SHARING ASSESSED KNOWLEDGE, SHARING HERITAGE

1. Premise: Tangible Cultural Heritage as systems of contexts and processes

Within the CHANGES Project (Cultural Heritage Active Innovation for Sustainable Society), Spoke 8 focuses on integrating advanced technologies and scientific approaches to increase knowledge and enhance sustainability and resilience of Tangible Cultural Heritage (TCH). This Spoke thoroughly addresses the impact of anthropogenic, natural, and climatic factors on TCH, promoting integrated conservation strategies that consider the interconnection between cultural, social, and economic aspects. Furthermore, it focuses on the development of knowledge infrastructures and the promotion of participatory governance models that actively involve both public and private entities, as well as local communities, to ensure a sustainable and inclusive management of cultural heritage. The underlying premise of this research is that Tangible Cultural Heritage (TCH) can be conceptualized as a network of material entities – ranging from individual objects to structures and architectural complexes – distributed across space.

As physical entities identified (also) by specific spatial coordinates, elements of TCH inherently establish relationships with their surrounding environment. These relationships may be functional in nature or dictated by spatial proximity. Moreover, they are not static but subject to transformation over time. Similarly, the material entities themselves undergo modifications, as exemplified by architectural restorations or interior refurbishments that alter the fabric of a building. The interplay between these elements and their evolving relationships gives rise to contextual frameworks, which can be further aggregated into broader, more complex systems.

When applied to the past, this contextual-processual approach must contend with the fragmentary nature of the archaeological record. The original integrity of material entities and their relational networks has largely been lost, leaving only dispersed remnants. Objects often survive in an incomplete or deteriorated state, while architectural remains are typically reduced to ruins, stripped of the furnishings, decorative programs, colours and structural elements that once defined them. Moreover, the relational networks that once underpinned these contextual entities have been irrevocably disrupted.

Given this premise, the study of TCH necessitates a dual methodological approach (Fig. 1). The first objective is ontological, seeking to systematically document the fragmented remains of contexts and contextual systems. This process extends beyond the direct archaeological record to incorporate a
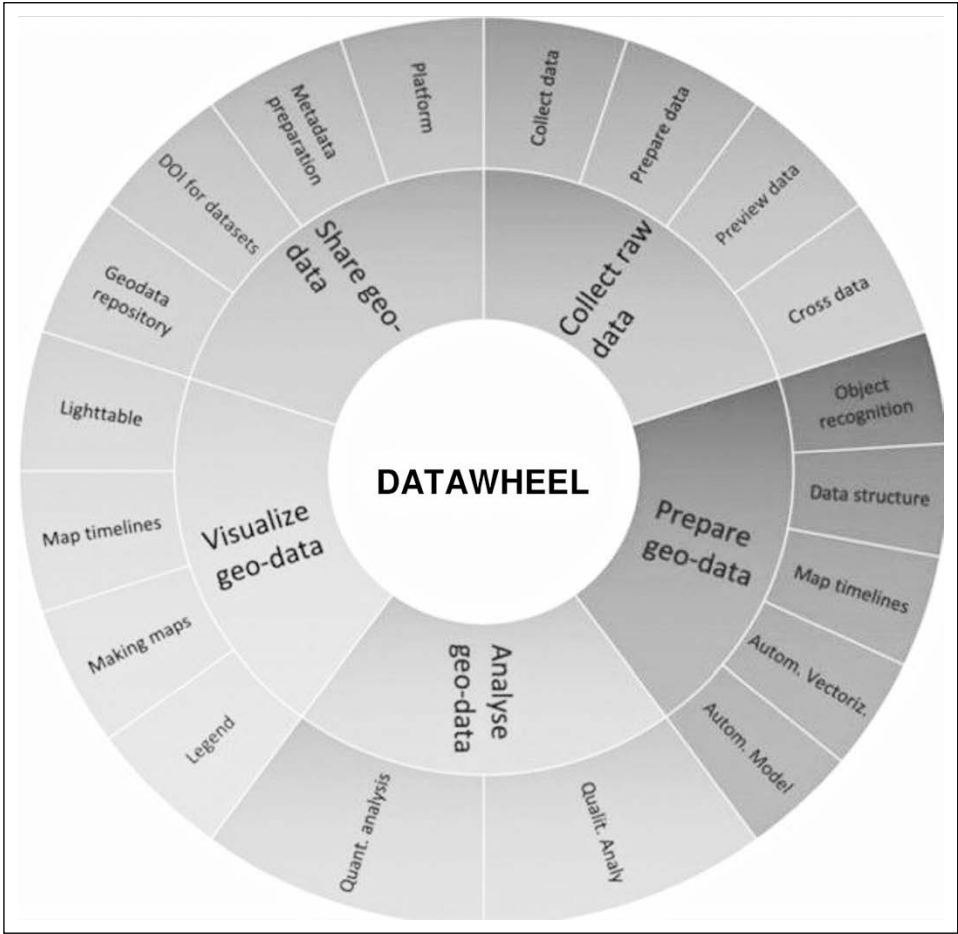
Fig. 1 – Datawheel methodology (el. Authors from Hein *et al.* 2022, fig. 31.1).

diverse range of historical sources, including literary accounts, ancient images (such as e.g. reliefs, images on coins), historical cartography, and post antique visual representations such as paintings, prints, drawings, and photographs from the Renaissance to the modern era. Any of these documents/sources of information can be located somewhere and dated – that is ordered spatiotemporally – thereby enabling the integration of many different kinds of information into topographical reconstructions.

The second objective is reconstructive, aiming to reassemble past contextual entities by examining the interrelations among fragmented

elements of TCH. Through the systematic cataloguing, classification, and spatiotemporal contextualization of these fragments, separate datasets can be transformed into systems of structured knowledge facilitating the reconstruction and dissemination of historical processes and cultural frameworks. This paper presents a selection of case studies that illustrates scientific approaches, common rules, methods, technologies and preliminary outcomes developed by the project.

2. Procedures for the creation of integrated archives and infrastructures of knowledge

2.1 *Sharing rules for assessing TCH data*

The first outcome of Spoke 8 has been to establish common methodological and operating rules which include: sharing both two-dimensional and three-dimensional information sources within a georeferenced geographic space; using the RDN 2008 coordinate system; integrating one-dimensional (textual), two-dimensional (graphic and topographic processings), and three-dimensional (3D models) data; adopting sustainable technologies already developed by other software designers; managing and assessing datasets composed of varied information sources; and developing best practices to enhance the understanding of TCH contexts while implementing strategies for their protection, enhancement, and communication of the associated historical and cultural contexts.

2.2 *From the Knowledge Map to contexts*

All the data have been collected in specific relational databases, which are part of an Information System. All archaeological, architectural, and topographical evidence, either visible or not but of certain location, can be georeferenced within an absolute coordinate system. In contrast, evidence related to epigraphic, textual, cartographic, iconographic, palaeobotanical, and paleoanthropological sources can be georeferenced either in relation to a fragment of the already mapped TCH (either visible or attested/documented) or to areas or sectors of the territory lacking archaeological, architectural, and topographical evidence. The first topographic representation of these data constitutes the Knowledge Map. Within it, where the information accumulates significantly or where it is few but sufficiently detailed, we can identify contexts that can be defined as UTs (Topographical Units; Carandini, Carafa 2017; Carafa 2021).

The UTs have a dual informational value and must be considered from two perspectives: topographical/morphological – as their position and architectural shape define the space in which they are located – and chronological, as each TU can be characterized by transformations that have

occurred over time. Topographical Units (UTs), when aggregated, can define large topographical ensembles that constitute complex realities, forming the different structures of the ancient landscape. For example, multiple UTs can constitute a complex (such as a boundary wall, altars, and temple of an extra-urban sanctuary) or a site, meaning a place considered and perceived as a unified entity in the landscape (for example: all the tombs of a necropolis, or all the buildings and infrastructures of a city), ultimately shaping the landscape.

3. Assessment and pilot cases

Such an assessment creates a series of cadastres in which all the documents have been (re-) connected to places. Thus, triggering a process of reconfiguration, reconstruction, and communication of monuments, ancient settlements, and, more generally, past (either ancient or post antique) architectural and topographical realities. These reconstruction activities push forward the assessment process, leading to different levels of analysis, from the reconstruction of frameworks to the storytelling and communication of the histories of the territories. This will be highlighted by the following case studies. They have been identified on the following criteria: readability of architectural and topographical features, along with their potential for geolocation and graphical representation; large-scale representation; extension no smaller than at least an extended urban area; multi-layered historical context; diversity and complexity of sources.

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3.1 *Ancient Latium project*

Ancient Latium project involves the mapping, classification, and reconstruction of the features that shape Lazio's landscape from prehistory to the Middle Ages (Fig. 2). This project builds upon the work carried out between 2018 and 2022 as part of an inter-institutional agreement between the Lazio Region and Sapienza University of Rome. The project aimed at the digital mapping of archaeological sites and assets dating from the 9th century BCE to the 6th century CE, located in the southern Lazio region, between the Tiber and Garigliano rivers (http://www.lazioantico.it/; Capanna, Carafa 2018; Carafa, De Paolis 2021; Carafa *et al*. 2021; Carafa 2022, 2024; Ippoliti 2023). The Ancient Latium project, in this context, served as a 'good practice' that connected the key players in scientific knowledge with the digital infrastructure that had been developed and enhanced in previous years through various innovative tools (such as the Single System for Cataloguing and Using the Cultural Heritage of the Lazio Region, the Regional Information System, the Regional Technical Map, and the open data portal).
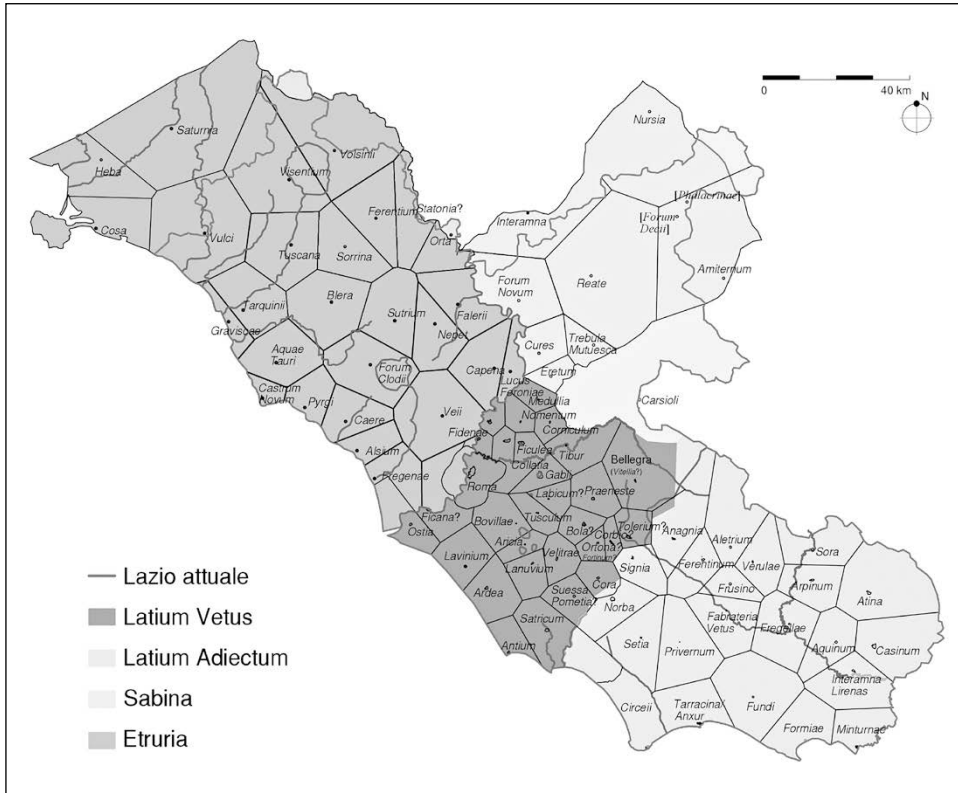
Fig. 2 – Map of ancient *Latium* with main sites and territories within the boundaries of Lazio Region.

The project promoted by Spoke 8 expands the disciplinary analysis by including epigraphical, archaeobotanical and paleoanthropological data, while also broadening its scope chronologically, covering a period from prehistory to the medieval era, and geographically, focusing on northern Lazio, which includes the provinces of Rieti and Viterbo, corresponding to the ancient territories of Southern Etruria and Sabina (including the Faliscan and Capenate areas). The research aims to present a historical narrative of the transformation of this region, analysed through the changes in its urban and rural landscapes. The vast amount of collected and standardized information will allow for a wide range of analyses aimed at defining regional and transregional processes, focusing on various topics such as the emergence, development, and eventual collapse of settlement systems. All of this aims to define different stages of cultural, social, and political complexity in the analysed territories.

The Ancient Latium project, in addition to having specific objectives, also enables the development of various thematic analyses from chronological, geographical, and topographical perspectives. In this regard, the first analysis has been focused on settlement patterns and their relationship with
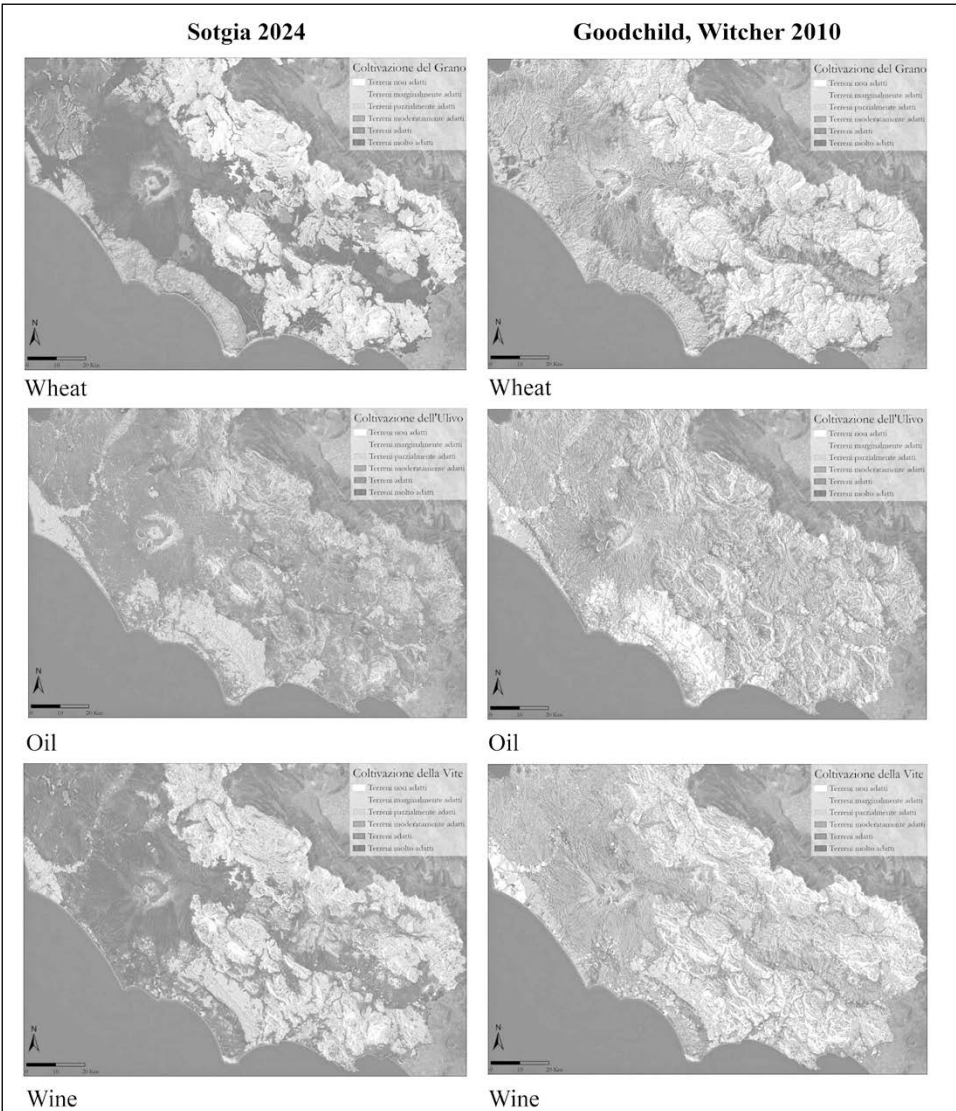

Fig. 3 – Land exploitation patterns and agricultural landscapes in Roman ancient *Latium* according to Goodchild, Witcher 2010 and Sotgia 2024 models.

environmental contexts during the prehistoric periods, examining how human settlements interacted with and adapted to their surrounding landscapes throughout time (Recchia, Marconi in press).

The second analysis investigated land use and agricultural productivity in Roman times, exploring how communities exploited and managed the land. It explores agricultural techniques, crop production, and the broader economic and social consequences of land use. The goal is to understand the connection between agriculture and the Roman economy, highlighting how natural resource exploitation played a role in the communities' growth and stability. Analyses of soil productivity have been conducted for vineyards, olive groves, and cereals, considering factors like geology, slope, exposure, elevation, humidity, soil fertility, erosion, and proximity to watercourses. These analyses are based on the *Atlante dei suoli del Lazio*, literary sources (notably works by Marcus Porcius Cato, Marcus Terentius Varro, Lucius Junius Columella, and Pliny the Elder), and GIS-based calculation methods (Goodchild, Witcher 2010; Sotgia 2024; Carafa, De Paolis 2025; Fig. 3).

A third level of analysis focuses on the environmental and historical-topographical study of a sub-regional area between Lazio and Umbria, falling across the northern border of ancient Sabina. This analysis examines the interaction between the natural environment and historical developments in the region, aiming to uncover the topographical features and how they influenced settlement patterns, cultural practices, and the broader historical context of the area. Specifically, the analysis focuses on the territory corresponding to the municipalities in the province of Terni, within the Valnerina region (Arrone, Ferentillo, Montefranco, Narni, Polino, Stroncone, Terni/*Interamna Nahars*). This area, which currently lacks a comprehensive assessed historical and territorial analysis, is a culturally rich and stratified context, shaped by the succession of different populations over time. It is a region where settlements and sanctuaries are found in low-density urban areas, and the relationship between archaeology and the natural and hydrogeological landscape highlights the region's territorial significance and uniqueness.

Given the complexity and multi-layered nature of this context, the analysis of this territory has been structured as an independent pilot case, named the Valnerina project, yet connected to the Ancient Latium project. Due to the largely rural nature of the area under study, it has been deemed essential to reconstruct and spatially analyse the physical landscape using a dataset that includes all the geo-environmental information required to reconstruct various geomorphological contexts. These physical landscapes, as parts of the cultural landscapes, include hills and valleys, exposed and subterranean rock, as well as deposits left by glaciers, rivers, and lakes that are perennial, seasonal, or now dried up. They are environmental contexts

subject to varying and modest degrees of change compared to anthropogenic contexts, yet they still evolve over time and influence settlement patterns and land use (McKnight, Darrel 2008).

Starting from a heterogeneous data set, it is possible to reconstruct the physical landscapes that characterized the study area from prehistory to the medieval period. To fill this dataset, various sources of information were gathered, including literary, toponymic, palaeobotanical, palynological, paleoenvironmental, and iconographic data, as well as landscape reports, regional technical maps, soil maps, geological maps, and digital elevation models (DTM, DSM, and DEM). This approach will enable the reconstruction, classification, and characterization of paleo-environmental
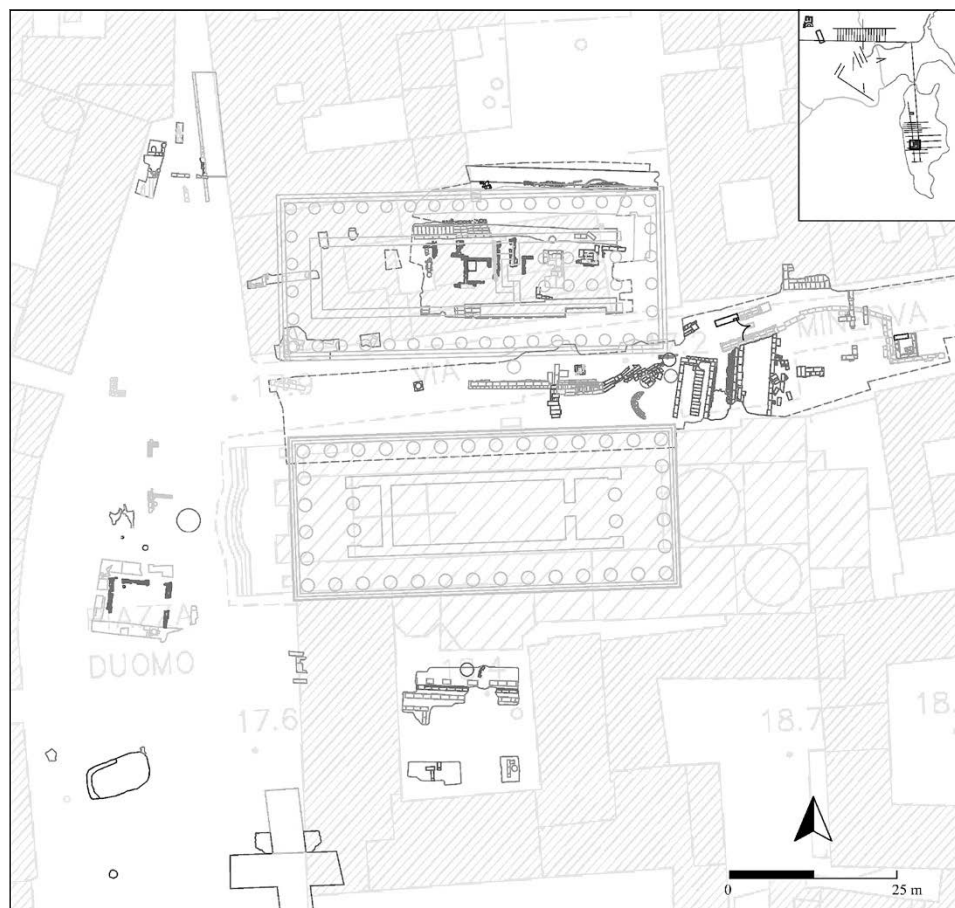
Fig. 4 – Syracuse, piazza Duomo area. Archaeological map of the evidence pertaining to the ancient city.

transformations, as well as the identification of forest resources, mining areas, and wetlands within the geographical space. Moreover, it will allow for the calculation of solar exposure and the examination of seasonal landscape changes, shedding light on how these factors influenced past human activities and settlements. The analysis of these information sources will enable the creation of digital orographic models, spatial analyses, and the definition of physiographic classes, all integrated within the historical and archaeological landscape context.

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3.2 *Syracuse - Toward an Atlas of an ancient Mediterranean metropolis*

Atlases represent a powerful instrument for cultural communication, enabling the narration of a place's history. The use of specifically designed cartography to illustrate the evolution of a landscape – whether a territory, an urban area, or a specific sector – contributes to visually reconstructing the key stages of historical, urban, and architectural transformations. We have previously employed this narrative approach to trace the changes in the urban landscapes of Rome within the Aurelian Walls, spanning from the 8th century BCE to the 5th century CE (Carandini, Carafa 2012, 2017).

As part of the CHANGES Project, we have started a new endeavour dedicated to the creation of an *Atlas of Ancient Syracuse*, following in the footsteps of the work created by Cavallari more than a century ago (Cavallari, Cavallari 1883). Since that time, the enormous amount of archaeological, architectural, and epigraphic data that has emerged in the city has never been systematized and transformed into a system of knowledge aimed at the narration of the history of the changing urban landscapes of Syracuse. Consequently, the Ancient Syracuse Atlas Project aims to pursue this goal covering a chronological span from pre/protohistoric evidence predating Greek *polis* to the de-structuring of the Roman urban framework. This work has been made possible through an Agreement between the Dipartimento di Scienze dell'Antichità of Sapienza University of Rome, the Assessorato Regionale dei Beni Culturali e dell'Identità Siciliana and the Soprintendenza per i Beni Culturali e Ambientali di Siracusa.

A significant contribution to this project derives from the integration and systematic reassessment of legacy data through specific classification procedures. These data, produced by scholars in vastly different historical and methodological contexts, require careful re-examination using contemporary archaeological and epistemological approaches. In this specific case, the access to the archive of excavation notebooks and diaries from Paolo Orsi's archaeological investigations has provided new and crucial insights into the urban and architectural organization of several sectors of Syracuse.

A preliminary outcome of the research is the assessment of a particularly significant sector of the ancient city, corresponding to present piazza Minerva and the Archbishop's Palace on the island of Ortygia. In antiquity, this area was part of the major central sanctuary of the island. Published documentation from excavations conducted in this sector by P. Orsi, G.V. Gentili, P. Pelagatti, and L. Guzzardi (ORSI 1910, 1918; GENTILI 1967; PELAGATTI 1973, 1982; GUZZARDI 2012), has been critically re-examined alongside unpublished documents from Orsi's investigations in piazza Duomo (1922). This reanalysis has enabled the correlation, phasing, and chronological attribution of stratigraphic sequences and architectural structures. As a result, the historical development of this part of Syracuse's urban landscape has been articulated into five major chronological periods, further subdivided into ten phases, spanning from the Bronze age to the Roman era. Additionally, for each chronological phase, specific contexts and monuments have been identified and classified in UTs (see above): their construction, modification, and destruction marked the transformation process of this area (Fig. 4).

3.3 *Assessment for museums of local community. Amendolara and landscapes of ancient Sybaritides*

The historical narratives of different sites within a given territory, when examined through the lens of contexts and processes within a holistic framework, generate increasingly complex layers of assessment and provide critical insights for both museums and local communities. A compelling example of this methodological approach is the ongoing research in the territory of Amendolara, in the Upper Ionian region of Calabria. Here, a multi-scalar investigative strategy – ranging from sub-regional territorial analyses to the detailed study of individual contexts and assemblages of material culture – has been implemented through a formal collaboration agreement with Soprintendenza Archeologia, Belle Arti e Paesaggio per la provincia di Cosenza and Museo e Parco Archeologico di Sibari.

Within the broader scope of this research, encompassing the entire Upper Ionian area, a systematic study has been undertaken to gather and analyze all available data concerning past human settlement patterns, the diachronic distribution of habitation sites, and their functional classification (e.g., primary centers, villages, farmsteads, villas, necropolises, and production areas). This investigation has significantly benefited from datasets compiled during an extensive archaeological survey program conducted between 2000 and 2005, which aimed to reconstruct the ancient agrarian landscapes within the current municipal boundaries of Amendolara and Castrovillari (CARAFA 2019, 2025 with previous bibliography; CAPANNA, CARAFA 2021). The systematic surface survey – covering the entirety of the
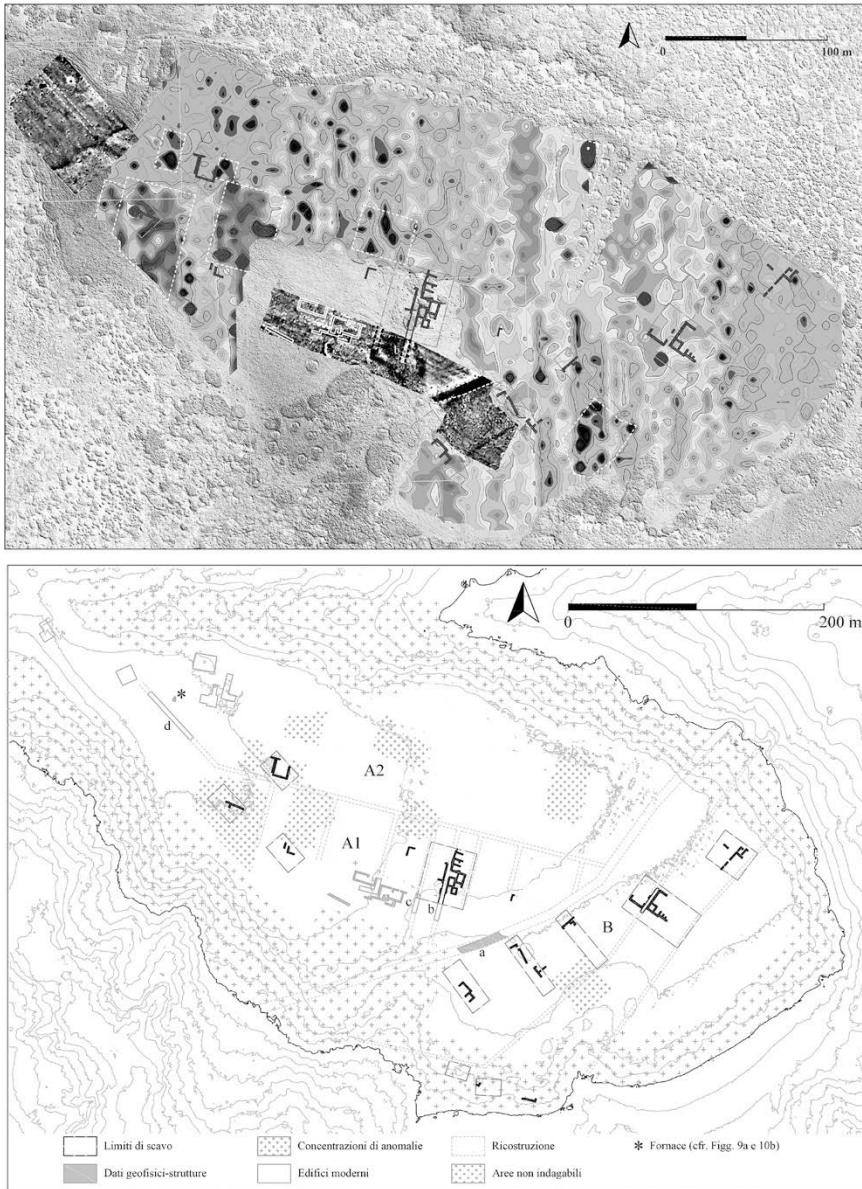
Fig. 5 – Amendolara (CS). Distribution of anomalies detected through magnetometric survey and identification of profiles and orientations detectable and compatible with buried archaeological remains. Above, in black, the archaeological remains identified during stratigraphic excavations; below, restitution of the distribution, extent, and configuration of anomalies compatible with buried archaeological remains and the main orientations detected.

Amendolara municipal territory and approximately 40% of that of Castrovillari – has yielded a substantial body of data, allowing for the reconstruction of settlement dynamics, the processes of demographic expansion and contraction, and the strategies employed for the exploitation and management of agricultural resources.

In parallel, a comprehensive cataloguing and analysis of artifacts and material culture assemblages recovered through stratigraphic excavations and field surveys has been initiated. These materials have been classified according to their respective settlements and chronological frameworks to reconstruct the networks of production and exchange that characterized this territory in antiquity.

A more targeted investigation has been dedicated to the topographical structure of a particularly significant settlement located on the plateau of San Nicola di Amendolara (CS) and to the socio-cultural identity of the community that once inhabited this site.

Archaeological research on the San Nicola plateau has been conducted through multiple field campaigns between 2021 and 2022. The methodological approach has integrated: 1) aerial mapping of the site and its surrounding landscape using drone technology and 2) geophysical prospections. The aerial survey aimed at generating a high-resolution three-dimensional digital terrain model (DTM) of the plateau, providing a detailed geomorphological framework within which to contextualize the spatial distribution of previously documented archaeological features (DE LA GENIÈRE 1970, 1991; DE LA GENIÈRE, NICKELS 1975). Additionally, multispectral surface analysis was conducted to enhance the identification of potential archaeological anomalies.

Geophysical surveys, carried out over two distinct campaigns (2021 and 2022, CARAFA *et al.* 2023; CARAFA, DE STEFANO in press), initially focused on selected sample areas to test the diagnostic potential of different survey techniques, specifically magnetometry and ground-penetrating radar (GPR). The objective was to assess the comparative effectiveness of these methods in preparation for a broader-scale investigation. Both techniques detected anomalies consistent with buried archaeological remains; however, comparative analysis demonstrated that magnetometry provided a clearer and more interpretable dataset. Consequently, during the 2021 campaign, a large-scale magnetometry survey was extended across the entire San Nicola plateau, with the exception of areas rendered inaccessible due to dense vegetation or challenging topographical features.

The research conducted thus far on the San Nicola plateau has yielded significant preliminary results, contributing to a more refined understanding of the ancient settlement (Fig. 5). The integration of archaeological data with remote sensing and geophysical survey results has enabled the reconstruction

of the site's spatial organization and the identification of key structural patterns across different sectors of the promontory. These findings will serve as a foundation for the strategic planning of future excavation and research initiatives.

Alongside investigations focused on the built environment, a parallel line of inquiry has been dedicated to examining the community that inhabited the site through the analysis of associated necropolises. The funerary contexts of San Nicola di Amendolara have been the subject of only partial and systematic publication (DE LA GENIÈRE *et al.* 1981; DE LA GENIÈRE 2012), with the eastern sector of the so-called Paladino necropolis remaining unpublished. Within the framework of the ongoing research agreement, the study of this sector has now commenced. This area corresponds to a funerary zone utilized primarily between the late seventh and early sixth century BCE and the late sixth century BCE, a period that coincides with the peak expansion and political dominance of the Greek colony of Sybaris. This chronological correspondence suggests the likely integration of the San Nicola settlement within the broader territorial sphere of Sybaris. The findings from this study, soon to be published, have facilitated a preliminary reconstruction of the social composition of this community and have shed light on evolving funerary practices and cultural customs during a pivotal phase in its historical development.

The various research approaches employed – spanning multiple investigative scales – have generated new cultural content that has been directly incorporated into the curatorial design of the newly conceived exhibition at the Museo Archeologico Nazionale della Sibaritide and the development of the forthcoming Museum of Prehistory of Sibaritide in Amendolara.

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4. CONCLUDING REMARKS

The Spoke 8 project is aiming at the creation of a multidisciplinary unit dedicated to enhancing the understanding, actualization, management, and dissemination of contexts, territories, and assets within TCH. The project's cultural and scientific premises are supported by a well-tested workflow, applied across several case studies. Therefore, isolated and fragmented data are turned into shared systems of knowledge. More than this, suggested procedure is basically oriented towards an innovative operating track inspired by the Datawheel methodology by Carola Hein and a group working on Maritime Heritage at Delft University of Technology (HEIN *et al.* 2022). Different datasets are implemented thanks to advanced disciplinary philologies and approaches, thus validating trans-disciplinary assets available for the first time at abroad scale for the TCH management, at least in this country.

Such assets are also related to places and space transforming landscape in the main hub for the knowledge of the Heritage itself. Locating information will help in focussing our 'scientific knowledge' on specific problems and contexts in the perspective of a data driven management system.

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ABSTRACT

Within the CHANGES Project, Spoke 8 focuses on integrated advanced technologies and scientific methods to enhance the sustainability and resilience of Tangible Cultural Heritage (TCH). The project fosters the creation of a transdisciplinary unit aimed at improving the knowledge, understanding, management, and dissemination of TCH contexts and assets, supported by innovative workflows and methodologies. It emphasizes transforming fragmented data into shared systems of knowledge. By geolocating information, the project

directs scientific focus toward specific problems, promoting data-driven, interdisciplinary approaches for sustainable heritage management. The case studies, including the Ancient Latium, Amendolara (CS), and Syracuse projects, represent preliminary outcomes of this methodology, encompassing the systematic inventory and classification of diverse data, the assessment of knowledge frameworks, and the implementation of cultural narratives.