, where this structure is represented, in different ways, in all the main cemetery sectors (BARDELLI *et al.* 2023, 320-325, figs. 2-4). The long continuity of occupation of the pre-Roman settlement of Numana

allows us to trace a morphological evolution of the funerary structure over time: although there are significant exceptions, we can see that in the Orientalising phase the circles are larger, up to 30 m in diameter, while from the Archaic period onwards they are around 20 m, with the last attestations in the 5th century BCE being only 12 m in diameter. In most cases at Numana the circle delimits an area occupied by several burials (between 10 and 20), probably taking the form of a family monument. The most important exception is undoubtedly the Tomb of the Queen (LANDOLFI 2001; BARDELLI *et al.* 2022), a monument from the end of the 6th century BCE, which seems to recall an older ideology (and therefore an older type of funerary structure), with a large circle of 40 m in diameter, in the centre of which are two large pits, one dedicated to the deceased and the other to the burial goods. This is perhaps a reference to the custom of the Orientalising period, when a pit was dug in the centre of large circles (in Matelica, but also in Pitino: SILVESTRINI, SABBATINI 2008, 141-153) in which the burial goods were deposited. In these cases, the deceased was probably placed at a higher altitude, which is why it is almost never recovered in this phase (this is the case in Corinaldo and in Matelica, except for two cases in which the skeleton was actually found at a higher altitude).

The trends summarised here seem to be confirmed in numerous contexts in the Marche; it does not currently appear possible to relate the size of the circle to chronology directly, although the largest manifestations, over 25 m in diameter, seem to be exclusive to the Orientalizing phase, when, however, circles of 15 m in diameter were already present, as demonstrated by the case of Corinaldo (Circle 4: BOSCHI *et al.* 2022, 5-8) or that of Fontenoce di Recanati (FINOCCHI *et al.* 2017, 139-148). The practice of dedicating a circle to a single corpse appears to be typical of the 8th century (e.g. Matelica, Numana, Ancona) and 7th century (Matelica, Corinaldo), with a resumption of the practice in Numana still in the late 6th century BC; otherwise, in the 6th century the circle always delimits a group of burials.

From a strictly structural point of view, it seems problematic to define the visible conformation of the funerary monument and whether the presence of a tumulus was foreseen: it is therefore challenging to integrate the evidence from the Marche into the broader debate on ‘tumuli’ in central Italy (see, for example, NASO 2011). The existence of a burial mound only seems certain in the few cases where it has been documented in the form of a stone cover, as is well known in Fabriano (SILVESTRINI, SABBATINI 2008, 123-138), Tolentino (MASSI SECONDARI 2003) or, more recently, in Pollenza (CASCI CECCACCI *et al.* 2018, 67-69) and Urbania (VOLTOLINI 2022). An earthen accumulation has been hypothesised in several contexts in Matelica (BALDELLI *et al.* 1999, 36-38), as well as in Numana, where it has been shown that some of the earliest tombs (8th c. BCE) maintained a buffer area throughout the long period

of the necropolis' frequentation (NATALUCCI, ZAMPIERI 2019, 644-645), and also in Corinaldo, on the basis of the area not occupied by burials until the Roman period (BOSCHI *et al.* 2022, 8). However, this remains an aspect that has never been adequately verified on a stratigraphic basis and is therefore difficult to recognise in the non-invasive characterisation process that we wish to outline here. In the same way, it is important to stress the scarcity of data on the ring ditches, which have not always been fully investigated, either in the context of old excavations for which there is insufficient documentation, or in the context of more recent preventive archaeological activities, often carried out in emergency situations: this is the case of Matelica, but also of the more recent acquisitions of Fontenoce di Recanati and Morrovalle (FINOCCHI, PIERMARINI 2020, 43-66).

In this sense, the amount of unpublished material is certainly critical, and even in the most frequently mentioned contexts, the morphology of the ditches is often not fully investigated. Another feature that has not been studied in detail (but which is attested at Matelica, Numana, Corinaldo and Fontenoce) is the presence of a gap in the ditches, which could have been used as an entrance to the area delimited by the circle (assuming the absence of a tumulus or the presence of a smaller mound only in the central sector) or as an access to the summit, useful for the maintenance of an earthen cap, subject to the natural development of vegetation over time.

Given the impossibility of characterising the burial monuments in elevation, it is appropriate to restrict ourselves to analysing the morphological element represented by the ring ditch. Another criterion that can be used to characterise these sites is the topographical distribution, the analysis of which reveals recurring patterns. The 'cluster' arrangement is common, stratigraphically attested at Matelica, but with comparable sites throughout the Italic world (an interesting case of comparison for burial circles is the Sarno valley in Campania: GASTALDI 1979; DÉ SPAGNOLIS 2001; PRAYON, KÖDER 2011). It has also been observed that ring ditches, when arranged 'in clusters', are often tangential to each other, a circumstance that also seems to be found in some sites analysed only by remote sensing and that raises further questions about the monumental arrangement of such installations when present in groups. Finally, the topographical arrangement is always the result of precise choices: the circles are systematically found in strategic locations for the control of the road network, often at river confluences and/or in particularly visible positions in relation to the landscape, over which the monument is obviously an expression of control.

In light of all these data, it is also possible to include in this preliminary typological review (to be considered *in fieri*) the evidence recognised only by photointerpretation, such as those discussed here identified in the Misa-Nevola compartment, as well as others in the Potenza valley (PERCOSSI *et*

al. 2006, 120) or in the Metauro valley near Cagli (BALDELLI, POCOBELLI 2015). This case is particularly significant due to the recognition of 64 circular cropmarks between 13 and 50 m in diameter: stratigraphic samples in the larger cropmarks have led to the discovery of dwelling structures, while no tests appear to have been conducted on the cropmarks between 20 and 30 m in diameter, which in the wake of what is stated here are more likely to be attributed to funerary structures. It is therefore appropriate to attribute only cropmarks with a maximum diameter of 30 m, most frequently 20 m, as funerary circles.

3. CASE STUDIES FROM MISA AND NEVOLA RIVER VALLEYS

With the start of the SEARCH project it has been possible to carry out new non-invasive investigations at sites previously known only from remote sensing, opening the possibility of comparison with areas already known from prospecting carried out in previous years. To date, at least partial geophysical mapping has been completed on four of the sites listed above². The most recent acquisitions concern the Contrada Molino area in Ostra Vetere and via Spineto in Serra de' Conti, which were presented in a preliminary way recently (BOSCHI *et al.* 2024, 51-56), and the Piano d'Appresso area, which is described here under a new perspective, also in light of the new field surveys³.

3.1 *Contrada Molino (Ostra Vetere) and via Spineto (Serra De' Conti)*

The first area is located in the middle valley of the Misa river, a short distance from the Roman town of Ostra, at the confluence with a small stream, at a point where the river serves as a boundary between the municipal areas of Ostra Vetere to the N and Serra de' Conti to the S. On both banks of the river, the aerial survey, supplemented by an analysis of the satellite images from May 2020 available on Google Earth Pro, has made it possible to identify two clusters of circles (at least 14 in total: Fig. 3) with a diameter of between 20 and 35 m (BOSCHI, SILANI 2013; BOSCHI 2022). As part of the new field activities in 2023, it was possible to complement this preliminary reading with a field survey of both areas and a geomagnetic prospection of the sector on the hydrographic left of the Misa (Contrada Molino). The

² The geomagnetic survey at Contrada Nevola and Contrada Farneto was carried out with a GEM Systems magnetometer-gradiometer specifically configured for an archaeological application (BOSCHI 2009); at Contrada Molino and Piano d'Appresso, a Foerster FEREX 4.0434 gradiometer equipped with two Fluxgate sensors positioned 15 cm above the ground and 50 cm apart was used. In all cases, profiles were acquired every 50 cm.

³ The visibility conditions in each sector are given in the corresponding paragraphs; the field survey was always carried out by recording the position of the finds using the smartphone provided by each operator, with an average accuracy of 5 m. The point data were then reported in the GIS environment.



Fig. 3 – Cropmarks found in the Contrada Molino and via Spineto sites (left) and their cartographic restitution (right).

systematic survey was only able to cover the same area N of the river studied by geophysics, while to the S it was possible to investigate a larger extension up to via Spineto (Fig. 4).

In Contrada Molino the geomagnetic survey (Fig. 5) covered a total area of 2.2 hectares. Despite some modern disturbances in the southernmost and northernmost sectors, two circular anomalies of 30 and 25 m in diameter, tangent to each other, appear clearly in the centre of the survey area, corresponding to what was found in the aerial photographs. The third circle detected in this sector is not clearly visible, possibly due to a different state of preservation of the ditch. The fact that the archaeological deposit here has been considerably affected is also confirmed by the field survey which, despite being carried out in less-than-optimal conditions (after the harvest but before ploughing), yielded a significant concentration of archaeological material: numerous fragments of worked flint and tiles, with little evidence of pottery. However, the presence of a bronze phalera stands out as a clear sign of Picenean material culture, attested in tombs from the 7th and first half of the 6th century BCE in Novilara and Numana.



Fig. 4 – Distribution of archaeological finds at the Contrada Molino and via Spineto sites during the field survey.



Fig. 5 – Results of the geomagnetic survey at Contrada Molino.

In the via Spineto sector, to the hydrographic right of the Misa river, it was not yet possible to carry out a geomagnetic prospection (which is however planned with the continuation of the research); however, a systematic field survey was carried out over a total area of 30 hectares, under optimal visibility conditions, approximately two months after ploughing, with a group of four surveyors placed at an inter-personal distance of 5 m. During the fieldwork, two distinct concentrations of outcropping material could be recognised. The first (UT1) coincides for the most part with the area of the circles: here, in addition to the usual presence of flint, there is a considerable number of fragments of pottery clearly referable to the pre-Roman period, as well as a fragment of bronze foil, all strong indicators of the funerary nature of the buried context, evidently already damaged by agricultural work. The second concentration (UT2), located further N in a slightly raised position, is of great interest due to the presence, amidst building and ceramic material from the Roman phase, of tiles that can be preliminarily dated to between the 4th and 3rd centuries BCE. Although it falls outside the specific focus of this contribution, it represents an important acquisition that could significantly

enrich the dossier on pre-Roman settlements in the Marche region, which is still known to be notably incomplete (CIUCCARELLI *et al.* 2022). In a wider perspective, the finding contributes to the analysis of the dynamics of occupation of the landscape in the pre-Roman period, albeit at a later stage than that of the funerary circles.

3.2 *Contrada Piano d'Appresso*

In the course of 2024, the Piano d'Appresso site, previously known for circular cropmarks identified only thanks to the aforementioned May 2020 satellite images available on Google Earth Pro (BOSCHI 2022, 173), was also involved in various non-invasive investigations: the traces were therefore subjected to a process of 'validation', so to speak, through new drone flights (which actually documented at least one circle in May 2024: Fig. 6), geophysical survey and field survey. The total area covered by magnetometry in this case is 0.6 hectares (Fig. 7). Excluding also in this case the north-westernmost



Fig. 6 – Cropmarks detected on satellite images (bottom left) and oblique UAV image (top left); on the right, cartographic restitution of the traces at Piano d'Appresso.



Fig. 7 – Results of the geomagnetic survey at Piano d'Appresso.

sector, where the strong magnetic disturbances are probably to be attributed to modern human activity, the central sector is rather revealing, with traces clearly overlapping with the already known cropmarks. There are two semicircular anomalies, probably interpretable as sections of annular ditches (presumably between 15 and 22 m in diameter), and a third circle with a diameter of 20 m, which is entirely recognisable; the geophysical survey would also appear to show the presence of a ditch break, and thus an opening, in the NW sector, a circumstance that is in direct comparison with the circles documented by the Contrada Nevola excavation (BOSCHI *et al.* 2024, 60, footnote 26). Finally, some dipolar anomalies are noted to the SE of these circles, and perhaps, given the context and the comparison with Contrada Nevola, they are attributable to different types of burials.

In this case the field survey (Fig. 8), carried out in October 2024 in excellent visibility conditions, after the ploughing, by a group of four operators placed at a regular distance of less than 5 m, did not allow us to recognise a concentration of material comparable to that observed in other sites, characterised by a very substantial presence of worked flint. Rather, the area presented

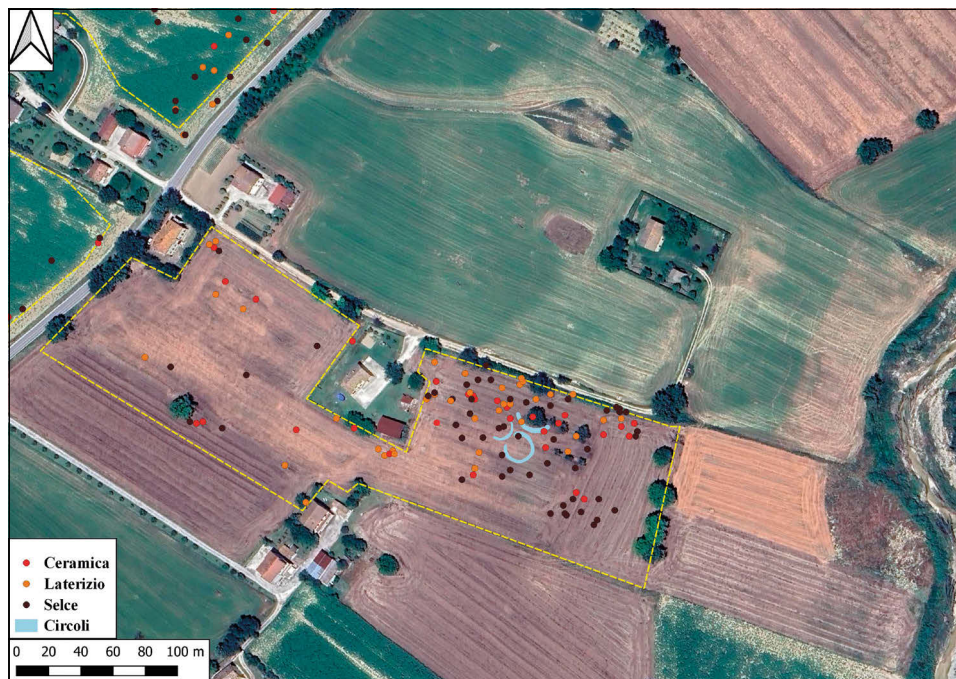


Fig. 8 – Distribution of archaeological finds at Piano d'Appresso during the field survey.

a sparse scatter of such material, together with a few fragments of tiles from the Roman period (referable to a rural type of settlement well documented by the survey in the neighbouring fields) and pottery exclusively referable to the Middle Ages. This is a relevant piece of information, which confirms the importance of integrating different methods of non-invasive investigation: the survey materials, although they are certain evidence of an ancient occupation protracted over time, would hardly have allowed for a precise recognition and interpretation of this site, if not adequately supported by aerophotographic acquisitions and now by geophysical prospecting.

Bearing in mind the random component inevitably inherent in a field survey datum, this lack of archaeological material may suggest that the deposit was less affected in this context. On the other hand, the morphology of the anomalies visible by remote sensing, and even more so by magnetometry (which only returns limited sections of some of the ring ditches), suggests that these circles are not completely preserved: the small amount of recorded finds would therefore be due to a significant disturbance of the site, possibly already in the Roman period.

3.3 *A comparison between traces and sites*

As already pointed out, the new acquisitions are in direct continuity with previous investigations that already included prospections at Contrada Farneto and Contrada Nevola. The latter context obviously remains a benchmark, also for the application of further geophysical techniques, in particular geo-electricity (both traditional tomography and apparent resistivity: BOSCHI 2020b, 151-154), which proved to be particularly performing in such a context. However, the new investigations confirm the effectiveness of the geomagnetic method by offering even more intelligible data than in the case of Corinaldo, where the traces of the circles were in several points 'obscured' by the consistent presence of the magnetic anomalies pertaining to the Roman tombs (an association that remains exclusive to that context).

At a comparative glance (Fig. 9), the sites and the anomalies themselves, which can now all be more convincingly interpreted as funerary circles, show clear points of contact, leading to the hypothesis of shared ideologies and strategies in the monumental arrangement of the necropolises and the occupation of the landscape. First, a systematic strategy for the installation of the necropolises is confirmed, with the choice of the most stable geomorphological units of the river terraces, whose favourable conditions for occupation in ancient times are now also supported by survey data, which in all cases attest to a prolonged occupation over time. The presence of Roman building materials is significant, although they are characterised differently in each case. They are linked to a rural settlement in the area that has been widely studied but still needs to be covered in depth (SILANI 2017). Even more significant are the concentrations of worked flint, which are present in all the sites but which the territorial surveys currently underway testify to be widely distributed throughout the Nevola valley (BOSCHI *et al.* 2024, 57); this indicates an even more ancient frequentation never studied in this area.

Going on to analyse the individual circular traces, also in light of the general considerations on funerary structures expressed at §2, several features are worthy of attention. In terms of size, the known parameters seem to be confirmed, with few examples of circles reaching 30 m and a larger number of attestations between 15 and 20 m. The presence of a gap in the ditches seems to be a recurring but not systematic condition, attested in two cases at Contrada Nevola, two at Contrada Farneto, two at via Spineto and in the only specimen whose circumference is fully visible at Piano d'Appresso. It can be seen that the ditches in the geomagnetic maps of Contrada Molino and Contrada Farneto are *de facto* tangent, without any solution of continuity, while the circles of Piano d'Appresso and Contrada Nevola are only juxtaposed: however, the excavation data of the latter site confirm that the agricultural works have significantly affected the ditches dedicated to the

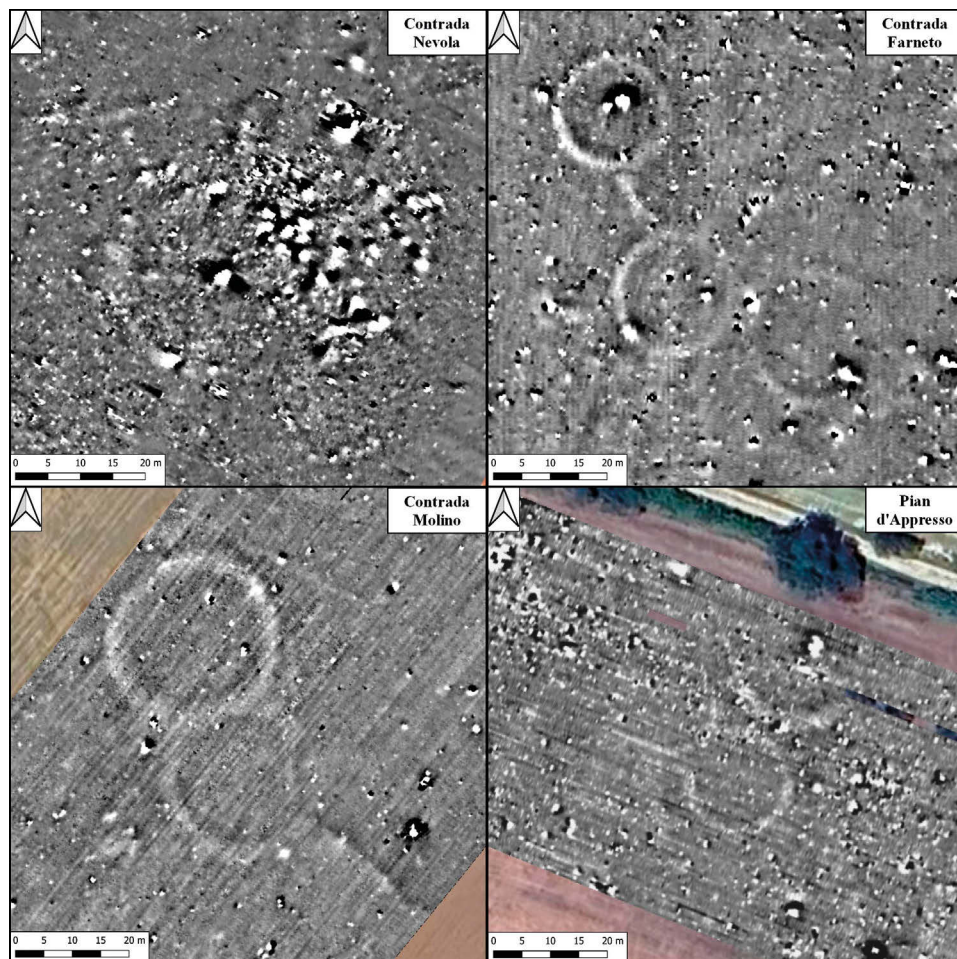


Fig. 9 – Comparison of the results of the geomagnetic surveys conducted. For all maps the scale is normalised to ± 3 nT/m.

grave goods and, realistically, also the ditches themselves, at least by 0.5 m. Therefore, considering the section of these ditches (which, when investigated stratigraphically, turned out to be ‘V-shaped’), it is possible that also in this case the ditches were originally tangent to each other, replicating a highly widespread pattern, as has been shown. The same circumstance, even in the absence of stratigraphic evidence, is perhaps also conceivable at Piano d’Appresso: the site would be plausibly depleted on the basis of field survey data and the visibility of circles from remote sensing and geophysics.

These considerations, instrumental to a non-invasive characterisation of the buried record and an assessment on its preservation, can ultimately also take into account in the magnetometry reading the presence of strong punctual magnetic anomalies near the geometric centre of the circles, detectable at Contrada Nevola, Contrada Farneto and perhaps even in one case at Piano d'Appresso, an occurrence closely linked to specific materials present in the burial pits (BOSCHI 2020b).

4. OPERATIONAL INTERVENTION PROTOCOLS FOR THE ANALYSIS OF PRE-ROMAN BURIAL SITES: CONCLUDING REMARKS AND FUTURE PERSPECTIVES

At the end of this brief investigation, the importance of an integrated analysis using different survey methods becomes clear: an approach that, especially in contexts such as those studied here (where excavation is a logistically complex practice that also requires a significant economic commitment for the conservative restoration of artefacts), can become a stable practice within an effective research and prevention strategy. To apply this procedure on a large scale, it is necessary to define effective intervention protocols that are as replicable and sustainable as possible, compatible with the requirements of knowledge and protection of the territory, which must necessarily be included in long-term programmes.

It has already been noted that the first identification of the Contrada Nevola site from aerial photography was made possible thanks to particularly favourable conditions between 2014 and 2015, a circumstance that underlines the importance of constant and protracted monitoring activity (BOSCHI 2020b, 150-151). This long-term commitment was also the basis for the recognition of the other sites discussed here, the presence of which only emerged in certain years and in the presence of specific weather and soil conditions. This idea has now been widely adopted and put into practice in the Marche region (see the cases already mentioned in §2 of Cagli, Pian dell'Incrocca in Matelica, Passo di Treia, Morrovalle), and the same approach, with an important integration of legacy data, has also been adopted in Abruzzo for the Capestrano site (FERRERI 2018). This practice, which for a long time required complex planning to manage and was in any case subject to a high degree of randomness (which is still significant today), is now generally more sustainable with the use of drones, even those of commercial use.

The contribution of geophysics in this type of context can certainly be very significant, as has been shown, both as a tool to validate the hypotheses initially made based on photointerpretation alone, and to offer a more precise characterization of the individual site. However, it is necessary to emphasize some limitations inherent to this technique, mostly on a logistical level, which do not allow its systematic application: firstly, although this methodology is

increasingly widespread in the archaeological field, the tools and expertise required may not always be available (or economically viable) within the numerous preventive archaeological procedures that may involve contexts of this type. There is also a second logistical aspect, linked to the location of the circles, which, as we saw in the initial review, are often located in cultivated fields (we do not therefore consider those near built-up areas, such as in Numana, which clearly pose other obstacles to the application of magnetometry): the time window functional to a geomagnetic survey is therefore rather reduced, being limited to the period (increasingly shorter in recent years in the Marche region) between harvesting and ploughing.

More extensive is the timeframe suitable for traditional field survey, which, in the sites we have considered, has brought new, sometimes even surprising data, but that could legitimately be considered insufficient to support the protection (and especially the restriction) of the archaeological context (see the case of Piano d'Appresso in §3.2). For this specific purpose, therefore, the most cost-effective non-invasive survey technique is the aerial survey, to be carried out especially in late spring, in coincidence with the ripening of the crops. In this regard, multispectral remote sensing could open up new perspectives for analysis, both at a distance and, above all, at close range, using sensors mounted on UAVs, which are becoming increasingly widespread and affordable. This technique, which has been successfully applied in recent years in the archaeological field, also for the detection of circles in the Marche region (CICCONE in press), could provide data with a reliability comparable to that of magnetometry, eliminating the problem of direct access to the field (although the time window of applicability is in any case very limited and strictly dependent on the type of crop: see e.g. MATERAZZI, PACIFICI 2022, 5). According to the same principle, a promising development could be the application of magnetometry from a drone (see for example STELE *et al.* 2023): an experimentation at one of the sites described here could in this sense offer a useful term of comparison to test the reliability of the technique, which, however, currently remains prohibitively expensive for large-scale application for protection purposes.

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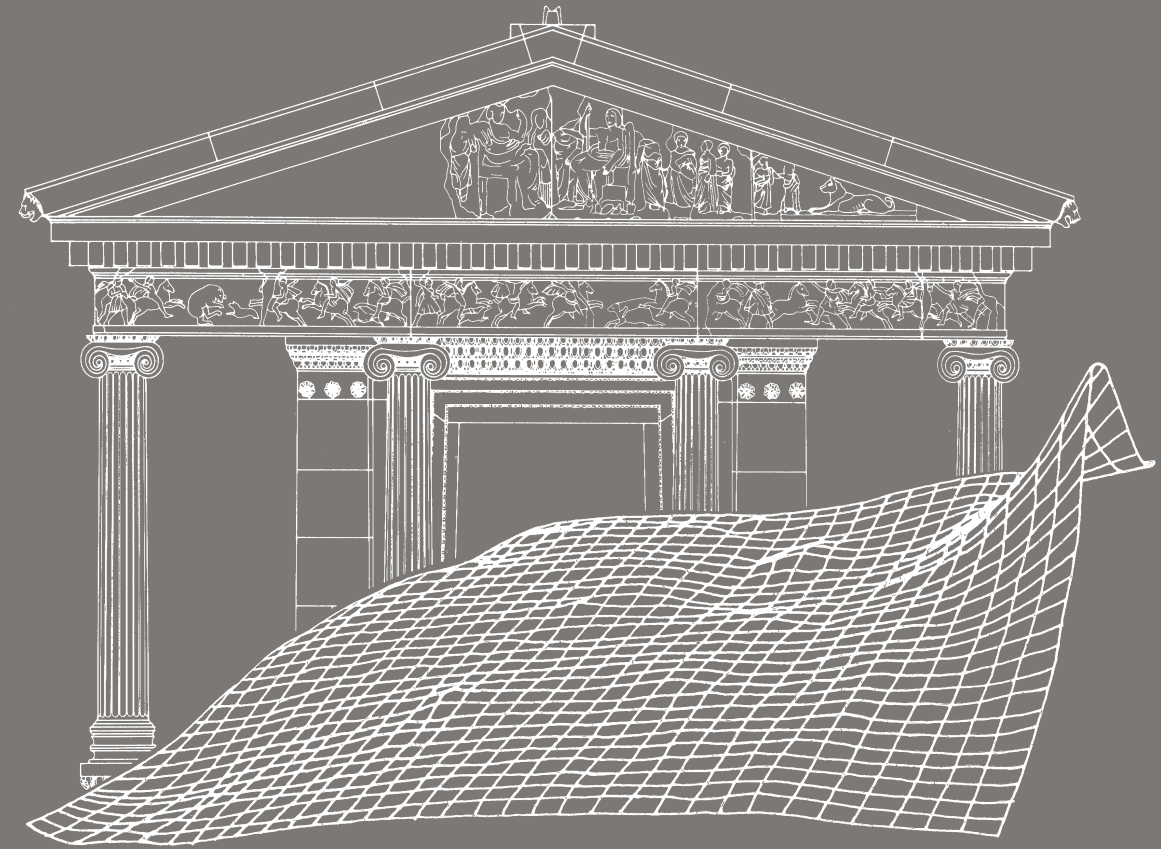
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ABSTRACT

The paper focuses on several sites in the northern Marche region identified by the presence of circular traces detected by remote sensing and tentatively interpreted as funerary monuments of the pre-Roman period. After a brief overview of this characteristic type of archaeological evidence, the results of recent field activities aimed at studying these sites with an integrated approach, including remote and proximal sensing, geophysics and field survey, are presented. The final aim is the theorisation of operational intervention protocols, functional for both territorial research and the safeguarding of the buried archaeological heritage, as part of a prevention strategy based on the non-invasive characterisation of contexts.

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