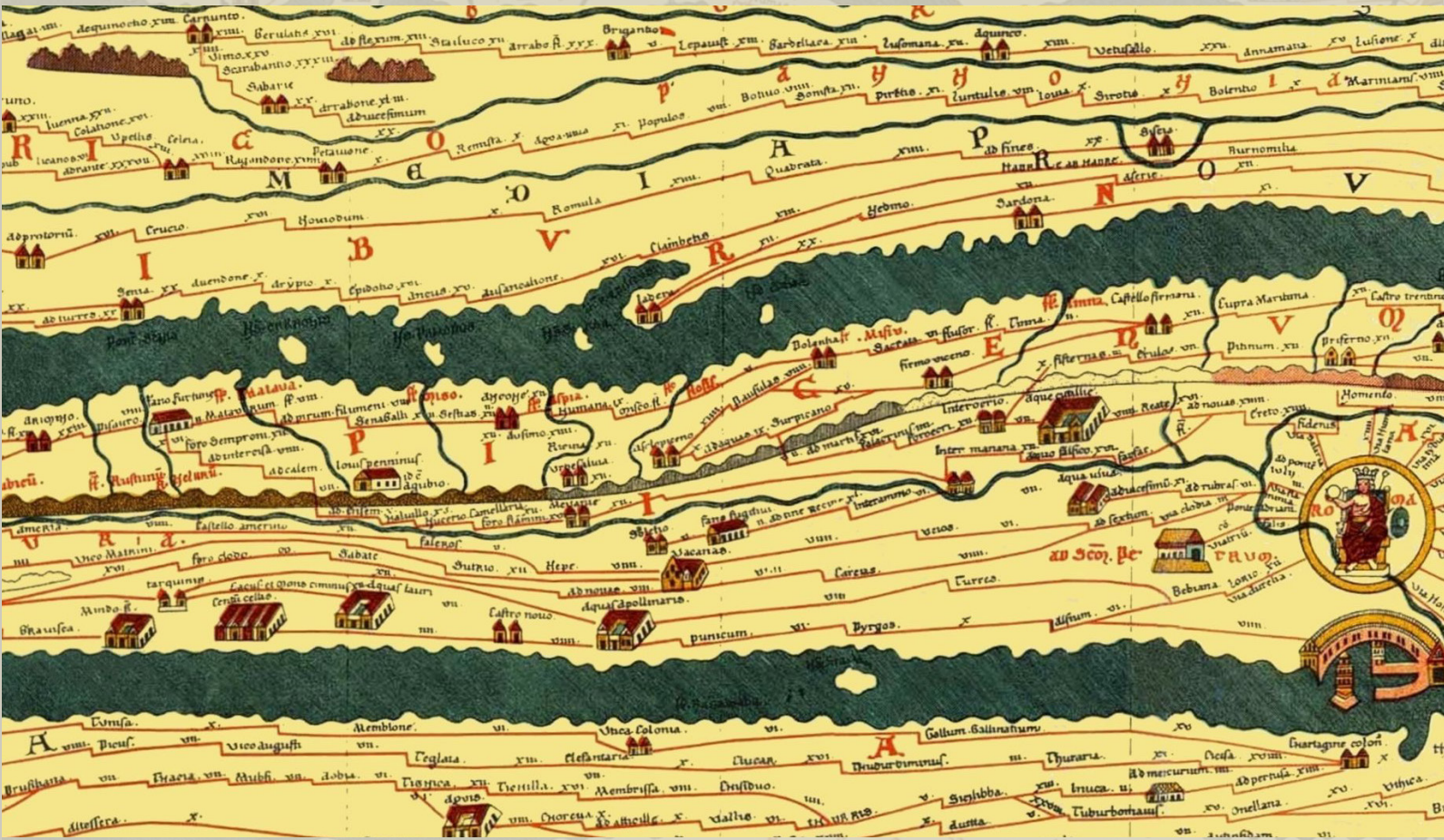


UNION ACADÉMIQUE INTERNATIONALE
TABULA IMPERII ROMANI / FORMA ORBIS ROMANI
TIR-FOR INTERNATIONAL COMMISSION



PROCEEDINGS OF THE 1ST TIR-FOR SYMPOSIUM. FROM TERRITORY STUDIES TO DIGITAL CARTOGRAPHY

Edited by Marta Prevosti
and Josep Guitart i Duran

Institut d'Estudis Catalans
Institut Català d'Arqueologia Clàssica
Societat Catalana d'Estudis Històrics

PROCEEDINGS OF THE 1ST TIR-FOR SYMPOSIUM.
FROM TERRITORY STUDIES TO DIGITAL CARTOGRAPHY

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UNION ACADÉMIQUE INTERNATIONALE
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MARTA PREVOSTI
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INSTITUT D'ESTUDIS CATALANS
INSTITUT CATALÀ D'ARQUEOLOGIA CLÀSSICA
SOCIETAT CATALANA D'ESTUDIS HISTÒRICS

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Introduction

Josep Guitart i Duran

President of the TIR-FOR International Commission

The TIR-FOR International Commission decided to hold this first TIR-FOR Symposium with the firm belief that it could be a useful platform to raise awareness of the latest advances made by a project whose roots date back over a century, at the same time as providing the opportunity for researchers working in related areas to share their experiences, methodologies and findings. On behalf of the organisations responsible for the Symposium, a collaboration between the Institute for Catalan Studies (IEC), the Catalan Institute of Classical Archaeology (ICAC) and the Catalan Society of Historical Studies (SCEH), we would like to thank all those who responded to its call for proposals and who continued to participate in spite of the difficulties caused by the COVID-19 pandemic, which prevented us from carrying out the Symposium in person at the headquarters of the Institute for Catalan Studies, holding it online instead. In any case, although we regret it has not been possible for people to participate in person, it has nonetheless been very profitable, as can be seen by the interest shown in this publication.

The International Commission has been commissioned by the International Union of Academies to manage the unification, digitisation and updating of these two, initially parallel, projects on the cartographic topography of the Roman world: the *Tabula Imperii Romani* and the *Forma Orbis Romani*. Two projects which, in the 20th century, published numerous volumes on paper that cover a considerable proportion of the Roman Empire. At the time, the methodological coordination achieved led to significant results and, right from the start, the

approach taken was one of open international collaboration among the teams from each of the countries involved. An attitude which, today, the International Commission wishes to preserve and strengthen even further.

This resolve underlies the decision to digitise the geographical and archaeological information of the TIR-project in a large database, employing unified criteria and making the data available on a digital portal that anyone can access. The first step was therefore to implement a computer program for the project, sufficiently robust for the large amount of data that would be entered but at the same time agile enough for the teams from each country to manage their documentation independently, as well as being able to connect and share information with other databases on a range of subjects related to the antique and medieval world.

It was decided to develop a prototype for this program step by step, with progressive tests of the application every time the teams involved in the project in their respective territories entered their data. So far, the data from three of these territories have been entered and are openly available, highlighting the results and potential of this tool, whose features have gradually been enhanced by introducing successive improvements and functions. The application is currently in the phase of testing and fine-tuning.

All this has resulted in the creation and maintenance of a digital platform with a map of the Roman Empire that can be broken down into thematic, typological and chronological maps with the basic information of all the

antique toponyms and significant archaeological sites, as well as the thoroughfares, the natural resources exploited in Antiquity and any geographical information gleaned from ancient sources and archaeology. Without doubt, thanks to this new, comprehensive version of the project, the TIR-FOR now has huge potential as a means of raising cultural awareness, for education and even to promote tourism; but without forgetting the project's initial purpose as an instrument for scientific research.

In fact, the decision to organise a Symposium, which the International Commission hopes will be held regularly, results from this desire to raise awareness of the TIR-FOR project's scientific potential. The subject chosen for this first Symposium, *From Territory Studies to Digital Cartography*, is clearly along these lines, with the aim of encouraging reflection and debate regarding the inextricable interaction between research into archaeological sites, territory and archaeological topography and digital cartography.

The wealth of possibilities offered by digital cartography have made it an essential tool for investigating and disseminating knowledge of the Roman world. Joining efforts exponentially increases the potential of results from research and it is increasingly evident that important achievements require international networks of researchers with common goals and agreements regarding the methodology to be applied to their work.

Given this situation, it is of vital importance for the studies of settlement, communication networks and economic elements, toponymy and archaeological topography, as well as studies of the territory and landscape, that form the basis of many of these cartographic processes, should use commonly agreed methodologies to allow, collectively, interaction and the construction of maps of the Roman world, exploring the huge potential offered by Linked Open Data. A network needs to be set up between the different research groups so they can reach agreements regarding the mapping of the elements under study and, at this point, evaluate the research

being carried out and provide a forum for discussion.

The Symposium was held on the 26th and 27th of October 2020, in the format of a Zoom meeting. The virtual room had a capacity for 100 people, which was soon reached and unfortunately the last few applicants had to be turned down.

The President of the IEC, Mr. Joandomènec Ros, opened the proceedings at 8.30 in the morning on Monday, the 26th of October.

The Symposium was divided into three sessions, each starting with a talk to introduce the topic. The first session, on *The present and future of the international TIR-FOR project*, began with a presentation by the Catalan team, followed by five communications by the Italian, Romanian, Greek, Polish and Tunisian teams, all involved in the TIR-FOR project, thereby presenting the digital TIR-FOR project to the scientific community, one of the main reasons for holding the Symposium. The large number of people taking part was proof of the interest aroused, as well as the fact that, after the Symposium, several proposals were received for collaboration.

The second session focused on *Digital maps of the Roman world and specialised applications*, starting with a talk by Johan Åhlfeldt and followed by four communications. The third session, on *Studies of landscape, settlement and archaeological topography in the development of digital cartography*, was introduced by a talk given by Hector Orengo and Josep M. Palet, followed by fourteen communications.

In total, therefore, we heard three talks and 23 communications, and four posters were also commented on. Extremely interesting research was presented, starting with the DARE digital platform by Prof. Johan Åhlfeldt, who explained his splendid work in a relatively technical presentation. Of particular note was the readiness shown by Prof. Åhlfeldt to connect the DARE digital platform with the TIR-FOR platform. Also important was the talk by Héctor Orengo on the contribution made by the development of new methodologies to map ancient settlements, as well as to detect more sites.

**THE PRESENT AND FUTURE OF THE INTERNATIONAL
TIR-FOR PROJECT**

The digital *Tabula Imperii Romani* – *Forma Orbis Romani* project

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ABSTRACT

The TIR-FOR International Commission, within the International Union of Academies, is developing an online map of the Roman world based on the documentation accumulated during the project's one hundred years of history. The article explains this digital application, consisting of a database with a map viewer, a public website, an administrator website and a powerful advanced search facility. It will be indispensable as a research and outreach infrastructure for the Roman world intended as a large-scale collaboration between countries.

KEYWORDS: Digital map, mapping, Roman Empire, LOD, archaeology, online database.

1. INTRODUCTION

The TIR-FOR International Commission, within the International Union of Academies, includes all countries that wish to take part in the project to create a digital map of the Roman Empire. It's the online evolution of the paper map started in the 1920s. The Institute for Catalan Studies (*Institut d'Estudis Catalans*, IEC), which currently holds the presidency of the Commission⁶, has produced the application we present here (<https://tir-for.iec.cat/>). The IEC is developing this project together with the Catalan Institute of Classical Archaeology.

We should stress that we've created this application as a contribution to the project carried out by the aforementioned institutes. However, we believe the application belongs to all the teams working on the TIR-FOR project because it has been produced under the guidelines of the Commission's agreements. Our desire is not only that the application be available to all the project teams but that everyone should feel it is theirs. We would therefore like everyone working on the TIR-FOR project to be as proactive as possible in proposing improvements and in using the application, making the most of all its potential. (Fig. 1)

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2. THE AIM OF THE PROJECT

The main aim of the project is to share an online map of the Roman Empire. The project is

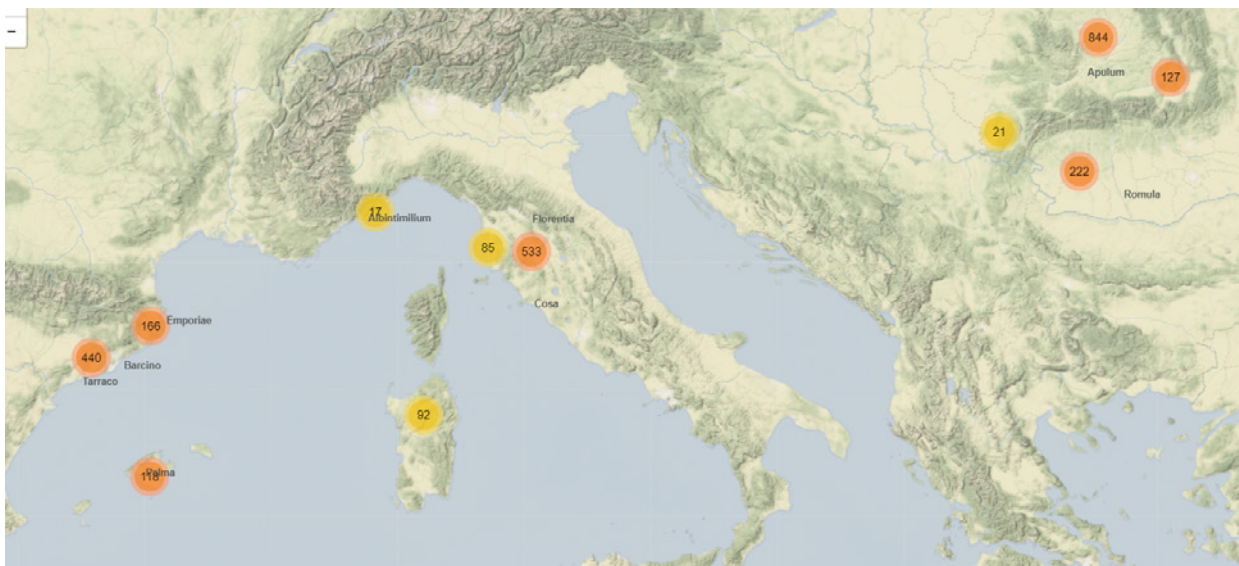


FIGURE 1. The TIR map with the sites currently entered in the application.

creating a huge online digital application, cataloguing and mapping all the information available on sites, toponyms and landforms in the Roman Empire based on precise, reliable and first-hand archaeological data provided by specialists from each of the regions we're working on. The Commission's goal is to globalise and systematise all this information via an online portal shared by all the teams involved in the project. Technologically, the current basis of the project is the combination of an SQL Server database, a geoportal or map viewer and a public website with a powerful search tool. The IEC provides the server and maintains the application.

One fundamental objective is to link this application with other maps and databases of the Roman world to enrich their capacity and help build up an extensive network of information and analysis related to the Roman world. (Fig. 2)

For almost 100 years the TIR-FOR project has been the basic topographic study for the Roman Empire. Given the recent emergence of a large number of other projects on Roman topography that are highly specialised in various subjects, the TIR-FOR project may seem to have become less relevant. However, our proposal will help to rejuvenate this project. It's an innovative proposal, possible due to the structure created by TIR-FOR within the UAI and thanks to the huge amount of information generated by it.

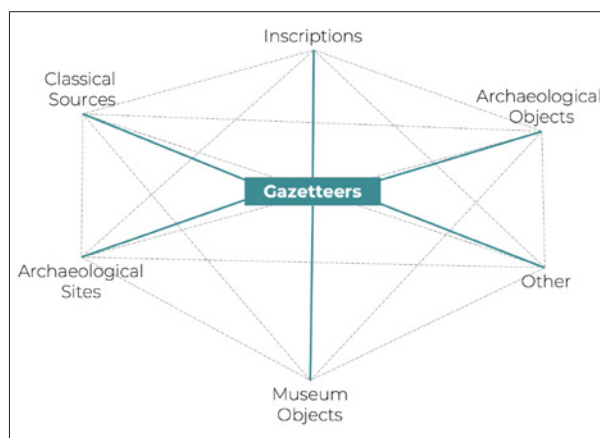


FIGURE 2. Diagram of the function of gazetteers as connectors of Linked Open Data projects.

3. THE PAST AND PRESENT OF THE *TABULA IMPERII ROMANI* (TIR) AND THE *FORMA ORBIS ROMANI* (FOR)

In fact, this application is the sum of two historic centenary projects: the TIR and the FOR. The TIR project focused on summary maps with record sheets and reviews of all the Roman toponyms appearing in the classical sources and the archaeological research carried out in countries formerly occupied by the Roman Empire. It was designed to create maps to the scale of 1:1,000,000. The objective of the

TIR project was therefore to create a scientific map with a gazetteer summarising the Roman world (Gardiner, 1973; Migliorati, 2014).

The FOR project, on the other hand, was designed to produce more detailed maps. It was set up as a large-scale collaboration between countries in order to create a detailed cartography of the Roman world with maps to the scale of 1:25,000 or 1:50,000, accompanied by site catalogues (gazetteers) on all the features that appear on the maps themselves, as well as scientific analysis with conclusions regarding the corresponding territories⁷. The ultimate goal of the FOR project was to produce an exhaustive collection of all the evidence available from sources, epigraphy and archaeology that can be included on a map. The online FOR will therefore have great research potential as it's based on information from either excavations or direct surveys and reports in the archives.

The current online project is actually an enlargement of the TIR project with the FOR project, producing even more detailed mapping. It's like zooming in on specific regions. Both objectives have been maintained, namely to produce a general map and also a detailed map. Consequently, when a general (or TIR) map is being created for an area, we enter only the most significant and well-known archaeological sites and the toponyms. When a detailed (or FOR) map is being created for an area, however, all the toponyms and also all the sites and finds known must be entered (including small, doubtful and/or relatively unknown sites and finds).

On digitising the projects and given the current data model, it was decided that each site should have a unique record sheet containing different levels of information: basic information, which in the original project was associated with TIR maps, and more detailed and exhaustive information, traditionally displayed on the FOR maps. As a result, in the current application basic information (TIR) can be provided as well as more detailed information (FOR) for any site or toponym, whether a more general or detailed map of the area is being created. The record sheet can therefore contain more basic information fields (which are obligatory, both for the TIR

and for the FOR map), and other, more detailed information fields, compulsory only for the FOR map. These later fields are optional in areas for which the TIR map is being produced but obligatory for areas where the FOR map is being produced.

Which sites should be included and which not? Following the criteria observed in the published volumes of the TIR, which selected all the toponyms that appear in the sources, epigraphy and numismatics, as well as all the cities, the most representative Roman villas and the rest of the most representative and well-preserved sites, we have established a dictionary of toponyms and elements eligible to appear on TIR maps. It's important to constantly focus on the end result; the aim of the TIR is to create a scientific summary map of the Roman world on a large scale to provide an overall cartographic picture and outline. The FOR project, on the other hand, provides a detailed view of specific zones on the TIR map, as an extension and more detailed version of the TIR for those regions that have been studied more thoroughly and are particularly rich in terms of their documented archaeological evidence. The application allows detailed information to be available for some sites even when these were originally part of the TIR project. When moving from managing data to viewing these data on the public website, since zones with sites from the TIR project are now being managed together with zones from the FOR project, the origin of the sites must be indicated so that the desired view can be chosen. Otherwise, some areas on the map could appear with a very high concentration of sites but the reason for this concentration would not be evident.

4. TIR-FOR, THE ONLINE APPLICATION

We've created a complex geodatabase to digitise the TIR-FOR data and disseminate it online. The Postgre SQL online relational database allows us to apply spatial treatment tools to the project's archaeological data and the application is equipped with a map viewer, a public website, an administrator website and a powerful advanced search facility.

7. For example, Marchi, 2010; Ebanista, 2017.

This system has been created following strict security protocols and creating an independent multi-user environment. Each country has its own workspace within the database system in order to enter, edit and search information. In the management application, each team can only see and manage its own data whereas, on the public website, all the information from all the countries can be seen, albeit only information that has been classified as public.⁸

As mentioned above, the database encompasses both levels of content covered by the TIR and the FOR projects. This means that each site has a unique record sheet where the necessary fields are provided to enable general information about the sites and toponyms, as in the TIR project, as well as fields for the more detailed information, previously only included in the sites included on the FOR map.

The current project is driven by a new unified methodology. The database is used as an integrated system to store the data generated by each country's archaeological team and is the result of considerable systematic work regarding all the concepts concerned. Unified criteria enable the data to be compared, as well as producing chronological-typological maps of the whole Empire or extensive parts of it.

We're currently fine-tuning the TIR-FOR methodology, adapting it to the needs of all the countries that once belonged to the Roman world. Our aim is for regional teams to work in parallel with each other, performance testing and adjusting the database to produce a fully-integrated online system. By working together we can refine and optimise the system and ensure it's suitable for all the countries within the Roman Empire. We also run constant checks to ensure the system works properly for everybody.

The main database tables are those for sites, chronologies, typologies, elements and ancient sources. (Fig. 3)

8. The database record contains information on the author and how to cite the record. This work comes under the terms and conditions of the public Creative Commons licence.

5. THE RECORD SHEET

The record sheet is divided into the following sections: 1. Site information to provide data that identify and locate the site on the map; 2. Coordinates; 3. Chronology; 4. Typology and elements; 5. Ancient sources (literary, epigraphic, numismatic and iconographic sources); 6. Juridical status; 6. Bibliography; 7. Images; 8. Text (description); 9. Author. (Fig. 4) Each of these sections have been worked on to ensure advanced searches can be carried out based on all the fields or a combination of them.

Chronology is divided into epochs, periods and sub-periods. The periods have been established by the Italian team and approved by the Commission and are based on the history of Rome as a reference point for all the provinces in the Roman Empire. Sub-periods are century by century. It's important for all countries to adapt their data to these chronological periods to be able to create consistent chronological maps of the whole Empire. (Fig. 5)

Unified criteria have been important in establishing the chronological periods but they have been even more important in creating the typologies and elements. It's fundamental for the typology assigned to a site to specify well-defined characteristics recognised and shared by all the teams involved. That's why substantial systematic work has been carried out, agreed by all the teams. The application has a drop-down dictionary of typologies with definitions of the different concepts. The dictionary also includes the criteria used to justify a site appearing on the TIR. (Fig. 6)

Different elements can often be defined within one site (for example, within a city there might be a forum, city walls, baths, etc.). To be able to define these, a drop-down dictionary of elements has also been created, with their definitions and defining characteristics.

The ancient sources have also been defined and systemised (literary, epigraphic, numismatic and iconographic). A drop-down dictionary has been created for the ancient literary sources and each team can ask to add the sources that are missing for their particular geographic area. (Fig. 7) The juridical status section is also the result of considering all possible statuses and how they

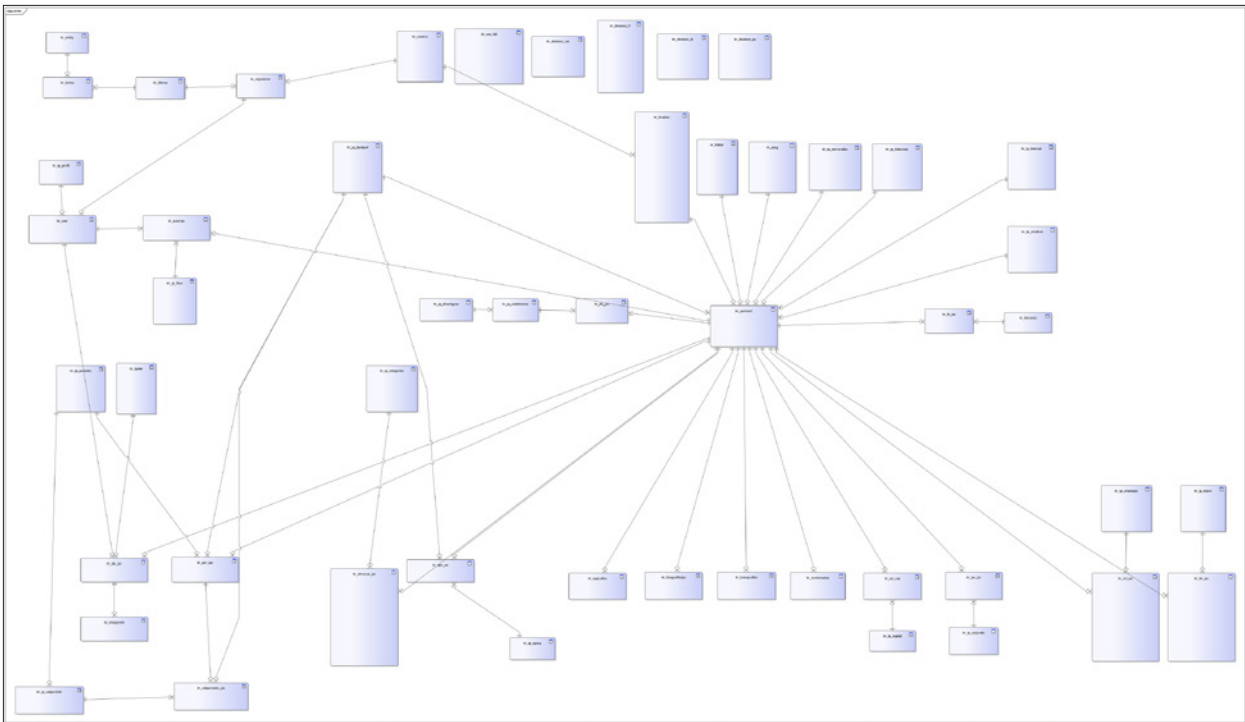


FIGURE 3. TIR-FOR application database tables.

FIGURE 4. TIR-FOR record sheet with the drop-down list of ancient administrative divisions.

FIGURE 5. TIR-FOR record sheet with the drop-down list of periods.

FIGURE 6. The TIR-FOR application has a drop-down list of typologies and elements as well as a dictionary of typologies and elements with definitions of the different concepts, criteria to identify them and TIR criteria to include them in the database so that they appear on the map.

should appear on the maps to ensure they are useful and informative.

A text field allows the author of the record sheet to explain any fundamental features of the site. Particularly relevant aspects are the data used to define the typology, the elements found within it and which data justify them, as well as the data used to date the site (pottery, other finds, etc.).

Each sheet created in the application's database must represent a point on the map. The record sheet may contain a lot of information and even links to other websites but it's represented by a single dot on the map or a symbol of its typological classification. A link can be entered in any text field, whether intra-

project from one record sheet to another, or to an element outside the project.

A user's guide to completing the record sheet can be downloaded from the home page of the data management site. The TIR-FOR record sheet, the list of symbols that appear on the map and the typology and elements dictionary, with the definition and criteria used to identify the typologies and/or elements as well as the requirements to appear on TIR maps, can be downloaded from the public website (methodology section). The typologies and elements have been highlighted as key fields on the record sheet.

For several fields contained in the record sheet (i.e. Ancient administrative division, Typology,

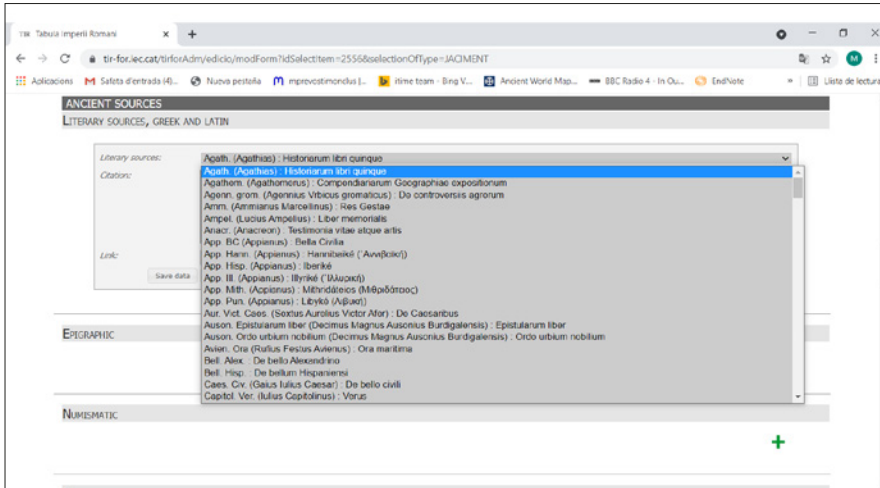


FIGURE 7. Ancient literary sources should be selected from a drop-down list.

Element, Epoch, Period, Sub-period, Juridical status documented, Other categories documented), a doubt can be added to the choice made for each field. For example, in the specific case of typology and elements, the doubt should be marked if there is evidence, but not *in situ*, that might indicate the type of site chosen or the elements indicated for the site.

A two-stage system has been created for completing the record sheet. First, users must enter the more general data of the site corresponding to TIR data. When the sheet is being edited, the basic information fields (TIR fields) become available. When the user needs to enter more detailed information (FOR fields), the command “Detailed data” is activated and the FOR fields appear against a cream background. For each of the chronological periods selected in the TIR fields, the option to detail sub-periods, century by century, will become available. These periods and sub-periods can also be related to different typologies as a site may have evolved over time, for example from a rural settlement to a villa. The elements selected in the basic information fields produce a sub-sheet in the detailed information fields, with its own decimal coordinates, where more data can be entered, as well as illustrations, specific bibliography and a description of the element. The text of the FOR sheet is expected to be more detailed and the bibliography more exhaustive. Both the author field of the TIR sheet and the author field of the FOR sheet must be completed.

6. ENTERING TIR AND FOR DATA

The Catalan team has been preparing the TIR for Catalonia. At present, 551 entries have been uploaded for the K/J-31 record sheet that was published on paper in 1997. Half the territory has been revised, with 134 new entries uploaded and the existing records updated. The rest are now being revised. The TIR map for Catalonia is therefore relatively complete and gives us a good idea of the desired result in general (Fig. 8). It provides a very solid, informative global view of the distribution of Roman settlements, their greater concentration along the coast with the most notable clusters being around *Barcino*, *Baetulo* and *Iluro* (Fig. 9), although the density is also quite high around *Emporiae* and *Gerunda* in the northern coastal area (Fig. 10) and around *Tarraco* in the south (Fig. 11). Further inland, beyond the line of hills that run along the coast known as the Serralada Litoral, Catalonia was less densely populated. We can see that the Pyrenees were also populated, albeit less densely. Essentially, settlement was concentrated along the roads, both major and secondary, undoubtedly playing a key role in spreading Roman culture. It also shows how the Romans introduced a pattern of settlement that has lasted up to the present day, this being its initial development. In other words, the cities — a fundamental factor in the Romanisation process — are essentially the same today as they were in Roman times. The pattern



FIGURE 8. The TIR map of Catalonia.

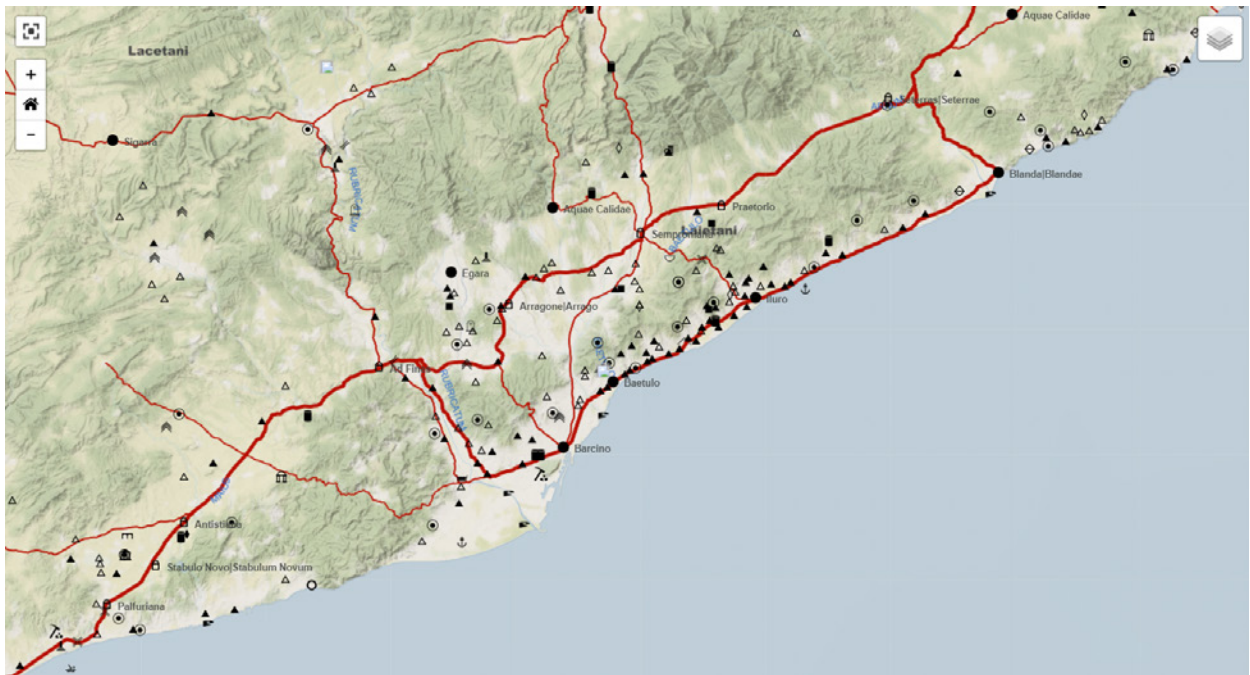


FIGURE 9. TIR map of the central coast of Catalonia.



FIGURE 10. TIR map of the south coast of Catalonia.



FIGURE 11. TIR map of the north coast of Catalonia.

of Iberian settlement, on the other hand, is quite different.

The Balearic Islands have also joined the project and 121 entries which had already been published on paper in 1997 have been uploaded with some updates, while the area of Valencia already has 279 entries. (Fig. 12)

Regarding the FOR data, since 1997 the Catalan team has been working on the FOR sheet corresponding to Eastern *Cossetania* (Guitart, Palet, Prevosti, 2003) as well as the *ager Tarraconensis* area (Prevosti, Guitart, 2010; idem, 2011; Prevosti, López, Guitart, 2013), for which the corresponding databases have been made available. 372 FOR record sheets in the application have been created within this project.

We've already migrated data from the *ager Tarraconensis* project databases. This has been the first test of the system in terms of the FOR. In this case, we're migrating data from another database which obviously doesn't fit exactly with the fields in our TIR-FOR application but it's still a great advantage over having to enter all the data manually.

7. SEARCHES

One of the main objectives established in the TIR-FOR online project was to create a powerful search and filtering system for data and archaeological sites. This element is essential to

offer a really useful platform to society and researchers on the archaeological reality of the Roman era. The application is equipped with a "Search" tab and an "Advanced search" tab. On entering "Search", users can carry out a free search via multiple options such as the publication status, ancient or modern name, within the TIR sheets, within a location, by selecting a main typology or one or more elements. On entering "Advanced search", a multiple-choice menu becomes available to undertake more powerful and complex queries. This kind of search represents a detailed query system where users can combine all the fields from the database sheet and create personalised filters.

Each search produces a map with the results, as well as a list of the sites resulting from the query, which can be downloaded in a csv file. This format is suitable for exporting data to GIS programs, including records with the selected archaeological and geographical information for each site. (Figs. 13 - 15)

8. DISPLAYING TIR-FOR INFORMATION

Another issue we're working on is how the map is visualised. When the user accesses the online application, a map with all the sites entered to date appears, large scale and in clusters, to provide an idea of the site density for the region in question. As we zoom in, these

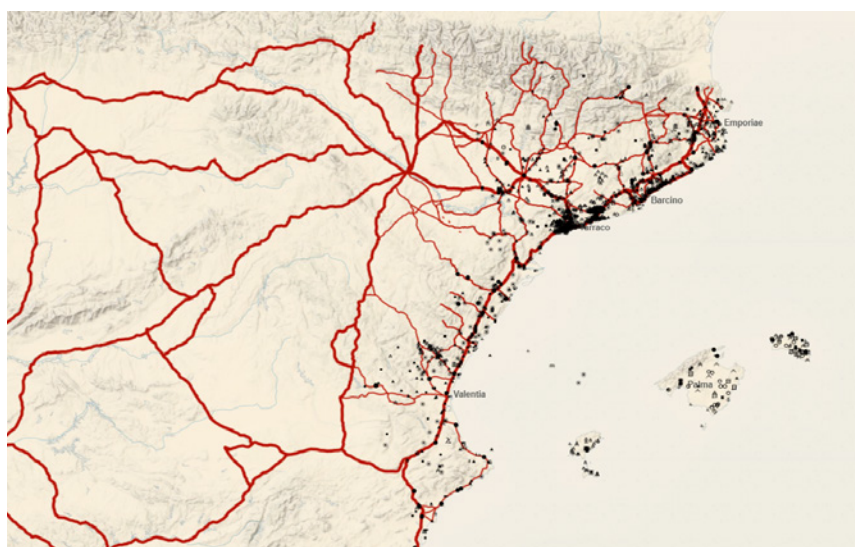


FIGURE 12. TIR and FOR work in progress map of Catalonia, the Balearic Islands and the region of Valencia. The black spot surrounding Tarraco corresponds to the FOR.

clusters are successively broken down into each of the territories. At the top right of the map is the option to view the sites in clusters or via Sites/Typology. When this option is selected using the most distant zoom, to avoid showing a black blob made up of all the sites, only the



FIGURE 13. Search for Catalonia, city, *mansio*, milestone and roads.

particularly important cities in each territory are shown with their corresponding ancient name.

It will also be necessary to study how the FOR is visualised. The FOR is actually a zoom-in on a specific area, studied in depth, where there's a lot of detail. But as you enter this view there should be a warning explaining why the area has so much detail. We cannot mislead the public into thinking the territory is necessarily more densely populated; we need to explain that there is so much information because it has been more thoroughly studied, an issue that has yet to be addressed and must be dealt with in the near future.

The list of eligible cartographic bases appears to the right of the map. The default map has very pale lines and colours; it's very neutral, without settlements and very few names, only geographical information ensuring the points and symbols of the TIR-FOR map stand out well. In order to facilitate navigation and geographical location of the sites, we have also included some open layers such as ESRI Roads, Google Roads, Google Satellite and the Digital Atlas of the Roman Empire.

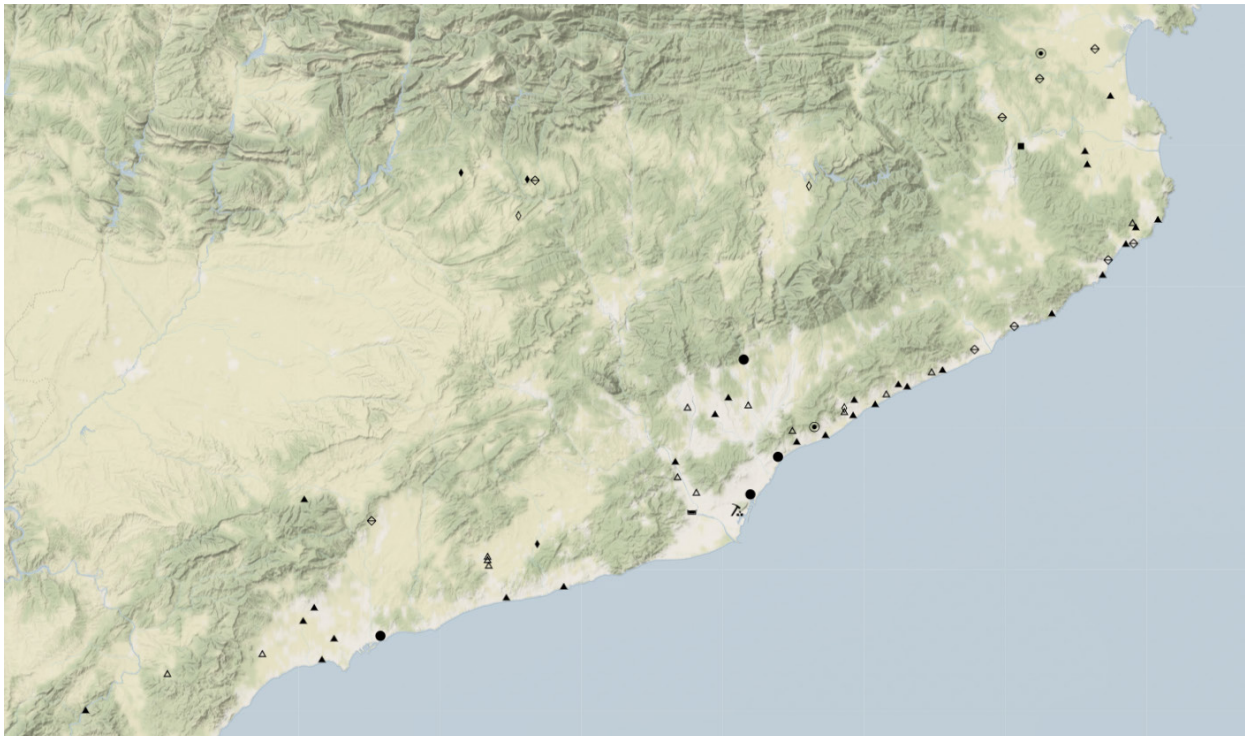


FIGURE 14. Search for Catalonia, pottery workshop, pottery kiln and pottery workshop dump.

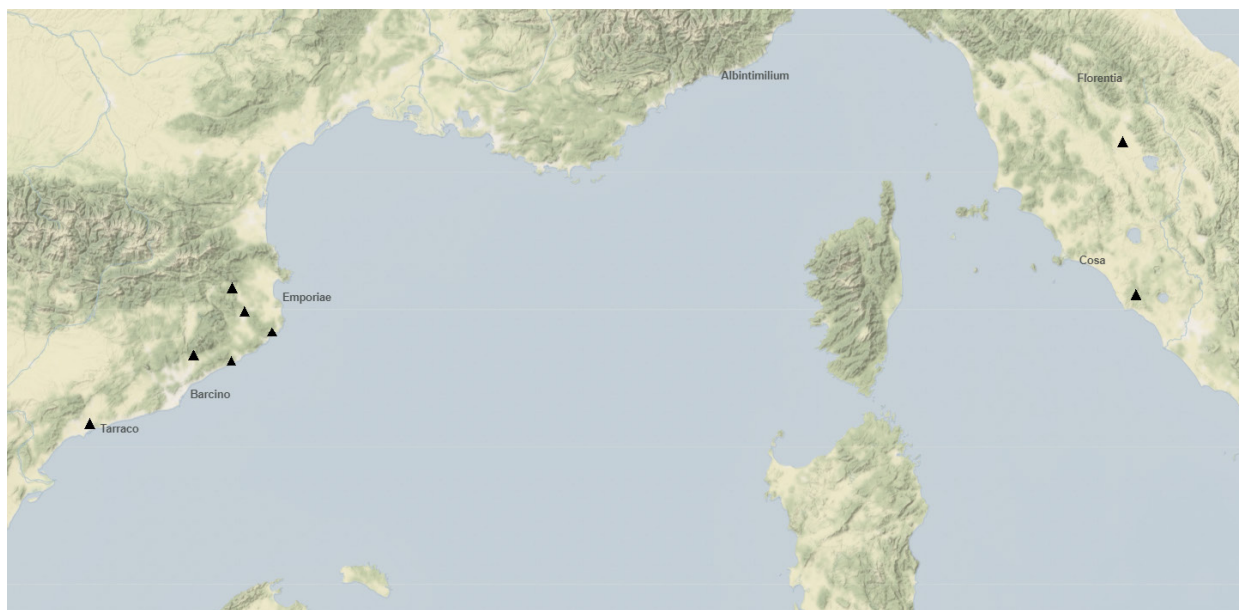


FIGURE 15. Search for villa with aqueduct.

Users can enrich their view by adding some other information layers. We have included the possibility to visualise Roman roads, rivers, geographical features, Roman borders and *populi* names. For the time being, we've applied the easy and cheap solution of map layers to represent these elements on the map but, in the future, we'd like to prepare our database to also include records for the category of toponyms that can only be mapped as lines or polygons.

9. A RESEARCH TOOL

Once a region's information has been collected and entered, we'll have compiled information about all the Roman sites under unified criteria, providing us with a good quality tool to manage scientific data. This will become a key tool for historians and archaeologists to consult and carry out advanced searches, providing basic information about sites that's often difficult to obtain outside a researcher's own country of work. This tool will therefore help to advance many aspects of archaeological research, for instance comparisons between regions, cross-border issues and specific types of

sites. It's also quick and easy to update, ensuring up-to-the-minute information that's nevertheless always based on agreed criteria.

Currently, there is a large number of historical gazetteers and international databases that include archaeological heritage information on different historical, epigraphic, numismatic and archaeological aspects. Our application can be networked with these using linked open data protocols. Our aim is for the different archaeological sites to be linked with online applications such as DARE, Pelagios, GAP, ORBIS, Epigraphische Datenbank Heidelberg and others. The value of our application lies in the fact that it's a tool created on a geographical basis that produces a map, so all data that meet certain criteria are included, without exception.

The system allows a team or individuals to work on entering information from a region before making this public. Such information can be disclosed once the data to be entered have been exploited scientifically, but it can also be treated as open research. With the TIR-FOR application, typological and chronological maps can be produced, advanced searches can be carried out, regions can be compared with each other and information can be extracted. The

application can also be used to download data for GIS programs. In other words, the application is ready to be used as an ideal research tool.

10. DISSEMINATING AND SPREADING INFORMATION

This research tool can also be used as a tool for dissemination. We've created an online portal where users can access a large number of Roman sites with information on their typology, chronology and materials as well as graphic information, among other data, and make queries about archaeological sites on maps using a wide range of filtering options. Another priority is to create an innovative, user-friendly website whose usefulness and attractive design add value.

In the future, we expect the same system will connect the different archaeological sites with other online applications and provide additional information such as photographs, videos, classical texts, links to museum websites, information about sites open to the public, actions, activities and so on.

A freely available interactive map will be created with additional information and links, keeping Roman archaeological heritage alive and evolving. Open access, free at the point of use, is one of our priorities in promoting the dissemination of research into our Roman heritage. This tool will help us bring our Roman past closer to our Mediterranean present, thereby improving awareness of the past and fostering a shared identity.

The easy availability of data should help to encourage citizen involvement as part of the concept of citizen science. By making people more aware of our Roman past and heritage, we should be able to try out new approaches for dissemination.

In short, we hope this tool will become an essential resource for anyone interested in the Roman world and specifically in archaeological sites, since it combines open access, the backing offered by TIR-FOR and the scientific quality of its data. Combining our archaeological knowledge and historical heritage in an innovative, direct, entertaining and appealing way will engage the public at large. As a heritage dissemination and

management tool, it can be used in teaching, museums, demos, tourism, outreach and entertainment. One consequence of this unification will be to promote a sense of a common Mediterranean origin based on classical culture. The ultimate aim is for it to become a fundamental tool for knowledge but also a way to enjoy the Roman world's archaeological heritage.

11. TIR-FOR'S POTENTIAL

In its current state, the TIR-FOR platform is proving to be an extraordinary tool for managing and analysing archaeological data from Roman times. The detailed scientific process required to collect and document such information takes time to produce new data, which is why the entire territory of the Roman Empire has not yet been covered. When the whole of the Roman Empire has been completed, this project will have even greater potential, enabling both extraordinarily detailed and global analyses.

However, another aim for this tool is to roll it out to other kinds of historical and prehistoric heritage, as well as other territories and cultures, thereby enabling greater chronological and thematic interaction, as well as helping to disseminate and manage information but always applying the level of scientific thoroughness achieved to date.

The FOR application aims to study a territory in-depth. This is a key perspective in landscape studies and the FOR application can therefore be a useful tool for studies with a long-term chronological view, providing an overview. For instance, the evolution from Roman to Byzantine times becomes relevant from the perspective of landscape studies, even though it's also of great interest per se.

12. CONCLUSIONS

We'd like to stress that the TIR-FOR project is a work in progress, open to all teams working in the territory that are interested in collaborating to produce a map of the Roman world and in extending its network of information, linked to

a range of databases and resources. We're building up a basic research and outreach infrastructure for the Roman world in which all countries are welcome. This project offers an up-and-running interface prepared for the introduction and storage of archaeological data. We've also created a study protocol with scientifically considered and debated parameters. Finally, this project also provides a remarkable viewer for the data documented. Consequently, our research team is interested in encouraging dialogue and contact with any other projects and teams that may be interested in using our platform and publishing their data within the framework of the project.

BIBLIOGRAPHY

Bibliography on the subject: <https://tir-for.iec.cat/publications/>

- EBANISTA, Laura (2017). *Ager pomptinus I*. Roma.
- GARDINER, Richard A. (1973). "The International Map of the Roman Empire". *The Geographical Journal*, 139, 107–111.
- GUITART, Josep; PALET, Josep Maria; PREVOSTI, Marta (eds.) (2003). *Territoris antics a la Mediterrània i a la Cossetània oriental*. Barcelona: Generalitat de Catalunya.
- GUITART, Josep; PREVOSTI, Marta; SOTO, Pau de; ROMANÍ, Núria; CORTÉS, Ada; PADRÓS, Núria (2018). "El projecte internacional *Tabula Imperii Romani – Forma Orbis Romani* (TIR-FOR)". *Tribuna d'Arqueologia 2015-2016*. Barcelona: Generalitat de Catalunya, 332-347.
- MARCHI, Maria Luisa (2010). *Ager Venusinus II*. Firenze.
- MIGLIORATI, Luisa (2014). "Proyecto *Tabula Imperii Romani*". In: ÁLVAREZ, José María; NOGALES, Trinidad; RODÀ, Isabel. *XVIII CIAC: Centro y periferia en el mundo clásico/Centre and periphery in the Ancient World, Proyectos internacionales de investigacion/International research projects*. Vol. II. Mérida: Museo Nacional de Arte Romano, 1955-1962.
- PREVOSTI, Marta; GUITART, Josep (eds.) (2010). *Ager Tarraconensis 1. Aspectes històrics i marc natural / Historical aspects and natural setting*. Tarragona: Institut Català d'Arqueologia Clàssica.
- PREVOSTI, Marta; GUITART, Josep (eds.) (2011). *Ager Tarraconensis 2. El poblament / The population*. Tarragona: Institut Català d'Arqueologia Clàssica.
- PREVOSTI, Marta; LÓPEZ VILAR, Jordi; GUITART, Josep (eds.) (2013). *Ager Tarraconensis 5. Paisatge, poblament, cultura material i història. Actes del Simposi internacional / Landscape, Settlement, Material Culture and History. Proceedings of the International Symposium*. Tarragona: Institut Català d'Arqueologia Clàssica.

From ancient maps to Web-GIS systems for the future of *Tabula Imperii Romani*

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ABSTRACT

This paper traces the history of the International Map of the World (IMW), starting from the first attempts made by humans to represent the world in which they lived, including the difficulties faced in representing the spherical earth (Anaximander), until the well-known *Tabula Peutingeriana*, a map which documents the *oikoumene*. In 1928 Crawford highlighted the importance of a European historical map, choosing the *International Map of the World (IMW)* as the cartographic base for the *Tabula Imperii Romani*, subdividing this into sheets at a scale of 1:1,000,000.

In more recent times, the TIR has tackled the transition from a printed to a digital format and the last part of this paper deals with the complex mechanism of transposing the data from printed maps to the most modern GIS and WebGIS systems. This issue reveals numerous critical topics, including accurate positioning and the problem of varying scale ratios.

KEYWORDS: International Map of the World, *Tabula Imperii Romani*, digital cartography, WebGIS systems.

1. THE ORIGINS OF MAPPING THE EARTH

Humans have always tried to depict the whole world in which they live. For a very long time, different peoples have been certain that the known geographical area was identifiable with the whole Earth, leading to several attempts to draw a map of the world. The crux lies in the word “draw” as, at least since the 6th century BC⁴, ancients were perfectly aware that the Earth was a sphere and this is why mapping the globe has represented a problem ever since.

When speaking of Anaximander, Diogenes Laërtius, the well-known biographer of the Greek philosophers, doesn’t consider the problem; he simply separates the issue. Anaximander was “the first to draw an outline of the earth and the sea, but he also constructed the sphere”⁵. The adversative here is important, since it reveals an awareness of the difference between a drawing on a flat surface⁶ and a three-dimensional model, an actual representation of the globe.

5. Ibid.: καὶ γῆς καὶ θαλάσσης περίμετρον πρῶτος ἔγραψεν, ἀλλὰ καὶ σφαῖραν κατεσκεύασε.

6. Agathemerus, I, 1, records Anaximander as the first man to draw the Earth on a panel (πίναξ). For an overview of Greek cartography, with a selected bibliography, comprising fundamental works such as Bagrow 1964 and Dilke 1985, see Migliorati 2002. An almost complete bibliography can be found in Cinque 2002. A major tool on overall survey of cartography studies is the journal *Geographia antiqua*, directed by Francesco Prontera. As to the Greek perception

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4. Diogenes Laertius, *Vitae philosophorum*, c. 1, Ἀναξίμανδρος: he mentions the Earth’s sphericity in an aside, suggesting it is common knowledge.

The Pompeian mosaic floor⁷, showing the globe as the centre of a lecture by Plato to his disciples (Fig. 1), certainly cannot be considered a document of scientific cartography but does bear witness to the permanence of the correct concept of the Earth's sphericity – at the time firmly linked to the plot of the geographical grid – as well as to the familiarity of its three-dimensional representation.

With regard to Diogenes' text, it is also worth noting the term used to indicate the sphericity of the Earth: σφαιροειδής. It is plausible that, in the 6th century BC, geographical knowledge had not progressed any further than equating the Earth with a globe. Nevertheless, it is also possible that Diogenes, in the 3rd century AD, used the term in the proper, modern sense of a rotational ellipsoid (without, of course, going so far as to specify polar flattening). On the other hand, in the Augustan age Strabo was already speaking of the Earth as a spheroid⁸ and we know that the Greek geographer used several texts by earlier authors, in particular geographers, mathematicians and physicists from the Hellenistic age, in other words from those who had introduced mathematical geography⁹.

One issue related to drawing the Earth is the scale factor. Ancient maps almost never include their scale, although their use of constant proportional ratios indicates that some kind of scaling factor was used. However, especially with regards to geographical maps, there is very little documentation concerning ancient cartography, so we have to rely largely on ancient sources. While reading Aristophanes' "Clouds", I was struck by some analogies regarding both the current and past problems faced by researchers: it suggests different scale factors were used and addresses the difficulty of presenting the outcomes to lay people. A few lines in Clouds¹⁰ show the

of bounded space, an interesting approach is shown by Romm 1992.

7. The mosaic is dated between the end of the 2nd and beginning of the 1st century BC. The mosaic is kept at the National Museum of Naples.

8. Strabo, I, I, 20; II, V, 5. On historical sources for the term before Strabo, see Russo 2013, 358, no. 166, 167.

9. Regarding mathematical geography as a natural development of the empirical geography, see Russo 2013a, 357-364; Russo 2013b, 111-129.

10. Aristophanes, Νεφέλαι, 205-215.

issues faced by a non-expert in giving the right value to distances on a map of the whole Earth: for instance, Strepsiades doesn't understand how a dot can house all urban buildings because he can't see the seat of the Athenian judges. Moreover, his confusion regarding space and location, originating from a failure to understand the scale factor, means that he is very afraid of how close Sparta is to Athens!

Being able to switch within a very short period of time from a general level (the dots) to the level of symbols (a set of elements representing the land or urban functions concealed in the dots) and then to an urban layout is indeed a recent result of our TIR/FOR project; nevertheless, we still have to achieve a new goal by switching to a detailed plan of structures.

Another issue, since Antiquity, concerns geo-referencing. Errors are very common when copying coordinates from a paper map, as we can still see today, but registering coordinates in fieldwork using the new, increasingly precise tools and methods is gradually eliminating this problem. Essentially, this same issue occurs with Ptolemy, whose direct astronomical surveys only cover very few sites. This is one of the reasons for the discrepancies between the Ptolemaic measurement of the coordinates of about 8,000 sites and the real situation¹¹.

As I have already mentioned, since no world map drawn by ancient geographers has been preserved, a few modern scholars have proposed various reconstructions based on their interpretation of the texts, always using plane representations. We do, however, have an ancient map documenting the *oikoumene*: the well-known *Tabula Peutingeriana*¹². We can't give the same label to other medieval maps but, in any case, lacking anything else and although this has a specific aim and deformations due to its own particular purpose, the *Tabula Peutingeriana* can be considered as an IMW of Antiquity.

11. See Russo 2013b, 134-139 and 223-225, commenting on Ptolemy's different methods regarding latitude and longitude.

12. Among a large number of works on the *Tabula Peutingeriana*, I can mention Miller 1962, Weber 1976, Bosio 1983, Prontera 2002, Albu 2014, Rathmann 2018. An accurate, detailed analysis of segments of Italy has been carried out in numerous publications by L. Bosio and G. Rosada: see Bosio, Rosada 2021.



FIGURE 1. Pompeian mosaic floor: Plato and his disciples discussing a globe wrapped in the geographical grid.

The *Tabula* was obviously meant to be used as a specific road map, a purpose that has led to its cartographical deformation: a scaled ratio of approx. 20:1 in the length/width relationship for a roll of nearly 7 m per 34 cm; a layout that entails numerous alterations in the correct orientation of the land. It should be noted that, when measuring distances along the length, those of the *Tabula* correspond quite closely to the actual distances, unlike measurements along the width. The stretching effect is not so great as the compression and deformations depend on the shape and placement of the geographical areas (Fig. 2). Despite these errors, the map goes beyond the confines of the Roman Empire and reaches the Far East, where we can read *Hic Alexander responsum accepit. Usque quo Alexander*, referring to the known *oikoumene* borders (seg. XII, 4-5)¹³.

13. The document clearly shows an awareness that there was no correspondence between the extent of the

Besides the symbolisation typical of the *Tabula* (from the monotonous outline of the mountain chains to the more detailed hydrography, even recording of minor rivers, and the variety of drawings for sites using a standardisation of levels that was useful to travellers in order to be able to see, at first glance, the location of the nearest “pit stop”), there are numerous ethnic-political and geographical textual annotations whose aim is not to provide travellers with precise indications. For instance: *Campi deserti et inhabitabiles propter aquae inopiam* (seg. XI, 2), *Saline immense quae cum luna crescunt et decrescunt* (seg. VII, 4) are specific comments on the environment, whereas the names of peoples and regions pertain to the

Roman Empire and the world known by Romans. Material data now attest to Roman trade reaching the Far East. On the other hand, the western limits of the world known by the Romans are still under discussion today: see Russo 2013b regarding the hypothesis that America is a land discovered since Antiquity.



FIGURE 2a. Comparison between *Tabula Peutingeriana* and a geographical map: NE Italy.

historical feature; but to whom is addressed the following information: *Fossa facta per servos Scutarum* (seg. IX,1)? I could continue with more examples but let us reflect on the fact that most of the additional information is in those areas least covered by the road network, those of which the fewest details were known. This might be due to reasons of space since the background of the map has fewer sites as it moves eastwards,

appearing empty in comparison with the western areas? Given the density of information in the regions west of Antioch, the authors would have presumably attempted to avoid overloading the map. With regard to the variety of indications recorded, the *Tabula* can be likened to a tool that helps users to create a mental map of a part of the world they would probably never see. It intuitively communicates information on the



FIGURE 2b. Comparison between *Tabula Peutingeriana* and a geographical map: NE Italy.

world they live in using cartographic language. We cannot but agree with Christian Jacobs when he says “This is the paradox of geographical mimesis: recognising what you have never seen”¹⁴.

In other respects we are looking at a geopolitical map¹⁵: the *Tabula* is the heir of maps that had been the prerogative of power, the outcome of explorations prior to plans for conquest (of territorial or commercial domination), which had made cartography an obvious instrument of power¹⁶. The itinerary model makes the world map ‘publishable’.

Ultimately, we have a map that records a lot of levels of information, which could be confusing although it must be admitted that the road

14. Jacobs 1990, 66.

15. See Montoya Arango 2007 for the spatial language of power between Antiquity and the modern age.

16. For Roman antiquity, see the passage by Suetonius (*vita Domitiani*, X, 3) on Domitian’s death sentence for Mettius Pompusianus because he had circulated a world map.

network emerges clearly, even in the most data-intensive areas. In the same way, we are loading the IMW sheets with a large number of records in order to create the *Tabula Imperii Romani*, but the transition from paper to digital cartography means that the layers of information can be handled more easily, albeit requiring greater precision in positioning data, all the more so considering the present possibility to switch from general to detailed.

Luisa Migliorati

2. FROM THE PRINTED TO THE DIGITAL VERSION OF THE *TABULA IMPERII ROMANI*. SOME REMARKS ON THE BASIC CARTOGRAPHIC SYSTEM

The *Tabula Imperii Romani*, launched in 1928 by O.G.S. Crawford, was conceptualised using the *International Map of the World (IMW)* as its cartographic background. Its large scale (1:1,000,000) was chosen because it allows “a stratified inventory of archaeological finds from the areas affected by the greatest Roman expansion” (Sommella, 2006, 4). In the early 1970s, the use of the *IMW* was questioned by Robert A. Gardner who suggested, instead, the *World Aeronautical Chart* series, also at a scale of 1:1,000,000. The use of this new chart would have reduced costs significantly, as well as facilitating the introduction of a new style in the project (Gardner, 1973, 111). In fact, as pointed out by Gardner himself, problems of cartographic representation had frequently been brought up during the meetings of the scientific committee (Gardner, 1973, 108).

Notwithstanding a few changes in the graphic style of the sheets, the base cartography remained unaltered until the beginning of this century, when a new idea of digital cartography for the *Tabula Imperii Romani – Forma Orbis Romani* project was developed, employing vectorial cartography to overcome the obstacles resulting from the large reference scale. The project was originally developed using the program NetGis, an application in Java language allowing vectorial files in DXF format (Drawing Exchange Format - the export format of Autocad and Microstation), which can be consulted via any web server and

browser¹⁷. Despite an initial attempt to make it available online, the K-32 sheet, produced under the joint direction of professors Paolo Sommella and Robert Étienne (curator of the French section) is still in paper format.¹⁸ Only the records of the mapped sites were available online.

As the project has almost completed its transition to the digital format¹⁹, several problems can finally be resolved. In addition to individual sheets at a scale of 1:1,000,000 (the cartographic background on which the archaeological evidence was mapped), each volume included a black and white map on which the boundaries of the *Tabula* were overlaid on a grid with a scale of 1:1,000,000 and which could sometimes include more than one sheet, as in the case of northern Europe (Fig. 3)²⁰.

This map, however, has no geo-topographical reference and is no longer capable of fulfilling cartographic requirements. The digital interactive system developed in recent years informs users immediately of the geographical limits of their search. The use of a new base map was suggested during a meeting of the International Commission of the *TIR-FOR* project on the new, digital consultation system of the *Tabula Imperii Romani* (Fig. 4)²¹. The transition from a printed version to a digital one changed the original layout that had been the inspiration of the *Tabula*: a “silent map” was no longer sufficient for the purposes of the project. The use of digital cartography has definitively resolved the problem of a neutral interface on which other layers can be overlapped.

17. <http://www.formitaliae.it>.

18. The innovation of the K-32 sheet lies in the fact that a new system to visualise the data on paper has been implemented and that a detailed map at a scale of 1:250,000 has been attached to each publication, which allows users to appreciate archaeological data in full detail (Sommella, 2006).

19. The digital project has not completely replaced the final printed version. Over the last few years, for the *TIR* project sheet J-34 has been published in printed format, produced under the direction of V. Antoniadis (2016), P. Karvonis (2016), G. Zachos (Zachos, 2016), while, for the *FOR*, the *Ager pomptinus I* (Ebanista, 2017).

20. The sheets including various countries caused a number of diplomatic problems which were only resolved in 1993, when the International Commission promoted cooperation between the countries involved in the project (Migliorati, 2014, 1956).

21. Institut d’Estudis Catalans, Barcelona, 12-13 May 2016.

The use of a physical map showing geographic features in the background, which replaced the earlier black and white one and on which it is possible to overlay other cartography (such as the borders of modern countries included in the territory of the Roman Empire), made significant improvements to the project. It is now possible, for instance, to define the geographic scope of a search in relation to both ancient and modern landscapes. The most challenging issue we are facing is specifically the geo-topographical framework, which is necessary both within the context of visualisation using a denominator of a scale to the million, and within the context of visualisation using the *Leaflet* system, the opensource JavaScript library currently used in the *TIR-FOR* project, which obviously guarantees a much more detailed view. The interactive cartographic background seems to be helping to resolve the problems regarding the rendering of archaeological features. Users can now carry out thematic geographical searches by simply showing or hiding one or more layers.

The system has been significantly improved since 2016. It is now possible to overlay several items on the default background, listed under the Geographic Information Layers tool²²: peoples, rivers, geographical features (at the moment still in the form of a geometrical shape, only available for Spain but not *queryable*) and roads (only visible in the Hispanic provinces and for *Dacia*). Further tools could help to improve the system even further. It would be particularly useful, for instance, to add a layer with the boundaries of modern countries, which could be overlaid on the Google Satellite visualisation system²³, thereby allowing users to keep a physical background for their own research. These data, of course, will be combined with the area covered by the *TIR* sheets, and with the boundaries of the Roman Empire.

Direct access to the *DARE (Digital Atlas of the Roman Empire)*, Centre for Digital Humanities, University of Gothenburg, Prof. Johan Ahlfeldt), which users can overlay on the *TIR*, fills the gap

22. <https://tir-for.iec.cat/tirfor/showMapPage>.

23. Nowadays, in fact, the modern cartographic elements are only replaceable with the default physical cartography. In the interactive menu it’s possible to choose between other cartographic layers among ESRI Roads, Google roads, Google Satellite and Gray.

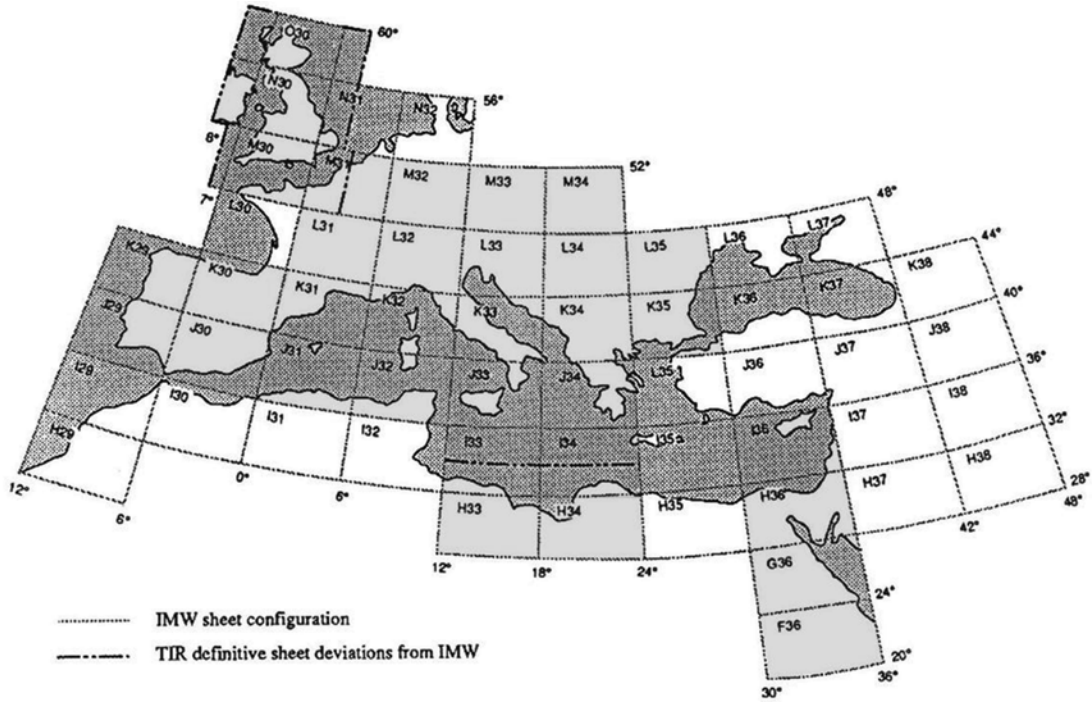


FIGURE 3. TIR and IMW sheets configuration (from Talbert, 2018). In grey: the TIR sheets published from the 1930s to 2016.

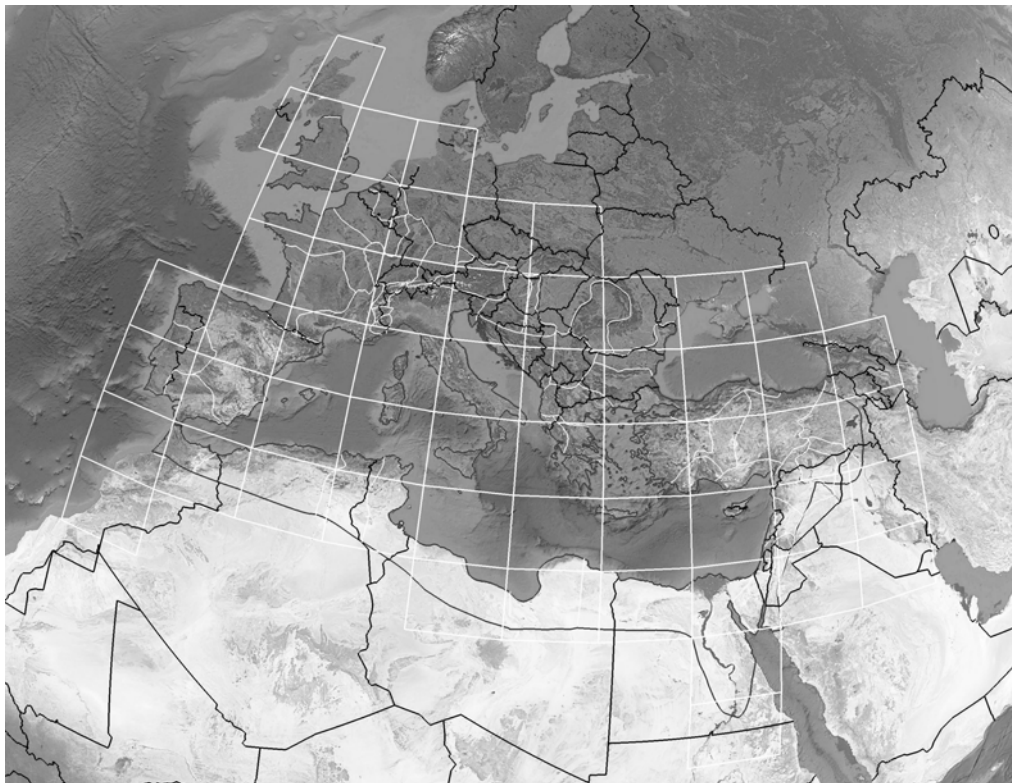


FIGURE 4. Proposal of a new base map produced on GIS and Google Earth with the limits of the IMW series, the boundaries of the Roman provinces, the limits of the Roman Empire at its maximum expansion and the boundaries of modern states. Rendering: Ilaria Trivelloni.

between the provincial division of the territory and the road network. The project can be completely superimposed on the *Tabula*, not integrated with it: when shown, the *DARE* covers all the other layers except for the archaeological sites featured on the *TIR-FOR*.

Even though there is still much that can be improved (e.g. we should aim to allow broader, simultaneous queries of all the layers), significant progress has been achieved so far. This new digital map, although still under development, will prove helpful in creating an increasingly specialised cartography, which could facilitate research. Given that the transition to digital cartography is almost definitive, the innovativeness of research should also be achieved via the increasing specialisation of the cartography included in the database. A turning point could definitely be the introduction of cartographic layers showing, for instance, the geomorphology of specific areas. This process would also enable valuable collaboration with other opensource systems. As the 1:1,000,000 scale is no longer a constraint, it's now possible to introduce tools which would allow the archaeological features mapped in the *TIR-FOR* to be seen in detail, yet without losing contact with their broader geographical setting.

The creation of an interactive map and the consequent creation of “talking cartography” are amongst the most important results in the transition of the *Tabula Imperii Romani* to a digital platform, in that they helped to overcome the many visualisation issues entailed in printed cartography at a scale of 1:1,000,000.

Ilaria Trivelloni

3. DATA TRANSPOSITION PROBLEMS FROM THE PRINTED TO THE DIGITAL MAPS: SOME CONSIDERATIONS

This paper stems from some considerations generated within the work of the TIR Italian team that dealt, from 2015²⁴, with the transposing of the map published in the *Tabula Imperii*

Romani. Sheet K-32 Firenze (Sommella, 2006a) to the TIR web platform (<https://tir-for.iec.cat/>).

From a practical point of view, the plan was to transpose the sites reported on the printed maps, specifically published as a general map (1:1,000,000 scale) and detailed maps (1:250,000 scale), both in the UTM geographic network and sexagesimal degrees²⁵. The operating mechanism has proven to be quite complex from the beginning, as the problem of the precise geolocation of the data has immediately arisen.

Nowadays, the digitisation of numeric data in cartography is immediate and expeditious, without using printed maps, the coordinates be obtained manually by geometric trilateration or from GPS systems, with a low margin of error or at least a quantified error rate, respecting the maximum scale of the final display (both digital and printed). Also the 1:1,000,000 scale of Sheet K-32 was produced to be “read” exactly at this specific scale and therefore the dot-shaped elements indicating the archaeological evidence are of a suitable size for easy reading (not too small), but also for the correct localisation of sites.

The problem arises when transposing the dots on the TIR web platform. The maximum graphic display scale can reach approximately 1:10,000, as is the case for the most common online maps, such as Google Maps or Google Earth, or libraries used to build web mapping applications, such as Leaflet (Lazzarin, 2007). Note that 1:10,000 is a graphic scale generally used for activities in the field and archaeological surveys, even larger than the one used in the FOR project²⁶.

So, once a dot has been transposed on the GIS it will correspond to the centroid (calculated as precisely as possible) of the dot or of the symbol represented on the printed map. In the 1:1,000,000 K-32 map the evidences are marked by dots with a diameter of approximately 1 mm, hence the practical difficulty of considering its centroid. In order to make this operation as precise as possible, the map was scanned and the coordinates read using digital image processing software, so as to draw more precise perpendicular and parallel axes

24. The work was first carried out only by the writer, and from 2016 also by Ilaria Trivelloni and from 2020 also by Dario Canino and Alessandro Vecchione.

25. Series 1301 - Sheet N. K 32.

26. Usually 1:25,000 for the Italian series of the *Forma Italiae* (<http://www.formitaliae.it/>).

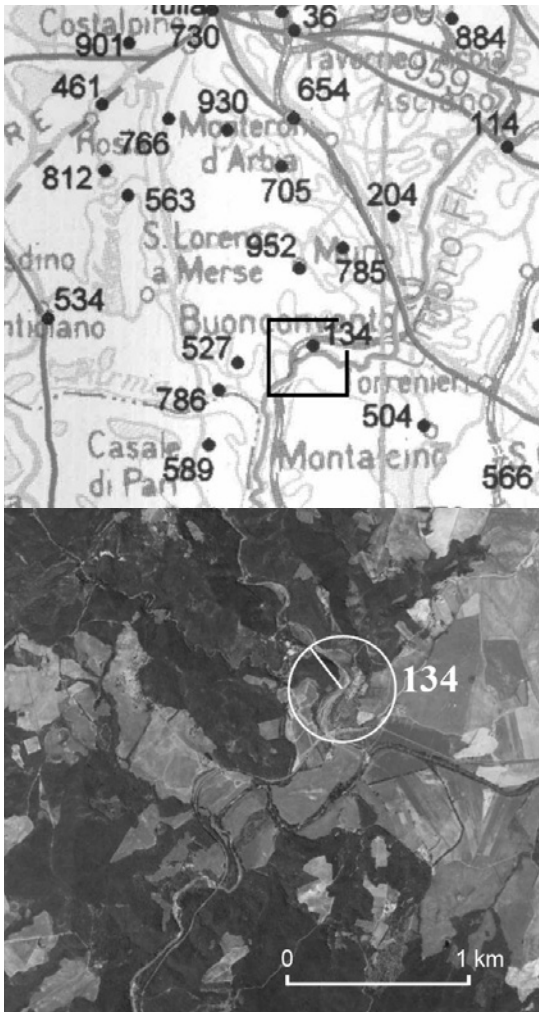


FIGURE 5. Comparison between the map printed on Sheet K-32 (at the top) and the visualisation in Google Earth (at the bottom). The area indicated in the square on the map corresponds to the satellite image window at the bottom, the circle is the extension occupied by point no. 134. Base: on the top Sommella, 2006a tab. I, on the bottom Google Earth. Rendering: Laura Ebanista.

than with manual instrumentation. In spite of this, considering the scale ratio, the dimension covered by the surface of a 1 mm dot is equivalent to 785,000 m², therefore 0.785 km² (Fig. 5). This situation does not improve with 1:250,000 scale maps where the evidences are marked not by dots but by symbolic graphic elements that occupy more space (Sommella, 2006b, 22-24). The symbols have an average size of 4 × 4 mm,

therefore the occupied area corresponds to about 1 km². The use of dots and non-graphic elements would obviously be preferred in this circumstance but also in general: a graphic element is usually of irregular shape (it's therefore more complex to calculate the centroid) and occupies an area that is too large in reality (regarding this topic in archaeological cartography, see Guitoli, 1999, 361). It should also be considered that, even if a symbol of minimum size is used, you cannot go below a certain threshold, on the one hand because it would be impossible to represent this graphically and, on the other, because the human eye can only perceive these as two separate points when they are placed at most 0.10-0.17 mm (Walker 2012, 507-509).

It is evident that an area of about 1 km² (the one covered by the dot on the map) cannot refer to specific evidence such as a *villa*, cistern or bridge, but to a series of items. On the TIR online platform (<https://tir-for.iec.cat/>) there are two levels of detail for the entries of archaeological evidence: “Main typology” (mandatory) and “Elements” (optional). This choice facilitates the reading of data in this respect²⁷: a macro-site is produced to which many elements refer. Nevertheless, the problem of precise localisation remains, “Main typology” being an area that incorporates more specific evidence within it. On the other hand, positioning can lead to considerable error when working only with dots and not with areas.

The key point is always the source of the data and the positioning methodology on the map, using a certain graphic scale during the specific search.

This problem will be partially overcome when the positioning on the TIR-FOR web platform starts with the entry of data in the FOR records²⁸, which are usually positioned on a map scaled to 25,000. This scale is more compatible with the best graphic visualisation possible using a web map viewer (about 1:10,000). In this case, the transition to the TIR would consist of selecting and grouping data from the FOR records, in line with the graphic scale. For

27. On this topic, see <https://tir-for.iec.cat/methodology-2/>.

28. See https://tir-for.iec.cat/wp-content/uploads/TIR_FOR_record_sheet-1.pdf.

example, a *villa*, a cistern and necropolis could be merged in the same record, albeit noting that their overall size may be less than the real size of the dot that represents them.

For example, Fig. 6 shows a proposal to handle such matters, as presented in Barcelona during the meeting of the International Commission for the TIR-FOR held in 2016. It is an excerpt from the archaeological map of the *Forma Italiae Ager Pomptinus I* (Ebanista, 2017, tab. I out of text). This is an area of the southern *Latium* coast, at the mouth of the Rio Martino canal, a watercourse dug in Roman times. This small area forms part of a larger region, the *Ager Pomptinus*, a territory characterised since Antiquity by the presence of extensive swamps. Many attempts have been made to reclaim this area, from Volscian, then during the Roman age, until the Papal reclamations and up to the so-called ‘Bonifica Integrale’ (Full Reclamation) of the 1930s. In the archaeological map there are 18 items of evidence, among dots, areas and polylines.

The map edited in the *Forma Italiae* volume is produced on a 1:10,000 CTR (Regional Technical Map) then scaled to 25,000. The location (Fig. 6) is clear and precise in relation to the printed map, also taking advantage of the extremely flat territory and a map with few contour lines, which remains legible even when reduced in scale. Starting from this map that corresponds to the FOR digitisation, it is possible to hypothesise its transposition to the TIR display.

At the mouth of Rio Martino (no. 12F)²⁹ there are buildings related to a Roman *villa* (no. 11F). Based on the different data collected, there is the *Clostris*, one of the *stationes* of the *Via Severiana* (no. 13F), a coastal road known from *Tabula Peutingeriana*. 2 km further inland, along the Rio Martino canal, there is another *villa* (no. 2F), identified thanks to the large amount of pottery and architectural material, periodically unearthed during seasonal ploughing. The presence of buildings is also confirmed by an unedited 18th-century map that locates structures when they were still visible (Ebanista 2017, 28 Fig. 22). Furthermore, some funerary inscriptions (no. 5F)

29. The numbers (12F, for example) refer to those marked on the archaeological map in Fig. 2. The corresponding texts are published in Ebanista, 2017, 47-59.

are known, most likely related to a necropolis in connection with *villa* no. 2. There are also sporadic fragments and areas of pottery and architectural material in the surrounding area (no. 1-3-4-7-8-9-10-14-15-16-40-41F).

Processing the findings of this area and transferring them from the FOR to the TIR web platform (or ideally on a 1:1,000,000 map) whose graphics only uses dots and not areas, only two records would be achieved, corresponding to the buildings located at the mouth of the Rio Martino, along *via Severiana*, interpreted as *Clostris statio* (no. 11F), and another related to the *villa* along the course of the canal, in a more internal position (no. 1-5F).

The result is represented by the two areas superimposed on the archaeological map in Fig. 6; areas of 1 square km have been drawn, corresponding to the dot of 1 mm in diameter, in comparison with the map of the K-32 at 1,100,000. The figure shows how, in going from the 25,000 to the 1,000,000 map, it is not possible to go into more detail. In the case of record 2, for example, the *villa* will be classed as “Main typology” and the necropolis and pottery as “Elements”.

This issue is complex, as can be seen by this small example. Although we live in the digital era and the processing of digital cartography is increasingly widespread compared to printed formats, I am convinced that printed cartography cannot be abandoned. On one hand, because the vast majority of scientific archaeological cartography is, today, still published in printed form (for the Italian territory, the TIR Sheet K-32, the *Forma Italiae* series, as well as numerous other publications of various kinds), and on the other hand because it’s undeniable that, even today, although cartography may be processed digitally, the outcome of research is always in a printed format.

Therefore, although GIS would seem to overcome every problem linked to graphic scales (it is possible to use, as a cartographic base, any kind of map at any level of scale or photographic and satellite images), the issue is still complicated. Despite GIS being a large container of data that enables comparisons and interpolations during the study and research phase, it’s always necessary to consider whether data will be consulted in its printed or digital form, as well as the graphic scale

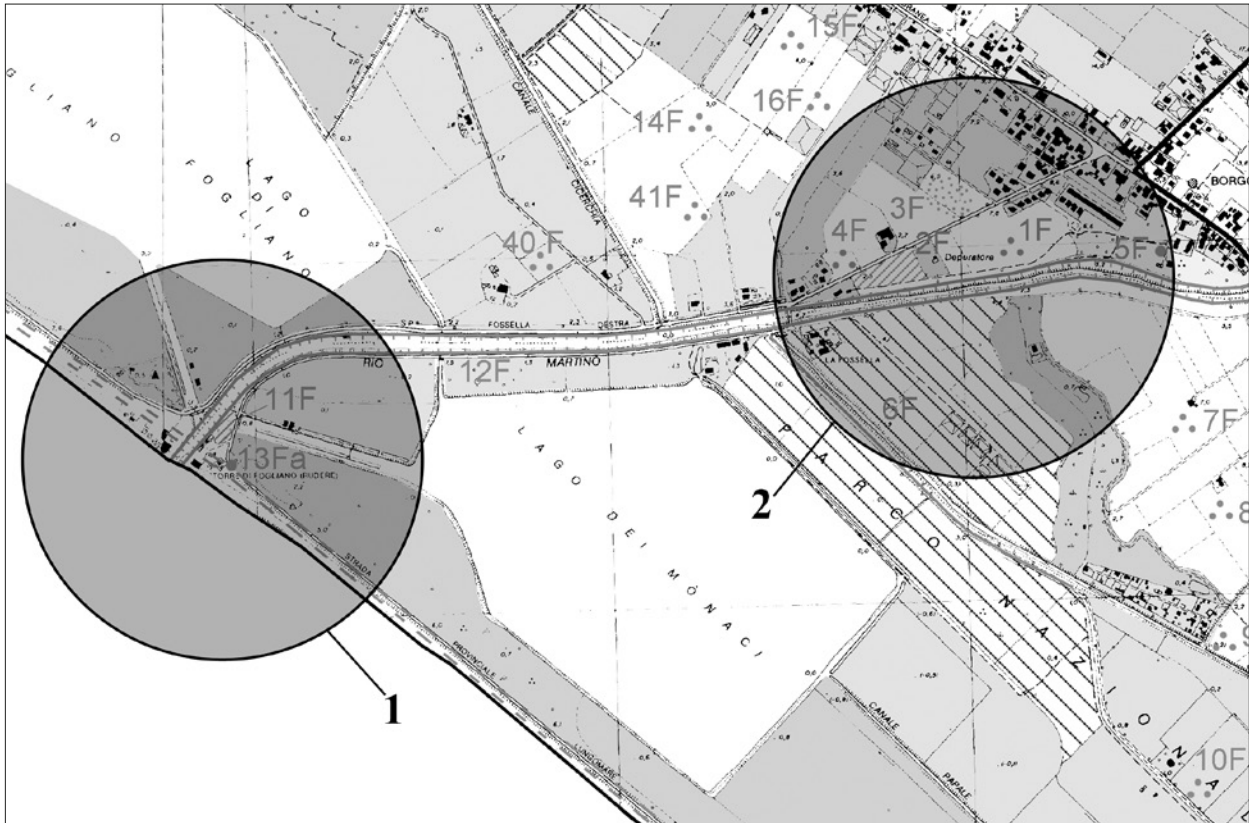


FIGURE 6. The two areas superimposed on the archaeological map represent the two hypothetical points of the TIR of 1 mm in diameter. Base: Ebanista, 2017, tab. I out of text. Rendering: Laura Ebanista.

required for the basic cartography or virtual map viewer.

Laura Ebanista

BIBLIOGRAPHY

- BAGROW, Leo (1964). *History of cartography* I. London.
- BOSIO, Luciano (1983). *La Tabula Peutingeriana. Una descrizione pittorica del mondo antico*. Rimini.
- BOSIO, Luciano; ROSADA, Guido (2021). Errare humanum est, sed etiam intelligere. Guardando all'Italia fisica nella Tabula Peutingeriana. In: CASTAGNARA CODELUPPI, M.; ROSADA, G.; TURCHETTO, J.; VISINTINI, M. (eds.). *Capire la terra. Un incontro per e con Luciano Bosio*. Testis temporum 6.
- DILKE, Oswald Ashton Wentworth (1985). *Greek and Roman maps*. London.
- CINQUE, Giuseppina Enrica (2002). *Rappresentazione antica del territorio τῶν πινάκων*. Rome.
- EBANISTA, Laura (2017). *Ager pomptinus I (Forma Italiae 46)*. Rome: Edizioni Quasar.
- GARDINER, Richard A. (1973). "The International Map of the Roman Empire". *The Geographical Journal*, 139, 107–111.
- GUAITOLI, Marcello (1999). "Nota sulla metodologia della raccolta, della elaborazione e della presentazione dei dati". In: TARTARA, Patrizia (1999). "Torrimpietra" *Forma Italiae 39*, Firenze: L. S. Olschki.
- GUITART, Josep; PREVOSTI, Marta; DE SOTO, Pau; ROMANÍ, Núria; CORTÉS, Ada; PADRÓS, Núria (2018). "El projecte internacional *Tabula Imperii Romani – Forma Orbis Romani* (TIR-FOR)", *Tribuna d'Arqueologia* 2015-2016, 332-347.

- JACOBS, Christian (1990). *Carte greche*. In: PRONTERA, F. (ed.) (1990). *Geografia e geografi del mondo antico. Guida storica e critica*. Rome-Bari.
- LAZZARIN, Gianmarco (2007). “I programmi per la visualizzazione di immagini della terra come ausilio didattico all’insegnamento della geografia: Google Earth e Nasa World Wind”. *Bollettino A.I.C.* 129-130-131/2007, 139-147.
- LACOSTE, Yves (1976). *La géographie, ça sert, d’abord, à faire la guerre*. Paris.
- MIGLIORATI, Luisa (2002). *Oriente e mondo classico: le fonti cartografiche*. In: *Il mondo dell’archeologia*, I, Rome, 142-146.
- MIGLIORATI, Luisa (2014). “Proyecto *Tabula Imperii Romani*”. In: ÁLVAREZ, José María; NOGALES, Trinidad; RODÀ, Isabel. *XVIII CIAC: Centro y periferia en el mundo clásico/ Centre and periphery in the Ancient World, Proyectos internacionales de investigacion/ International research projects*. Vol. II. Mérida: Museo Nacional de Arte Romano, 1955-1962.
- MILLER, Konrad (1962). *Die Peutingersche Tafel*. Stuttgart.
- MONTOYA ARANGO, Vladimir (2007). “El mapa de lo invisible. Silencios y gramática del poder en la cartografía”. *Universitas Humanística*, 63, 155-179.
- PRONTERA, Francesco, (ed.) (2003). *Tabula Peutingeriana. Le antiche vie del mondo*. Firenze.
- RATHMANN, Michael (2018). *Tabula Peutingeriana. Die einzige Weltkarte aus der Antike*. Mainz.
- ROMM, James S. (1992). *The edges of the Earth in Ancient Thought*. Princeton.
- RUSSO, Lucio (2013a). *La rivoluzione dimenticata*. Milan (7th ed.).
- RUSSO, Lucio (2013b). *L’America dimenticata*. Milano.
- SOMMELLA, Paolo (2006a). “Saper leggere la TIR (foglio K-32), a proposito di una recensione di W.V. Harris”. *Mediterraneo Antico*, IX, 2, 1-24.
- SOMMELLA, Paolo, (ed.) (2006b). *Tabula Imperii Romani. Foglio K - 32 Firenze*. Rome: Quasar.
- TALBERT, Richard John Alexander (2018). *Challenges of Mapping the Classical World*. Abingdon, Oxon: Routledge.
- WALKER, James S. (2012). *Dalla meccanica alla fisica moderna. Vol. 2. Onde. Eletticità. Magnetismo*. Milan-Turin: Pearson Italia SPA.
- WEBER, Ekkehard (1976). *Tabula Peutingeriana. Codex Vindobonensis 324, Kommentar*. Graz.
- ZACHOS, George (2016). “*Tabula Imperii Romani J34-Athens: Achaia Phthiotis-Malis-Aenis-Oitaia-Doris-Eurysania-East & West Locris-Phokis-Aitolia-Akarnania*”. Academy of Athens: Athens.

The TIR-FOR (*Tabula Imperii Romani - Forma Orbis Romani*) project and the contribution of Romania. State of research

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ABSTRACT

This study provides an overview focusing on the new digital TIR-FOR project and the results of the Romanian team involved in this project. The first part of the study is a short introduction to the topic, looking at the old TIR volumes published in the past which focused on the territory of the province of Dacia. The second part of the paper includes some aspects regarding the methodology of the project adopted for this new stage. The third part presents case studies related to some settlements in Roman Dacia, while the final part is devoted to the current results of the project and some concluding remarks, together with some future plans to continue this research.

KEYWORDS: TIR-FOR, Roman Dacia, mapping archaeological sites, gazetteer.

1. THE HISTORY OF THE TIR PROJECT IN ROMANIA. A SHORT OVERVIEW

In 1965, D. Tudor published the first work of the TIR (*Tabula Imperii Romani*) series for Dacia, covering a narrow strip of the southern part of Romania (Tudor (ed.), 1965). In 1968, the second volume was published (Soproni (ed.) 1968) and the third volume in 1969, covering section L35 (Russu (coord.) 1969).

Developed during the last century, the *Tabula Imperii Romani* (TIR) project represents, as of now, the most complex, scientific project dealing with the topography of the Roman world. The volumes published so far (114 in total)², comprising 56 sheets at a scale of 1:1,000,000 for the entire Roman world, produced significant scientific impact: for each settlement in the Roman Empire, the first work cited in any bibliography is TIR. However, the TIR volumes have led to two unresolved issues: 1. The maps have a very

small scale (1:1,000,000), which obviously does not enable the sites to be mapped accurately. In other words, the use of geographical coordinates to indicate the precise location of the sites was useless; 2. Certain areas of the Roman world need more detailed maps (e.g. 1:20,000 or 1:25,000). To resolve the second issue, in 1919 the idea of *Forma Orbis Romani* (FOR) was developed to produce detailed maps for various Roman cities. The FOR is actually an enlargement of TIR with more accurate and detailed cartography for certain regions.

Almost 50 years have passed since TIR L34 and TIR L35 were published. Inevitably, the requirements of professional researchers regarding the topography of the Roman Empire in general, and of Roman Dacia in particular, far exceed the outdated information contained in the old TIR volumes. Due to ongoing research, digital cartography and databases also need to be implemented in archaeology. Moreover, constant infrastructure developments for residential and agricultural areas, which endanger archaeological heritage, can be better managed using an online database containing the archaeological sites.

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2. Union Académique Internationale - Publications (uai-iaa.org)

The old TIR maps use a small scale (1:1,000,000) which obviously does not suit the need for accurate macro-scale geo-referencing. More suitable are the maps with a larger scale (1:5,000, 1:10,000, 1:25,000), which enable sites to be positioned in detail using decimal coordinates. Another drawback of the old TIR maps is that it is almost impossible to see the accurate position of any site, while it is obviously impossible to update the printed version of TIR maps. Furthermore, the obsolete reference system used is another important weakness in the old TIR volumes.

There is a third major (scientific) problem with the old TIR volumes: the outdated information for both old and also newly discovered sites (from settlements to relatively isolated spots). Half a century of archaeological research has contributed significantly not only to a better understanding of the topography of any Roman province but also to a rapidly increasing number of newly discovered sites.

Another scientific issue is the old bibliography cited in the TIR volumes. For example, the bibliography for Roman settlement and the Roman road segment from Aiton stops in 1915, while the three volumes of the TIR series for Dacia contained around 725 records of archaeological sites. However, since the late 1960s the number of known sites in Dacia has doubled. For instance, in 2005 there was evidence for approximately 1,300 sites in Roman Dacia (Bărbulescu (coord.) 2005) and today we know of around 1,400 sites. In addition, over the last few years digital technology has advanced so fast that the complexity and potential of geographical information systems have obviously gained the upper hand compared with the rigidity of scaled, printed maps.

2. THE NEW TIR-FOR DIGITAL PROJECT (2015-2021). DEVELOPMENTS. METHODOLOGY

In 2015, following the invitation of our colleagues from the Institut d'Estudis Catalans in Barcelona, we gladly agreed to form part of the international team planning the beginning of a new digital TIR-FOR project. From the start, we realised the project has several technological aspects that highlight the importance of a TIR-

type database developed via an online platform. The databases of each team are created in connection with and through a brand new platform (https://tir-for.iec.cat/tirforAdm/edicio/lListaTir.action?request_locale=en).

The Romanian team is made up of young doctoral students from Babeş-Bolyai University Cluj-Napoca and is coordinated by Mihai Bărbulescu and Florin-Gheorghe Fodorean. Soon after the work started, the Romanian team established several key objectives: 1. To enter digital records for all the archaeological sites in Roman Dacia via an already functional online platform; 2. To update the information for all these sites, as the data for almost every site contained in the old TIR volumes are very general and brief (e.g. Aiton – “Römische Siedlung” etc.). Also, the bibliography cited is absolutely obsolete; 3. To classify all the data entered online using particular criteria so that a range of theme-based maps can be produced by the end of the project. Now we are approaching the final stage in terms of fulfilling these objectives, with the aim of obtaining a complete, updated, easily accessible catalogue (in English) of all the recorded sites in Roman Dacia. The contribution made by our project is not only this catalogue but also the online database, because every site will also be recorded on the aforementioned platform.

Any online geographical information system or database has advantages for users compared with hardcopy (printed) methods. In our case, the first advantage is the possibility of producing digital, interactive maps at different detailed scales (1:5,000 up to 1:25,000), following various chronological, typological and functional criteria. These maps will be produced for the FOR part of the project, using an integrated GIS platform (ArcGIS) in connection with the TIR database platform. The two 1:1,000,000 scale maps for TIR L34 and L35 were geo-referenced using the World Geographical System (WGS). Moreover, data were stored in attribute tables, providing accurate information for any point with Roman archaeological finds. The format of these attribute tables (columns and rows) were developed to ensure they could contain all essential data, such as: location, coordinates, site typology, description and bibliography. The technological dimension of the TIR-FOR

database represents an advanced instrument for every future topographical study regarding Roman Dacia, from a thematic study in a micro-region to various geo-statistical analyses closely connected with the archaeological and historical background. We can therefore use a wide range of entry criteria, from the type of site, chronology and detailed descriptions to bibliography and photographs. The database will be regularly updated with the latest information regarding every single site and findspot.

The project provides not only innovative methods for recording and classifying archaeological sites but also stimulates new research perspectives regarding the digitisation of archaeological heritage, which now represents a major priority in Europe. Numerous countries have already developed digital instruments to record, update and protect their archaeological heritage.

The project offers a new approach, a new methodology, and it also provides a triple impact: 1. Economic: recording each site will provide a fundamental tool for the precise location of all sites; 2. Cultural: using this database, steps will be made to protect the archaeological sites; 3. Scientific: the project integrates all the information into a single database.

Therefore, the project: 1. has the capability to strengthen cooperation between researchers with expertise in archaeological heritage and those specialised in digital cartography and interactive tools; 2. promotes the use of online technologies, making information easy accessible for those interested in the archaeological heritage of the Roman world; 3. enhances the possibilities to protect heritage, following the recommendations of the La Valletta Convention (1992) which strongly recommends the following (Art. 7): “For the purpose of facilitating the study of, and dissemination of knowledge about, archaeological discoveries, each Party undertakes: i. to make or bring up to date surveys, inventories and maps of archaeological sites in the areas within its jurisdiction”. Last but not least, in order to protect cultural heritage, the project uses digital innovations so to follow the recommendations from Art. 9 of the same Convention, which recommends: “Each Party undertakes: i. to conduct educational actions with a view to

rousing and developing an awareness in public opinion of the value of the archaeological heritage for understanding the past and of the threats to this heritage; ii. to promote public access to important elements of its archaeological heritage [...]”³

The interface has eight interactive fields. The first one, ‘Sites’, allows us to view the sites in alphabetical order. By clicking on the site name, a new page opens containing a wide range of data about the site, data previously entered using the second, third, and fourth field: ‘New Site’, ‘Typology’ and ‘Elements’. The ‘New Site’ page contains input fields for basic information about the site: ancient name (if known), modern name, the county and modern administrative division, grouped together under ‘site information’. The second section contains fields for the coordinates of the site: the Ptolemy coordinates (if they exist), universal coordinates (origin), universal coordinates (current), and UTM coordinates. In our case we used decimal UTM coordinates due to the fact that the interface maps are connected to the larger Google Maps platform. Next is the ‘Typology’ section, to enter the main category of the site, and the ‘Elements’ section for more details regarding the typology. There is also a ‘Notes’ section to enter a description of the site and/or the finds, and the ‘Bibliography’ section. The ‘Chronology’ table gives us the possibility to enter the absolute chronology for every site.

The third field is called ‘Typology’. For every site the interface offers the possibility to choose the main type, a type that defines the general characteristics of the site/find.

The fourth field is in close connection with the third. This is called ‘Elements’ and it enables us to detail the typology more precisely. The online list on the platform contains elements such as ‘mosaics’ for a *villa* type structure, or *palestra* for the *thermae*. The fifth field is for ancient sources. Here we can select a predetermined textual reference from the online database. The sixth field is entitled ‘Coordinate conversion’ and its purpose is to convert coordinates from different systems to the decimal system, which is compatible with the

3. Full list (coe.int).

interface. ‘Map’ is the seventh field, supported by the Google Maps interface. Every point on the map is connected to the ‘Sites’ field. With a single click we can see the information about the site that has been entered in the aforementioned fields. Once the decimal coordinates are inserted in the specific field, the point is simultaneously marked accurately on the map. Finally, the last field allows us to download all the data in an Excel table. Every site will also contain the name of the author who entered the data. Any information entered in this database can be modified or updated at any time.

A third level of the methodology corresponds to the GIS analyses and geo-statistical exports. Based on a database that can be constantly updated, certain results can be exported due to the fact the TIR-FOR interface is closely connected with the GIS-dedicated programs. Through this connection we can export mainly the topographical features of the sites, in attribute tables. Such tables represent the foundation for every GIS-based study in the future, from precise general maps at different scales and thematic maps containing selected types of sites, to geo-statistical analyses for scientific research related to the landscape, impact of the Empire, distribution patterns, network analyses and many more.

3. CASE STUDY. SETTLEMENTS IN ROMAN DACIA

We have chosen to present some data for one important rural settlement in Roman Dacia, namely Aiton, to show how we have managed to present all the new data available for this site.

3.1. Aiton (commune, Cluj County)

Three important discoveries have been recorded within the territory of the village: a possible *mansio* in the northern part, a Roman milestone dated in 108 AD and the remains of an important rural settlement, scattered over the terrain, identified in numerous courtyards as well as outside the village, mostly in the centre and south-eastern part of Aiton.

a. *The mansio*

In 1913 Márton Roska excavated an L-shaped building with five rooms (recorded as A, B, C, D, E) in the northern part of the village (Fig. 1), in an area entitled “Podul de piatră” (Roska, 1915, p. 48-50). The foundations of the walls (0.50 m in width) were well preserved. On the western side of the building an apse was identified. Room “E”, the one with an apse shape, was provided with a *hypocaust* installation. A *praeefurnium* was identified in the southern part of room D.

Close to this construction, another building was excavated (Fig. 2) (Moțu, 1990-1991, p. 175-219). The point where the building was located is called “Locul lui Poțu” by the local inhabitants. The area is located at the exit from the village, on the right of the current road and very close to the former Roman road (Fig. 3, Fig. 4). The traces of the building were visible on the surface, scattered around an area of approximately 60 m². About 35 m² of the entire building were excavated. Three rooms were identified here, along with elements from another *hypocaust* installation. Among the artifacts, a bronze coin from Faustina the Younger was identified.

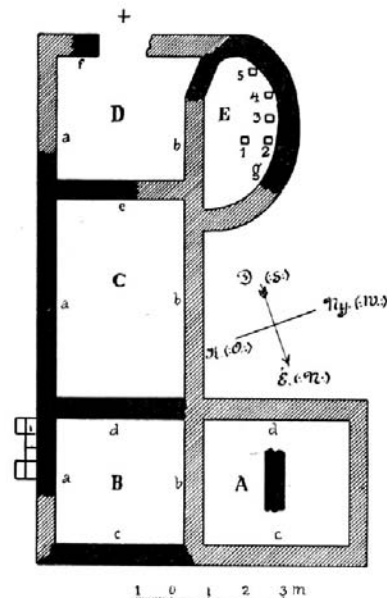


FIGURE 1. The building excavated in 1913 by Márton Roska in the northern part of Aiton (after Roska, 1915, p. 49).

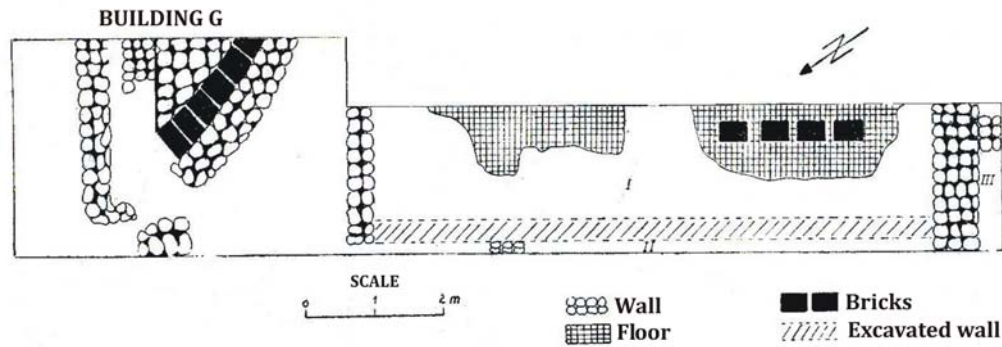


FIGURE 2. The drawing published in 1991 by I. Moțu (after Moțu, 1990–1991, p. 194).

South of these buildings, very close to them, another area with Roman artifacts was identified on the surface: the foundations of a stone wall together with ceramic fragments, tiles and fragmentary monuments. Close to this point a fragment from a column was discovered.

Between these two buildings excavated by I. Moțu, fragments of inscriptions, two weapons and other artifacts were identified. This area corresponds with the one described in the archaeological repertory of the Cluj County (Crișan, Bărbulescu, Chirilă, Vasiliev, Winkler, 1992, s.v. Aiton, p. 23, no. 13). This is, in fact, the courtyard of house no. 346 in Aiton, positioned at the exit to the village, on the right of the current road and close to the former Roman road.

Therefore, the discoveries grouped in the northern part of the village, close to the Roman road, might suggest the existence and functioning, during the Roman period, of a *mansio* (Fig. 5). The most important argument is, in fact, the location of these discoveries, very close to the Roman road (the sector Potaissa-Napoca). Such constructions, *mansiones* or *stationes*, provided accommodation for travellers in the immediate vicinity of the roads.

b. The milestone

In 1758 a Roman milestone was found in Aiton, within the territory of the village. Unfortunately, we do not have accurate data concerning the exact location of this monument. This situation has led to several suppositions,

summarised here: the milestone was discovered south, north or within the territory of the village. We also lack a detailed description as the milestone has been lost. Fortunately, Iudita Winkler discovered a drawing of the monument in a manuscript kept in the central library of Cluj-Napoca (Fig. 6) (Winkler, 1982, p. 83). The drawing belonged to M. P. Szathmári. During the 18th century, in 1773, J. Seivert was the first person to read and publish the text of the milestone (Winkler, 1982, p. 80). In the 19th century, other historians debated the text of the inscription. K. Torma was the first who actually read and commented on the inscription (Torma, 1864, p. 30). In 1982, Iudita Winkler discussed the milestone's inscription in a short note (Winkler, 1982, p. 80-84).

A copy of it can be found in the courtyard of the local school in Aiton. The text (CIL III 1627; Fodorean, 2006, p. 66; Fodorean, 2015, p. 220; Fodorean, 2016, p. 90) is:

Imp(erator) / Caesar Nerva / Traianus Aug(ustus) / Germ(anicus) Dacicus / pontif(ex) maxim(us) / [tribunicia] pot(estate) XII co(n)s(ul) V(sic) / imp(erator) VI p(ater) p(atriciae) fecit / per coh(ortem) I Fl(aviam) Ulp(iam) / Hisp(anorum) mil(liariam) civium R(omanorum) eq(uitatam) / a Potaissa Napocae / m(illia) p(assuum) X

This piece of evidence indicates that this section of the road was built by *cohors I Flavia Ulpia Hispanorum milliaria civium Romanorum equitata*. This troop is mentioned among the military forces used by Trajan in the war against the Dacians. After fulfilling its mission, it was garrisoned at Orheiul Bistriței, along the north-

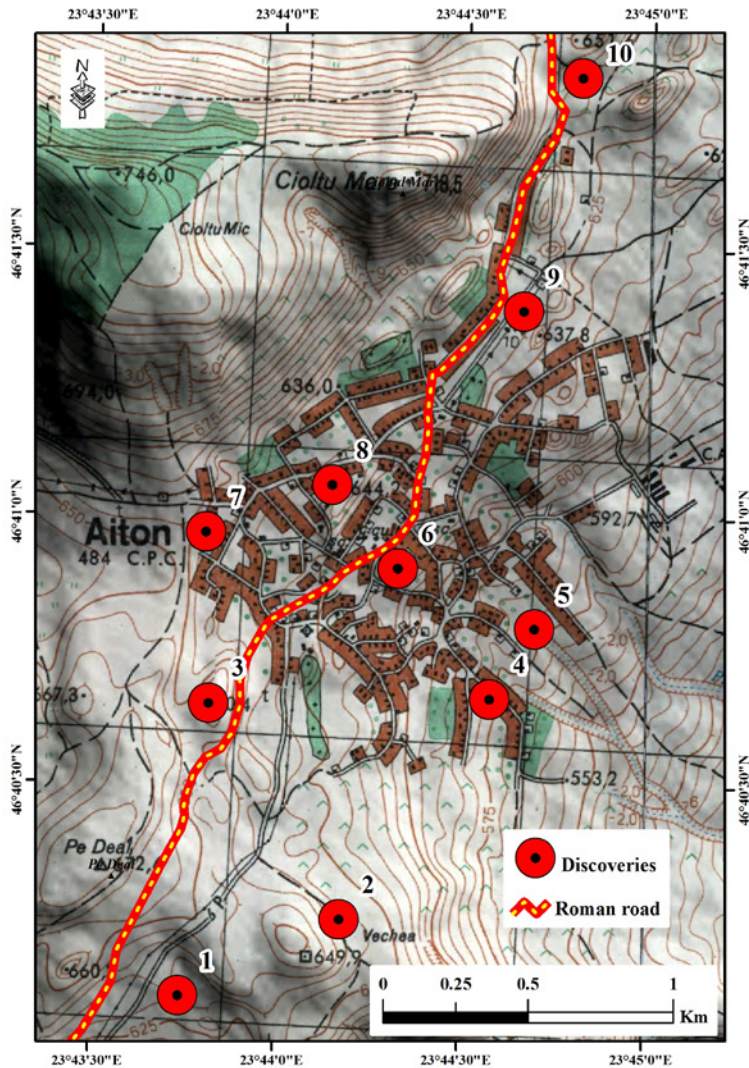


FIGURE 3. The repartition of the Roman sites indicated in the archaeological repertory of Cluj County (Map: F. Fodorean).

eastern frontier. The term *equitata* suggests the use of this cavalry unit to reconnoitre the terrain of northern Dacia.

Between Potaissa and Napoca this road was identified in the terrain and mapped with accuracy (Fig. 7) (about the road, selectively: Blăjan, Cerghi, 1978, p. 21-27; Fodorean 2015a; Winkler, Blăjan, Cerghi, 1980, p. 63-73; Winkler, 1982a, p. 587-589). The total length of this section is 36 kilometres; i.e. 24 Roman miles.

c. The rural settlement

During the Roman period, Aiton was an important rural settlement within the territory

of Potaissa. Based on several studies published in the last 50 years, we are now able to distinguish, topographically, an area with consistent discoveries, mainly located in the east, south-east and south of the current village (Fodorean, 2015, p. 217-232; Fodorean, 2015b). These discoveries are mainly registered as scattered on the surface of the terrain, consisting of wall foundations, ceramic fragments, tiles and some special artifacts (Blăjan, Cerghi, 1978, p. 21-27). Besides the usual fragments of ceramics, two discoveries are of special interest. One is a fragment from an amphora handle with the stamp VIRGIN. The other artifact is a small terracotta statue, representing a female. The authors mention the place called “Cânepi”, in

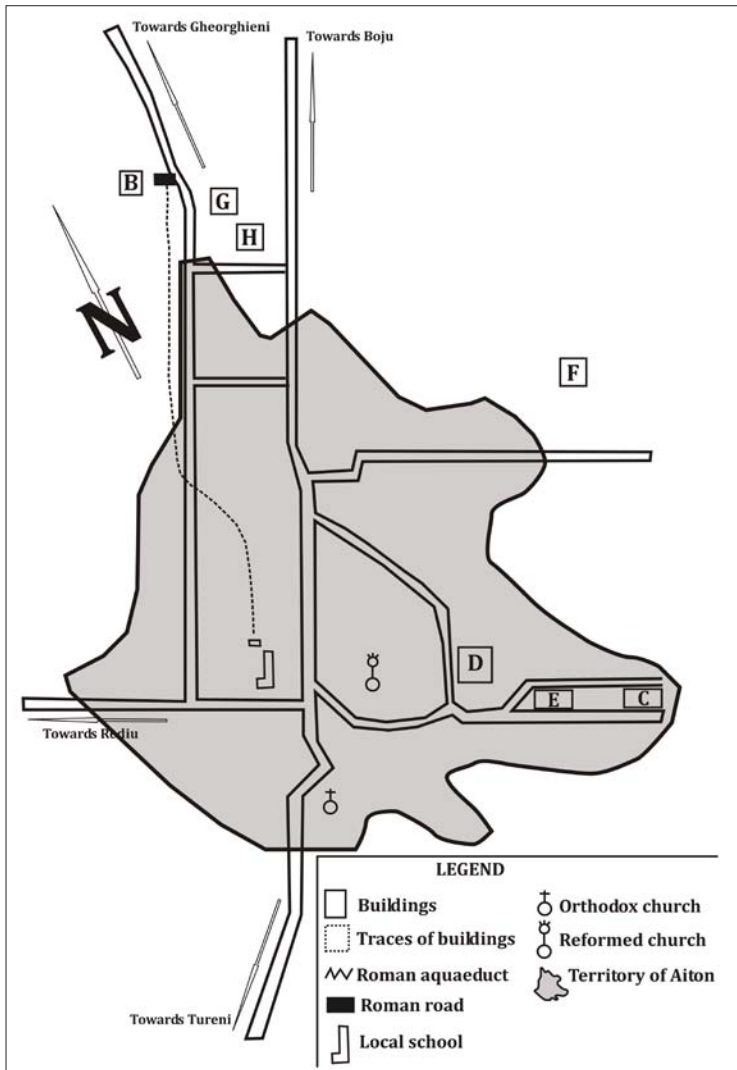


FIGURE 4. So-called “building G”, located in the northern part of Aiton (redrawn after Moțu, 1990–1991, 194, Figure 2).

the south-east of the village, where fragments of tiles and stones have been found, scattered on the surface due to the agricultural work. Traces of another building have been identified 0.5 kilometres south-west of the village. The same authors mention another point, located about one kilometre south of the rivulet Togu, on its right terrace, where ceramic fragments have been identified. All these data are more or less difficult to locate and have never been accurately mapped.

The local gazetteer (Crișan, Bărbulescu, Chirilă, Vasiliev, Winkler, 1992, s.v. Aiton, p. 22–26), records 22 points with archaeological discoveries in Aiton. Arranging these records from south to north and in summary, we are able to provide the following topographic details: 1.

Close to the rivulet Togu there is a small terrace, 1 kilometre south of the entrance to the village. Ceramic fragments belonging to the Roman period have been discovered here; 2. In the south-east of the village, at a point indicated by the toponym “La Cânepi”, numerous archaeological remains have been discovered: stones, tiles, ceramic fragments. Several sections have been excavated over an area of approximately 40 × 50 m. The foundations of a building of 17.6 × 14 m have been discovered. The building had several rooms. Below the Roman level, fragments of prehistoric ceramics have also been found; 3. On a small terrace, positioned close to the southern entrance to the village, traces of several former walls have been observed, scattered on the

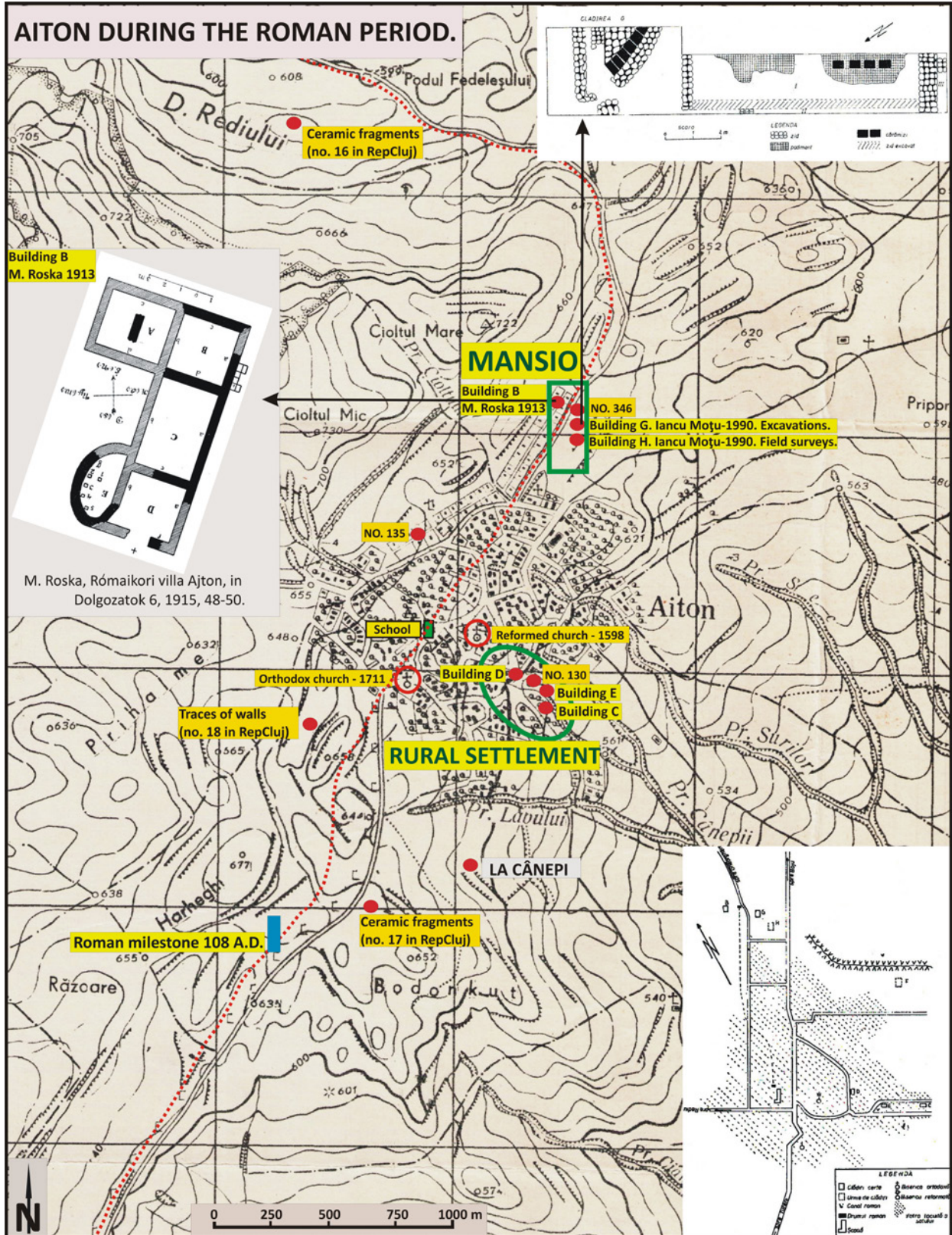


FIGURE 5. The topography of Aiton, indicating the location of a possible *mansio* and the rural settlement (Map: F. Fodorean).

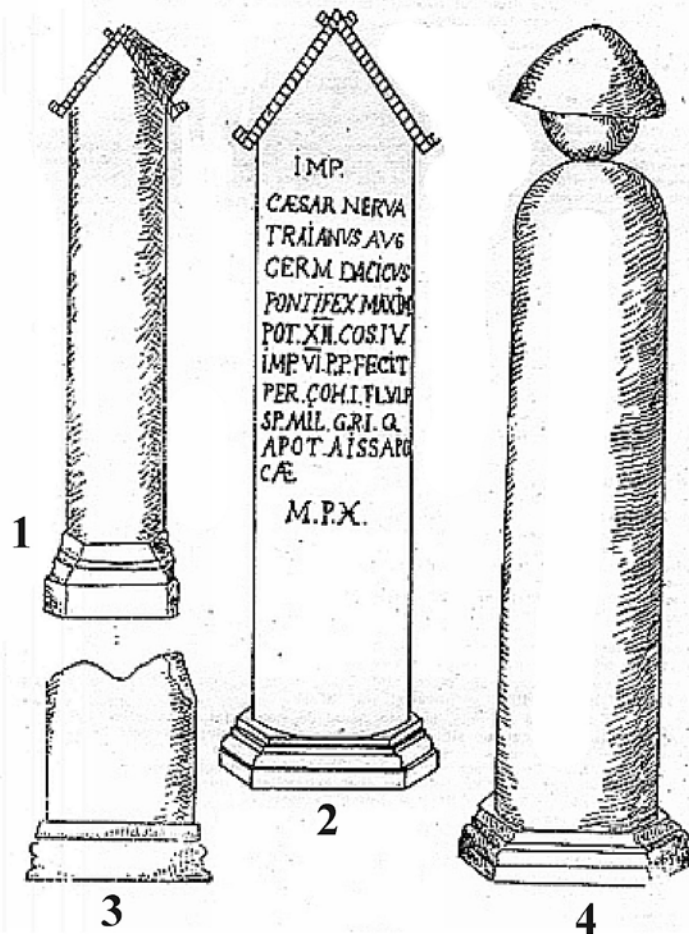


FIGURE 6. Drawing with the milestone discovered in 1758 in Aiton (after Winkler 1982a, 83).

surface; 4. In the garden of house no. 130, archaeological excavations led to the discovery of a channel 11.60 m in length. Roman ceramic fragments have been discovered close to this channel. Below this level, prehistoric fragments of ceramic have been found. Above the channel, two fragments of Roman monuments have been identified, one of them dedicated to IOM; 5. Agricultural works led to the discovery of Roman materials in the gardens of houses no. 83, 84, 116, 121, 126, 160 and 316; 6. In the garden of the Orthodox church, a Roman terracotta statuette representing a female was discovered; 7. In the garden of house no. 135, fragments of Roman ceramics have been discovered. Archaeological excavations were carried out here. Four sections were excavated, revealing a corner from a building; 8. In the garden of house

no. 346, other remains from a Roman settlement have been found, together with a large quantity of Roman ceramic fragments.

To summarise, all these discoveries represent solid proof of the existence, during the Roman period, of a rural settlement within the current territory of the village Aiton, in direct connection with the most important road in Roman Dacia.

4. THE CURRENT RESULTS. SOME CONCLUDING REMARKS. THE FUTURE OF THE TIR-FOR PROJECT IN ROMANIA

After six years of involvement in the project, the Romanian team has managed to reach several important milestones. We are approaching the final stage for our text. All the sites from Roman

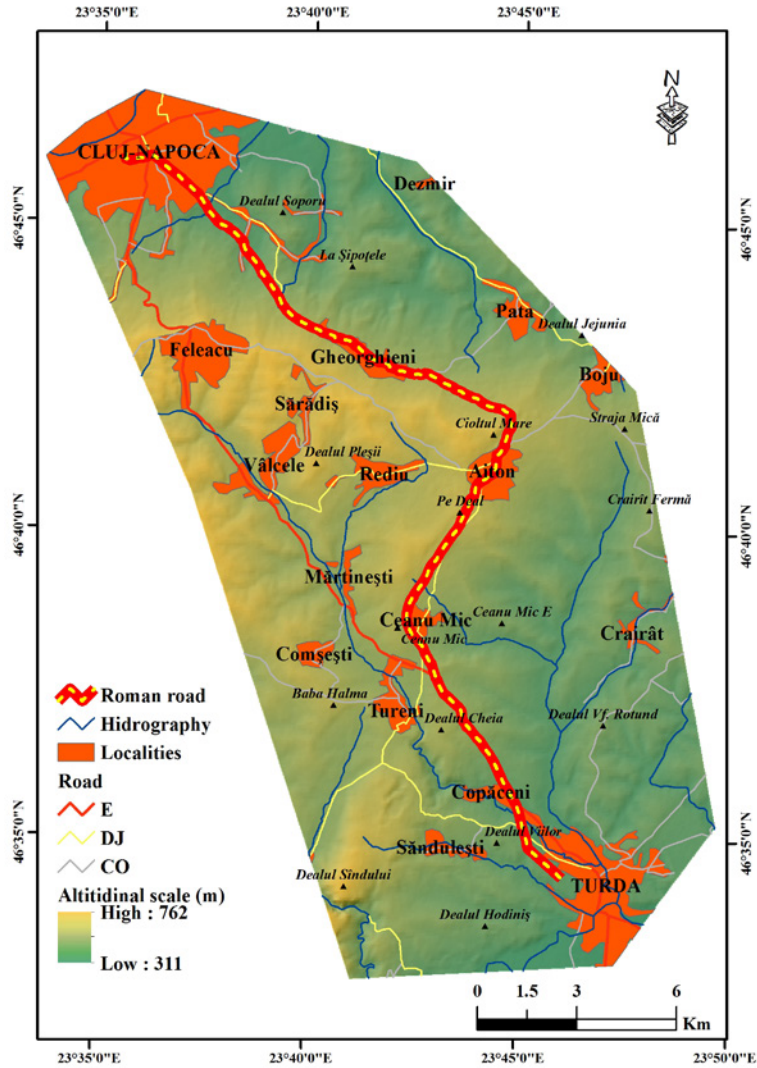


FIGURE 7. Digital map with the route of the imperial Roman road from Turda (Potaissa) to Cluj-Napoca (Napoca) (Map: F. Fodorean).

Dacia have been carefully documented and mapped (Fig. 8). We have followed a precise methodology in order to produce up-to-date information for each and every point with Roman discoveries within the territory of Dacia. We have also selected a significant number of illustrations, photographs and a topographic plan of important settlements because they are useful in understanding complex aspects concerning the topography of certain sites. Following all these achievements, we have uploaded data on 1446 sites (*Tabula Imperii Romani* - Institut d'Estudis Catalans - Union Académique Internationale (i.e. cat)). This year we hope to publish the printed edition of the new volume for TIR Romania, L34 and L35.

Regarding the FOR part of the project, the site of Potaissa has been chosen to begin this part of the project for several reasons. First, we have good knowledge of this site (the legionary fortress, the city and its *territorium*), based on archaeological excavations carried out here since 1971. Fifty campaigns of archaeological excavations have revealed important areas of the fortress, such as the *principia*, the *thermae*, the defensive elements, the interior roads, the *horrea*, the barracks of the soldiers, and an exceptional grave of a Germanic princess buried in the baths of the abandoned fortress during the second half of the 5th century AD. The ancient city is less known but, in the last 50 years, preventive archaeological research has also revealed parts of this (the *officina*, sections of

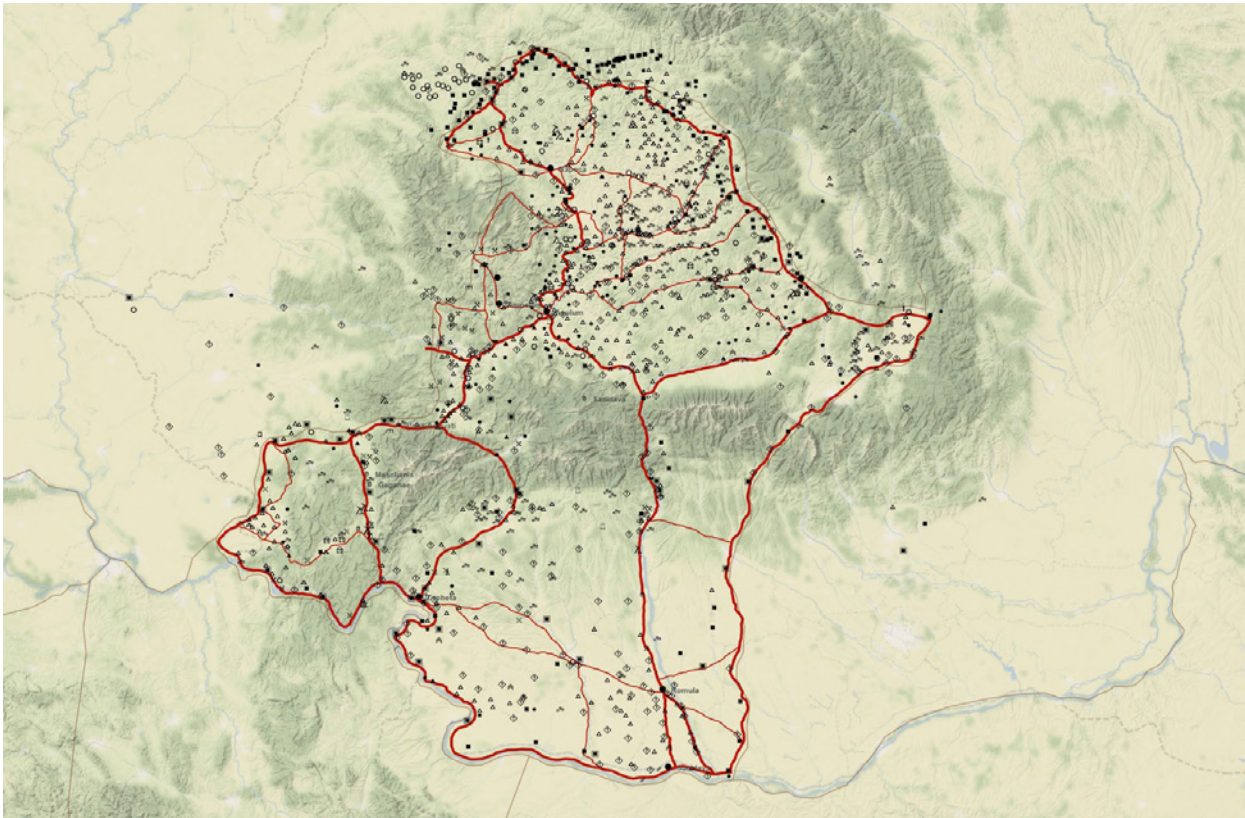


FIGURE 8. Roads and settlements from Roman Dacia digitised in the online TIR platform (*Tabula Imperii Romani* - Institut d'Estudis Catalans - Union Académique Internationale (iec.cat)).⁴

roads, aqueducts, tombs belonging to two cemeteries, a *cella vinaria* excavated in 1978, etc.). For the FOR part of the project, we will produce maps at different scales (1:5,000, 1:10,000, 1:25,000), with different types of sites.

BIBLIOGRAPHY

BĂRBULESCU (coord.) (2005) = BĂRBULESCU, Mihai; BĂRBULESCU, Cornelia; FODOREAN, Ioan; FODOREAN, Florin; HUSAR, Adrian; MIHĂILĂ, Carmen; NEMETH, Eduard; NEMETI, Irina; NEMETI, Sorin; PÎSLARU, Mariana; SĂLĂȘAN, Mihaela; ZOTIC, Vasile (2005). *Atlas-dicționar al Daciei romane*. Cluj-Napoca: Tribuna.

BLĂJAN, Mihai; CERGI, Tiberiu (1978). "Descoperiri romane și postromane la Aiton (jud. Cluj)". *Potaissa*, 1, 21-27.

CRÎȘAN, Ion Horațiu; BĂRBULESCU, Mihai; CHIRILĂ, Eugen; VASILIEV, Valentin; WINKLER, Iudita (1992). *Repertoriul arheologic al județului Cluj*. Cluj-Napoca: Bibliotheca Musei Napocensis V.

FODOREAN, Florin (2006). *Drumurile din Dacia romană*. Cluj-Napoca.

FODOREAN, Florin (2015a). "A Potaissa Napocae MP X'. The Roman rural settlement and the mansio from Aiton (Cluj County)". *Acta Archaeologica Academiae Scientiarum Hungaricae*, 66, 217-232.

FODOREAN, Florin (2015b). "Archaeological field survey along the Roman road from

4. I would like to express my gratitude to my colleague, Pau de Soto, who helped me during the process of producing this map.

- Potaissa to Napoca, Romania”. *Antiquity*, Project Gallery, 89, (345).
- FODOREAN, Florin-Gheorghe (2015c). “Archaeological field surveys in territorium Potaissae. New discoveries in Ceanu Mic and Aiton (Cluj County)”. *Ephemeris Dacoromana*, 17, 112-118.
- FODOREAN, Florin-Gheorghe (2016). *Pannonia, Dacia and Moesia in the Ancient Geographical Sources*. Stuttgart: Franz Steiner Verlag, series Geographica Historica 34.
- MOȚU, Iancu (1990-1991). “Așezarea rurală romană de la Aiton (jud. Cluj)”. *ActaMP* 14-15, 175-219.
- ROSKA, Márton (1915). “Rómaikori villa Ajton (Kolozs vm.) határában”. *Dolgozatok* 6, 48-50.
- RUSSU, Ion I. (coord.) (1969). *Tabula Imperii Romani. Romula-Durostorum-Tomis. Sur la base de la carte internationale du monde à l'échelle de 1:1.000.000. L 35 Bucarest*. Bucharest: Académie de la République Socialiste de Roumanie.
- SOPRONI, Sándor (ed.) (1968). *Tabula Imperii Romani. Aquincum-Sarmizegetusa-Sirmium. Auf dem Grunde der Weltkarte 1:1.000.000, L 34 Budapest*. Budapest: Akadémiai Kiadó, Verlag der ungarischen Akademie der Wissenschaften.
- TORMA, Károly (1864). *Adalék észak-nyugati Dacia föld- és helyiratához*. Pest.
- TUDOR, Dumitru (ed.) (1965). *Drobeta-Romula-Sucidava*. Bucharest: Editura Academiei Republicii Socialiste România.
- WINKLER, Iudita (1982a). “Date noi despre CIL III, 1627, cea dintâi atestare epigrafică a Potaissei”. *Potaissa*, 3, 80-84.
- WINKLER, Iudita (1982b). “Drumul roman Napoca-Potaissa II”. *Acta Musei Napocensis*, 19, 587-589.
- WINKLER, Iudita; BLĂJAN, Mihai; CERGHI, Tiberiu (1980). “Drumul roman Napoca-Potaissa. I”. *Potaissa. Studii și comunicări*, 2, 63-73.

Mapping the Barbarian world – outline of the issues

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ABSTRACT

This article discusses the main problems accompanying attempts to map the areas of Barbarian Europe. These problems relate to the difficulties in reconstructing both the ethnic situation and settlement structures prevailing in the territories of Barbaricum. Projects such as *Tabula Imperii Romani* and *Corpus der römischen Funde im europäischen Barbaricum* produce maps of all the finds of Roman imports recorded in a given area. In recent years, archaeological research has revealed new sources that allow the complex relationships between Barbaricum and the Roman state to be viewed in a completely new light.

KEYWORDS: Barbaricum, mapping, ethnic situation, settlement structures, Roman Empire, contacts, Roman imports, chronology.

1. INTRODUCTION

Beyond the borders of the Roman Empire, east of the Rhine and north of the Danube, there was a Barbarian Europe – Barbaricum. The demographic, cultural, settlement and economic situation on both sides of the Limes was radically different. They were two separate worlds but with different relationships. Military confrontations with the peoples of Barbaricum, as well as contacts of a diplomatic and commercial nature contributed to the acquisition of knowledge relating to these peoples by the Romans. Based on data from ancient written sources, it's possible to reconstruct, to some extent, the ethnic map of Barbaricum during the Roman period. The greatest amount of this data relates to the first two centuries after the birth of Christ and come from the works of Pomponius Mela, Pliny the Elder, Tacitus and Claudius Ptolemy, among others. The works of the above-mentioned authors contain the

names of peoples from Barbarian Europe, as well as information about the areas they occupy (Kolendo, 1998a, previous literature there; Kolendo, 2005; Kaczanowski, Margos, 2002, XV-XXIII; Nowakowski, 2005). It should be noted, however, that sometimes the same ethnonym appears in different parts of Europe (e.g. *Wenedi/Venethi*), and sometimes similar but different names appear in the sources (*Lugii/Lupiones Sarmate/Longiones*), at times separated by a chronological distance, which does not allow us to be sure they are the same tribe (Kolendo, 1998b, previous literature there; Kaczanowski, Margos, 2002, XXIV-XXV). In addition, ancient authors have sometimes transferred the names of peoples they knew well to other, newly-known tribes. It's also known that there are obvious anachronisms in ancient written sources as well as literary *topoi* – stereotypical images of Barbarians (Kolendo, 1998a, 50).

The ethnic map of Barbarian Europe, reconstructed by philologists and historians on the basis of data from ancient written sources, has been contrasted by archaeologists with an

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image of cultural diversity, drawn from the results of analysing archaeological sources. According to contemporary archaeology, Barbaricum can be divided into taxonomic units of a higher and lower order: cultural circles as well as cultures and cultural groups. Limits to the range of these units are sometimes difficult to define precisely as they are influenced by differing intensities of settlement for individual areas in different chronological ranges, as well as the state of archaeological research. At the same time, it should be assumed that, in most cases, the cultural units distinguished may have been polyethnic in nature. However, for some areas of the Barbaricum, terms referring directly to tribal territories are used, such as in the case of the Marcomannic settlement in the Czech Basin (Droberjar, 2009; Salač, 2016), or contemporary geographical terms are used, e.g. historical materials from the Danish islands, Gotland, etc. (Kaczanowski, Madyda-Legutko, 2005; Kaczanowski, 2010).

Contacts between peoples of Barbaricum and the Roman Empire were characterised by variable intensity, both in terms of time and space. The differences observed in this respect were not only quantitative but also qualitative. An important factor influencing these differences was, among other things, the distance of the Barbarian tribes' settlements from the borders of the Roman state (cf. Lund Hansen, 1987; Bouzek, Ondřejová, 1990; Jílek, 2016; Suharoschi, Dumitrache, Curca, 2020; Opreanu, Cociș, Lăzărescu, 2020).

Research projects have been carried out over several decades, resulting in publications aimed at mapping the areas of Barbarian Europe from the perspective of their inhabitants' contacts with the Roman Empire. In practice, this means recording all the finds of Roman imports from individual Barbaricum regions. This trend includes volume *M-34 Kraków* issued as a part of the prestigious international series *Tabula Imperii Romani*, published in 2002 by a team of researchers led by Professor Piotr Kaczanowski of the Institute of Archaeology of the Jagiellonian University in Kraków (Kaczanowski, Margos, 2002). The study covered an area comprising a significant part of the territory of today's Poland, as well as parts of Slovakia, the Czech Republic,

Hungary, Romania, Ukraine and Belarus. Currently, this volume is being digitised by means of an application used by all participants of the TIR-FOR Project. However, it should be remembered that the rules for describing and mapping the archaeological material in the *Tabula Imperii Romani* were developed with the territory of the Roman state in mind, so we are currently encountering some difficulties in adapting to them. Such difficulties result, among other things, from the specificity of the settlement structures in the Barbaricum and consequently from the presence of other categories of archaeological sources in these areas.

2. SPECIFICITY OF THE SETTLEMENT STRUCTURES OF THE PEOPLES OF BARBARICUM

Many attempts have been made by different specialists to identify models of settlement used by the peoples of Barbarian Europe. The view commonly accepted at present is that the settlement pattern was dispersed. In the territory of interest there is an observable, to some extent chronologically variable pattern of variously discernible microregions, sometimes visibly separated from one another by a zone with more sparse settlement or even by uninhabited lands. However, it should be mentioned here that, in some cases, the results of more recent field studies, mainly surface prospection, show blurring of the boundaries of previously differentiated microregions (Jankuhn, 1976; Godłowski, 1985; Kobyliński, 1988; Kobyliński, 2005; Kolendo, 1998c; Leube, 1992; Leube 2009; Rodzińska-Nowak, 2012, 11).

Apart from a few exceptions, in the vast majority of Barbaricum areas there are only open settlements; i.e. without any fortifications. Comprehensive analysis of archaeological sources makes it possible to attempt to reconstruct the spatial arrangement of settlements in relation to their various functions, including economic, as well as to restore the original size of settlements. Micro-regional settlement studies provide further information. On the basis of these studies, it's possible to try to determine the preferences of given groups of people in terms of selecting the landscape zones they inhabit, as well as infer

their demographic potential and, indirectly, the nature and scale of environmental exploitation. These micro-regional studies also contribute to our knowledge of the spatial and functional relations, including economic, between individual settlements (Leube, 1992; Leube, 2009; Rodzińska-Nowak, 2016, 308-310).

However, the research carried out in many Barbaricum micro-regions has not enabled the exact reconstruction of the settlement network existing in individual, short time periods, corresponding to the life span of one or more generations. In a few cases, on the other hand, it was possible to identify contemporary settlement complexes, consisting of settlement/settlements and cemetery (cf. Dąbrowska, 2008, 82-83). Moreover, the aforementioned studies do not lead, with some exceptions, to the recognition of mutual relations between individual settlements. For instance, in many cases it's not possible to convincingly identify settlements, within an area of a given concentration, that clearly differ in function and rank from the others and may therefore serve as a main centre within it (cf. Schuster, 2003). One extremely important factor that has a negative impact on the effectiveness of studies on the transformation of the economic structures of the Barbarian population of Europe is the difficulty in determining the chronology of archaeological materials discovered in the settlements. These difficulties are mainly related to the nature of the source base that tends to come from such sites. The most common category of artifacts, often the only one, is ceramics which, in the light of more recent research, provide a less precise basis for dating than was previously thought (cf. Rodzińska-Nowak, 2006; Rodzińska-Nowak, 2011).

Written sources, both ancient and early medieval, underline the importance of the family-neighbour communities in the social, economic, political, religious and ritual life of the inhabitants of Barbaricum. Based on the results of an analysis of written sources, it can be assumed that one characteristic feature of tribal territories was their segmental structure, consisting of small, local links. For 'civilised' observers, the number of these local links was important in attempts to determine the demographic and military potential

of individual tribes or their associations (Modzelewski, 2004, 255-284, 287, 348).

Individual microregions, perhaps the same as the structures described by Tacitus as *civitas*, probably consisted of many smaller territorial units, described as districts or 'neighbouring communities'. These communities probably correspond to those called by Caesar (*Commentarii de bello gallico*, IV.1) and then by Tacitus (*Germania*, 39) as *pagus*. In addition to their many economic tasks, neighbouring communities also carried out other activities collectively that indirectly affected how the economy performed, such as those of a policing, judicial and military nature (Modzelewski, 2004, 288, 322; cf. Sempke, Sanmark, Iversen, Mehler 2021).

3. METHODOLOGICAL PROBLEMS ARISING FROM THE APPLICATION OF TIR-FOR TO ARCHAEOLOGICAL SITES LOCATED IN THE BARBARICUM AREA

As mentioned above, in most areas of Barbaricum there are only open settlements. In addition there are numerous attested settlement points, necropolises, single graves, treasures, votive deposits in aquatic environments and scattered loose finds, including numismatics. It should be noted that not all of the above categories of archaeological sources are fully reflected in the typology developed for the TIR-FOR project.

First of all, it's important to emphasise a fundamental qualitative difference between the sites mapped within the Roman Empire and those recorded in the area of Barbaricum. In the case of the first category we are dealing with sites or complexes of sites representing the remains of various activities of Roman inhabitants (towns, *villae*, roads, aqueducts, etc.). On the other hand, the mapped sites in the Barbaricum area, with few exceptions, usually correspond to single finds of objects imported from the Roman provinces, or to groups of such finds, most often occurring within the context of settlements or sepulchral sites and sometimes as hoards or loose finds. Labelling sites recorded in the Roman Empire and in the areas of Barbaricum with the same name can therefore sometimes contribute to a distorted picture of reality.

Nonetheless, an attempt can be made to adapt the typology proposed by the TIR-FOR application for the purpose of describing the realities of Barbarian Europe. In the case of known settlements within its area, it can be assumed that they correspond to the category of rural settlements. They meet all the criteria which currently classify a site in this category. Another numerous group are sepulchral sites, to which the categories of “necropolis” and “burial” proposed by the TIR-FOR typology can be applied. It should be remembered, however, that the nature of these sites, when compared to the realities of the Roman state, is markedly different. In the case of numerous loose, surface or undetermined finds, the category ‘unknown’ should be applied, referring to finds whose full archaeological context is not known.

Particularly noteworthy are undoubtedly the finds of Roman coins, an important source for understanding the relationship between Rome and the Barbarians. In the territories of Barbaricum, coins usually occur as single, scattered finds and in treasures, which are the result of intentional hoarding, carried out for economic or non-economic reasons, e.g. as part of cult practices. Occasional finds of coins in graves have also been attested. In most cases a single category, “numismatics”, will be used for these groups of finds in the TIR-FOR application.

The excavations carried out over the last few decades in central and northern Europe, as well as underwater archaeological explorations, non-invasive surveys (aerial, geomagnetic, etc.) and prospecting with metal detectors, have led to the discovery of groups of sites with special characteristics. These discoveries allow us to look at the relationship between Rome and Barbaricum from a completely new perspective. This observation applies, for instance, to sites documenting military confrontations between the peoples of Barbaricum and the Roman army. Particularly noteworthy is the site of the famous Battle of the Teutoburg Forest in 9 AD, with considerable probability located at Kalkriese near Osnabrück, Lower Saxony, as well as the site of the battle supposedly fought by Maximinus the Thracian against the Alemanni

around 238 AD in Harzhorn, Lower Saxony (Meyer, 2018, previous literature there). Mention should also be made of the remains of temporary camps set up by the Roman army in what is now Slovakia, Moravia and Hungary, during the second phase of the so-called Marcomannic Wars in the second half of the 2nd century AD (Fig. 1), when the Romans shifted the fighting to the Barbarian banks of the Danube (Komoróczy, Vlach, Hüssen, Rajtár, 2019). Sites specific to the northern part of Barbaricum are the votive bog deposits, found primarily in the Scandinavian zone but also sporadically recorded in other parts of the Baltic Sea basin. These are the remains of cult practices connected with the intentional depositing of offerings in an aquatic environment, usually consisting of the weapons and personal equipment of warriors captured



FIGURE 1. Charvátská Nová Ves (Czech Republic). Aerial photo showing the course of the ditch and reconstructed area occupied by the Roman marching camp (orthophoto ©ČÚZK) (acc. to Komoróczy, Vlach, Hüssen, Rajtár, 2019).

from the enemy (Fig. 2). They often include numerous items of Roman provenance (cf. Blankefeldt, von Carnap-Bornheim, 2018, previous literature there).

Peaceful and diplomatic relations between the two worlds can, in turn, be seen in the grand residences of representatives of the Germanic elite built following the Roman model and using imported materials, erected by Roman craftsmen. Such buildings have been discovered in the middle Danube basin (cf. Varsik, 2020). One of the most impressive residences of this kind was discovered in Bratislava-Dúbravka, south-west Slovakia (Fig. 3), in the area covered by the settlement of the Germanic Quadii (Elschek, 2017). In addition, settlements described as ‘central places’, interpreted as centres for ceremonial exchange and the redistribution of Roman wealth, warrant special attention. Extensive sites of this nature have been discovered at Sorte Muld on the island of Bornholm, at Gudme on the island of Funen, at Upokrå in Skåne and possibly at Jakuszowice in western Lesser Poland. These settlements have provided evidence of a variety of manufacturing processes, a huge series of finds of Roman

imports, including coins, and sometimes traces of grand buildings (Bursche, 1998, 205, footnote 10; Watt, 2009; Lund Hansen, 2009).

A further difficulty in using the application developed for the TIR-FOR project with the Barbaricum area arises from the fact that, in practice, archaeologists dealing with these areas tend to use a system of relative chronological phases rather than an absolute chronology. For the dating of artifacts from the area of Barbarian Europe, both regional and supra-regional systems of relative chronology have been developed that are based primarily on the results of the typological analysis of metal parts of attire, among which *fibulae* are particularly important (Almgren, 1923), as well as other categories of finds, such as elements of armament. Sometimes it was also possible to carry out planigraphic studies; i.e. the horizontal stratigraphy of extensive, long-used cemeteries. It was only at a later stage of the research procedure that it could be determined which intervals, expressed in absolute dates, corresponded to the individual stages of relative chronology. These findings are based primarily on the results of an analysis of co-occurrence in



FIGURE 2. Finds from the Torsberger Moor (Germany). Photo: Archäologisches Landesmuseum Schleswig Schloss Gottorf (acc. to Blankefeldt, von Carnap-Bornheim 2018).

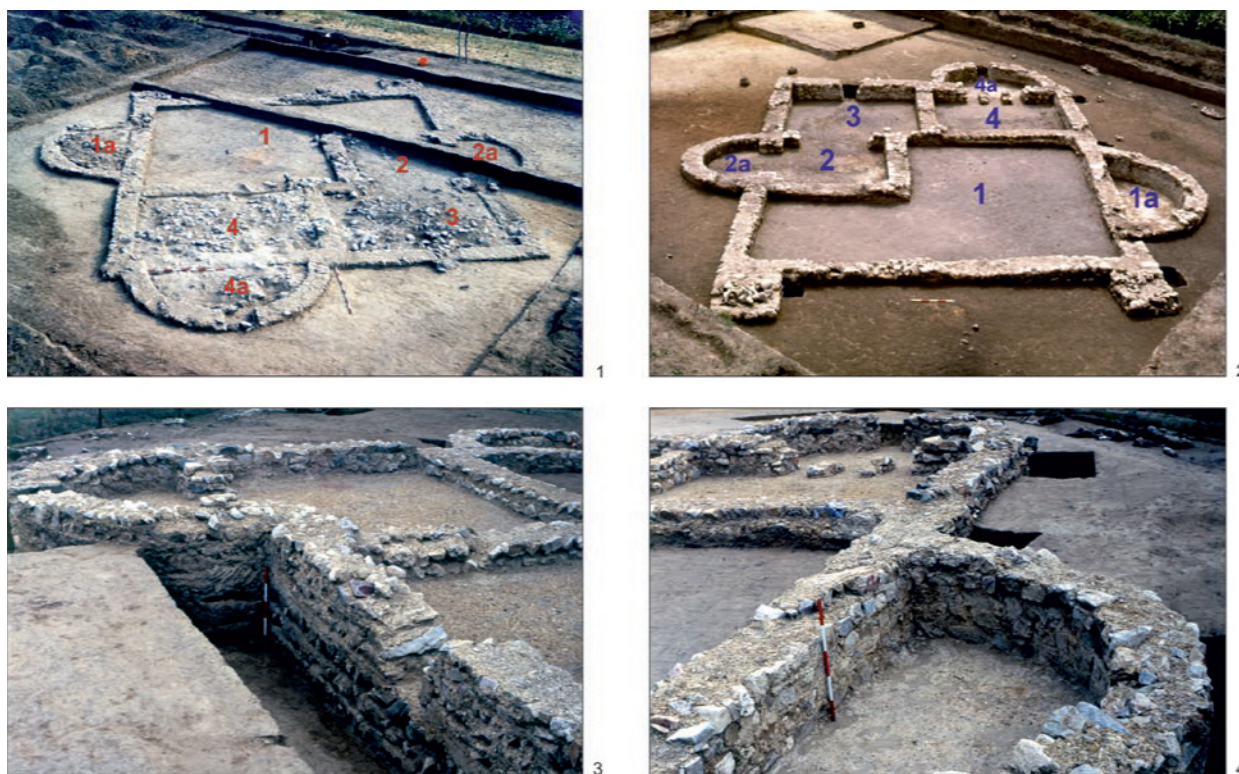


FIGURE 3. Bratislava-Dúbravka (Slovakia). Bath. 1. View from the west; 2. View from the east; 3. Caldarium/room 4 and 4a, view from the south-east; 4. Frigidarium/room 1a in the foreground, view from the north-east (acc. to Elschek, 2017).

compact sets (i.e. graves, hoards) of artifacts of Barbarian origin with precisely dated objects imported from the Roman state. The above inference has also been contrasted with findings from studies of the image of Barbarians in Roman iconography (cf. Eggers, 1955; Godłowski, 1970; Krierer, 1998; Hunter, 2009). Furthermore, data obtained by natural dating methods have been taken into account. This remark applies mainly to dendrochronology and sometimes also to radiocarbon dating; i.e. the C14 method (cf. Komoróczy, Vlach, Hüssen, Rajtár, 2019). Therefore, the absolute chronology of the different phases of the Roman period in the Barbaricum area still needs to be refined further.

An equally complex issue is the dating of certain objects of Roman provenance found in areas located to the east and north of the Limes. This applies in particular to republican *denarii*, as well as *denarii* minted in the 1st and 2nd centuries AD. As can be presumed, their

circulation in the Barbarian environment, unlike many other categories of imports, may have sometimes lasted much longer than in the Roman Empire. Among the many finds supporting this thesis is the tomb of the Frankish king, Childeric, who died in 481 or 482, discovered in Tournai (Belgium) in the mid-17th century. The furnishings of this tomb included silver coins, among which the earliest chronological position is occupied by a republican *denarius*; i.e. more than 500 years older than the burial of the ruler. This was not an exceptional find, as it was accompanied by other *denarii* dating from the 1st and 2nd centuries AD (Quast, 2015, 179).

The example cited above shows that, while a coin's date of issue determines the *terminus post quem* for the dating of an assemblage or site in Barbaricum, it does not necessarily determine its chronological position. The dating of a given find must therefore take into account the results of an analysis of the entire context in which it

was discovered. For this reason, the system of relative dating developed by H.J. Eggers, with later modifications (Motyková-Šneidrová, 1965; Godłowski, 1970; Liana, 1970; Tejral, 1988; 1992), should be applied to the monuments from the Barbaricum area.

4. NEW RESEARCH PERSPECTIVES

Slightly different in character from the *Tabula Imperii Romani* is the series *Corpus der römischen Funde im europäischen Barbaricum*, which was initiated by the Römisch-Germanische Kommission of the German Archaeological Institute. Currently, the Institute of Archaeology of the Jagiellonian University, in collaboration with the Faculty of Archaeology of the University of Warsaw, is working on the Polish edition of this series under the auspices of the UAI and the International TIR-FOR Commission (Nowakowski, 2001; Kaczanowski, Bodzek, Przychodni, Zuch 2017; Jakubczyk, Bursche, Mączyńska 2018). These volumes contain more data of interest to archaeologists of central and northern Europe, including the context of the find, type of monument, relative chronology, etc. An integral part of the volume are also illustrations and lists of particular categories of finds, such as coins, *terra sigillata*, etc.

The information contained both in volume M-34 Kraków and in the volumes of the *Corpus der römischen Funde im europäischen Barbaricum* can provide a basis for multifaceted analyses of the mechanisms and routes of the influx of Roman imports into Barbaricum, studies of the structure and chronology of these finds, as well as their presumed functions in the economic system and symbolic culture of the societies living there. These data can also be used to reconstruct the course of trade routes, which in areas outside the Limes should be understood as general directions of exchange. In all the cases mentioned above, it's necessary to pay attention to the broad environmental and settlement contexts in which the finds of Roman imports occur.

On the one hand, the examples selected of different types of finds, mentioned above,

demonstrate the complexity of Roman-Barbarian relations while, on the other hand, they illustrate the enormity of the research tasks facing archaeologists today. In the future, these studies may also result in new cartographic views of the Barbaricum area.

BIBLIOGRAPHY

- ALMGREN, Oscar (1923). *Studien über Nordeuropäische Fibelformen der ersten nachchristlichen Jahrhunderte mit Berücksichtigung der provinzialrömischen und südrussischen Formen*. Leipzig: Mannus-Bibliothek 32.
- BLANKEFELDT, Ruth; von CARNAP-BORNHEIM, Claus (2018). "Ritual sacrifices of military equipment in the Thorsberger Moor". In: FERNÁNDEZ-GÖTZ Manuel; ROYMANS Nico (eds.). *Conflict Archaeology: Materialities of Collective Violence from Prehistory to Late Antiquity*. EAA Monograph Series "Themes in Contemporary Archaeology". Volume 5. Abingdon/New York: Routledge, 219-229.
- BOUZEK, Jan; ONDŘEJOVÁ, Iva (1990). "Třetí zóna' mezi Římem a barbarikem při norickopanonském limitu". In: *Archeologické rozhledy* 42, 22-35.
- BURSCHE, Aleksander (1998). *Złote medaliony rzymskie w Barbaricum. Symbolika prestiżu i władzy społeczeństw barbarzyńskich u schyłku starożytności*. "Światowit" Supplement Series A: Antiquity. Volume II. Warsaw.
- DĄBROWSKA, Teresa (2008). *Młodszy okres przedrzymski na Mazowszu i zachodnim Podlasiu. Zarys kulturowo-chronologiczny*. Materiały Starożytnej i Wczesnośredniowiecznej 7.
- DROBERJAR, Eduard (2009). "Contribution to the history and archaeology of the Maroboduus Empire". In: SALAČ, Vladimír; BEMMANN, Jan (eds.). *Mitteleuropa zur Zeit Marbods*. Praha-Bonn, 81-106.
- EGGERS, Hans Jürgen (1955). "Zur absoluten Chronologie der Römischen Kaiserzeit im Freien Germanien". In: *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 2, 196-244.

- ELSCHEK, Kristian (2017). *Bratislava – Dúbravka im 1. bis 4. Jahrhundertn. Chr. Germanischer Fürstensitz mit römischen Bauten und die germanische Besiedlung*. Archaeologica Slovaca Monographiae. Volume XXIX. Nitra.
- GODŁOWSKI, Kazimierz (1970). *The Chronology of the Late Roman and Early Migration periods in Central Europe*. Zeszyty Naukowe Uniwersytetu Jagiellońskiego 217. Prace Archeologiczne 11. Krakow.
- GODŁOWSKI, Kazimierz (1985). *Przemiany osadnicze i kulturowe w południowej i środkowej Polsce w młodszym okresie przedrzymskim, i okresie rzymskim*. Prace Komisji Archeologicznej Polskiej Akademii Nauk – Oddział w Krakowie nr 23, Wrocław – Warsaw – Krakow – Gdansk – Łódź.
- HUNTER, Fraser (2009). “Barbarians and their equipment on Roman provincial sculpture”. In: GAGGADIS-ROBIN, Vassiliki; HERMARY, Antoine; REDDE, Michel; SINTES, Claude (eds.). *Les ateliers de sculpture régionaux: techniques, styles et iconographie* (Actes du Xe Colloque Internationale sur l’art provincial romain). Arles, 793-801.
- JÍLEK, Jan (2016). “Roman Metal Vessels in the Milieu of Germanic Elites in the Middle Danube Region”. In: *Studia Hercynia* XIX/1-2, 169-188.
- JAKUBCZYK, Ireneusz; BURSCHE, Aleksander; MAĆZYŃSKA, Magdalena (2018). *Mittelpolen*. Corpus der römischen Funde im europäischen Barbaricum – Polen (CRFB –Polen), Band 3, Krakow.
- JANKUHN, Herbert (1976). “Siedlung, Wirtschaft und Gesellschaftsordnung der germanischen Stämme in der Zeit der römischen Angriffskriege”. In: TEMPORINI Hildegard; HAASE Wolfgang (eds.). *Aufstieg und Niedergang der römischen Welt. Weltgeschichte und Kultur Roms im Spiegel der neueren Forschung*. Volume II, 5.1. Berlin-New York, 65-126.
- KACZANOWSKI, Piotr (2010). “Zur kulturgeschichtlichen Taxonomie des mittel- und nordeuropäischen Barbaricum”. In: LUND HANSEN, Ulla; BITNER-WRÓBLEWSKA, Anna (ed.). *Worlds apart? Contacts across the Baltic Sea in the Iron Age. Network Denmark-Poland 2005-2008*. Nordiske Fortidsminder Serie C. Volume 7. Copenhagen-Warsaw, 49-57.
- KACZANOWSKI, Piotr; BODZEK, Jarosław; PRZYCHODNI, Andrzej; ZUCH, Katarzyna (2017). *Kleinpolen*. Corpus der römischen Funde im europäischen Barbaricum – Polen (CRFB – Polen). Band 2. Krakow.
- KACZANOWSKI, Piotr; MADYDA-LEGUTKO, Renata (2005). “Strefy kulturowe w Europie Środkowej w okresie rzymskim”/“Die Kulturzonen in mitteleuropäischen Raum in der römischen Kaiserzeit”. In: KACZANOWSKI, Piotr; PARCZEWSKI, Michał (eds.). *Archeologia o początkach Słowian. Materiały z konferencji, Kraków, 19-21 listopada 2001*. Krakow, 125-135.
- KACZANOWSKI, Piotr; MARGOS, Urszula (2002). *Tabula Imperii Romani M-34 Kraków*. Krakow.
- KOBYLIŃSKI, Zbigniew (1988). *Struktury osadnicze na ziemiach polskich u schyłku starożytności i w początkach wczesnego średniowiecza*. Wrocław – Warsaw – Krakow – Gdansk – Łódź.
- KOBYLIŃSKI, Zbigniew (2005). “Zagadnienie struktur osadniczych na ziemiach polskich w końcu starożytności i na początku średniowiecza”/“Zur Frage der Siedlungsstrukturen im polnischen Gebiet am Ausgang der Frühgeschichte und zu Beginn des Mittelalters”. In: KACZANOWSKI Piotr; PARCZEWSKI Michał (eds.). *Archeologia o początkach Słowian. Materiały z konferencji, Kraków, 19-21 listopada 2001*. Krakow, 293-305.
- KOLENDO, Jerzy (1998a). “Źródła pisane w badaniach nad strefami kulturowymi i etnicznymi Europy Środkowej w okresie rzymskim”. In: BURSCHE, Aleksander; CHOWANIEC, Roksana; NOWAKOWSKI, Wojciech (eds.). *Świat antyczny i Barbarzyńcy. Teksty, zabytki, refleksja nad przeszłością*. Volume I. Warsaw, 49-56.
- KOLENDO, Jerzy (1998b). “Wenetowie w Europie środkowej i wschodniej. Lokalizacja i rzeczywistość etniczna”. In: BURSCHE,

- Aleksander; CHOWANIEC Roksana; NOWAKOWSKI, Wojciech (eds.). *Świat antyczny i Barbarzyńcy. Teksty, zabytki, refleksja nad przeszłością*. Volume I. Warsaw, 95-106.
- KOLENDO, Jerzy (1998c). "Pustki osadnicze w Europie barbarzyńskiej według przekazów autorów antycznych". In: BURSCHE, Aleksander; CHOWANIEC, Roksana; NOWAKOWSKI, Wojciech (eds.). *Świat antyczny i Barbarzyńcy. Teksty, zabytki, refleksja nad przeszłością*. Volume I. Warsaw, 73-84.
- KOLENDO, Jerzy (2005). "Mapa etniczna środkowoeuropejskiego Barbaricum. Swebia i Lugiowie w Germanii Tacyty"/"Die ethnische Karte des mitteleuropäischen Barbaricums. Suebien und die Lugier in der Germania des Tacitus". In: KACZANOWSKI, Piotr; PARCZEWSKI, Michał (eds.). *Archeologia o początkach Słowian. Materiały z konferencji, Kraków, 19-21 listopada 2001*. Krakow, 103-118.
- KOMORÓCZY, Balázs; VLACH, Marek; HÜSSEN, Claus-Michael; RAJTÁR, Ján (2019). "Absolutchronologische Daten aus römischen temporären Lagern im markomannischen Siedlungsraum im Mitteldonauegebiet". In: KARWOWSKI, Maciej; KOMORÓCZY, Balázs; TREBSCHKE, Peter (eds.). *Auf den Spuren der Barbaren, archäologisch, historisch, numismatisch. Archäologie der Barbaren 2015*. Spisy Archeologického ústavu AV CR Brno 60. Brno, 151-183.
- KRIEGER, Karl Reinhard (1998). "Barbarian enemies from beyond the frontiers. Representations of war, defeat, submission, captivity, death". In: DYCZEK, Piotr (ed.). *Acta of the International Conference Wykno*. Poland. 18-22 November 1995. Novensia 10. 1998. 211-230.
- LEUBE, Achim (1992). "Studien zu Wirtschaft und Siedlung bei den germanischen Stämmen im nördlichen Mitteleuropa während des 1. bis 5./6. Jh. u.Z.". In: *Ethnographisch-Archäologische Zeitschrift* 33, 130-146.
- LEUBE, Achim (2009). *Studien zu Wirtschaft und Siedlung bei den germanischen Stämmen im nördlichen Mitteleuropa während des 1. bis 5./6. Jahrhunderts n. Chr. Römisch Germanische Forschungen* 64, Frankfurt a. M.-Mainz.
- LIANA, Teresa (1970). "Chronologia względna kultury przeworskiej we wczesnym okresie rzymskim". *Wiadomości Archeologiczne* 35, 429-491.
- LUND HANSEN, Ulla (1987). *Römischer Import im Norden. Warenaustausch zwischen dem römischen Reich und dem freien Germanien während der Kaiserzeit unter besonderer Berücksichtigung Nordeuropas*. Kongelige Nordiske Oldskriftselskab (Nordiske Fortidsminder Series B, Volume 10). Copenhagen.
- LUND HANSEN, Ulla (2009). "Among the Elite of Europe". In: ADAMSEN, Christian; LUND HANSEN Ulla; NIELSEN, Finn Ole; WATT, Margrethe (eds.). *Sorte Muld. Wealth, power and religion at an Iron Age central settlement on Bornholm*. Rønne, 82-89.
- MEYER, Michael (2018). "The Germanic-Roman battlefields of Kalkriese and Harzhorn. A methodological comparison". In: FERNÁNDEZ-GÖTZ, Manuel; ROYMANS, Nico (eds.). *Conflict Archaeology: Materialities of Collective Violence from Prehistory to Late Antiquity*. EAA Monograph Series "Themes in Contemporary Archaeology". Volume 5. Abingdon/New York: Routledge, 205-218.
- MODZELEWSKI, Karol (2004). *Barbarzyńska Europa*. Warsaw.
- MOTYKOVÁ-ŠNEIDROVÁ, Karla (1965). "Zur Chronologie der ältesten römischen Kaiserzeit in Böhmen". *Berliner Jahrbuch für Vor- und Frühgeschichte* 5, 103-174.
- NOWAKOWSKI, Wojciech (2001). *Masuren*. Corpus der römischen Funde im europäischen Barbaricum – Polen, Band 1. Warsaw.
- NOWAKOWSKI, Wojciech (2005). "Hic Svebiae finis – sytuacja etniczna na wschód od Tacytowej Swebii"/"Hic Svebiae finis – die ethnische Situation östlich von Suebien des Tacitus". In: KACZANOWSKI, Piotr; PARCZEWSKI, Michał (eds.). *Archeologia o początkach Słowian. Materiały z konferencji, Kraków, 19-21 listopada 2001*. Krakow, 119-123.

- OPREANU, Coriolan Horațiu; COCIȘ, Sorin; LĂZĂRESCU, Vlad-Andrei (2020). "Barbarian brooches in Roman context. Analysis of the finds from the frontier marketplace at Porolissum (Romania)". In: RUBEL, Alexander; Voss, Hans-Ulrich (eds.). *Experiencing the Frontier and the Frontier of Experience: Barbarian Perspectives and Roman Strategies to Deal with New Threats*. Archaeopress, 67-93.
- QUAST, Dieter (2015). "Die Grabbeigaben – ein kommentierten Fundkatalog". In: QUAST, Dieter (ed.), *Das Grab der fränkischen Königs Childerich in Tournai und die Anastasis Childerici von Jean-Jacques Chifflet aus dem Jahre 1655*. Monographien des Römisch-Germanischen Zentralmuseums, Band 129. Mainz, 165-207.
- RODZIŃSKA-NOWAK, Judyta (2006). *Jakuszowice, stanowisko 2. Ceramika z osady kultury przeworskiej z młodszego i późnego okresu wpływów rzymskich i wczesnej fazy okresu wędrówek ludów*. Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Prace Archeologiczne 61. Krakow.
- RODZIŃSKA-NOWAK, Judyta (2011). "Zur Chronologie der Drehscheibenkeramik in der Przeworsk-Kultur im Lichte der jüngsten Forschungsergebnisse". In: BEMMANN, Jan; HEGEWISCH, Morten; MEYER, Michael; SCHMAUDER, Michael (eds.). *Drehscheibentöpferei im Barbaricum. technologietransfer und Professionalisierung eines Handwerks am Rande des Römischen Imperiums*. Bonner Beiträge zur Vor- und Frühgeschichtlichen Archäologie 13. Bonn, 284-293.
- RODZIŃSKA-NOWAK, Judyta (2012). *Gospodarka żywnościowa ludności kultury przeworskiej*. Krakow.
- RODZIŃSKA-NOWAK, Judyta (2016). "Societies in the lands of Poland, from 350 AD until 500 AD". In: URBAŃCZYK, Przemysław (ed.). *The Past Societies. Polish lands from the first evidence of human presence to the early Middle Ages*. Volume 4: 500 BC-500 AD, RZESZOTARSKA-NOWAKIEWICZ, Aleksandra (ed.). Warsaw, 307-344.
- SALAČ, Vladimír (2016). "Kvádové v nejstarších dějinách Čech a střední Evropy". In: *Archeologické rozhledy* 68, 477-531.
- SCHUSTER, Jan (2003). "Hof und Grab - Die jünger-kaiserzeitlichen Eliten vor und nach dem Tode. Eine Fallstudie aus dem Unteren Odergebiet". In: *Slovenská Archeológia* 51/2, 247-318.
- SEMPLE, Sarah; SANMARK, Alexandra; IVERSEN, Frode; MEHLER, Natasha (2021). *Negotiating the North: meeting-places in the Middle Ages in the North Sea Zone*. Routledge, London-New York.
- SUHAROSCHI, Alexandru; DUMITRACHE, Iulia; CURCA, Roxana-Gabriela (2020). "The Limes Germanicus trade and the Roman army". In: RUBEL, Alexander, Voss, Hans-Ulrich (eds.). *Experiencing the Frontier and the Frontier of Experience: Barbarian Perspectives and Roman Strategies to Deal with New Threats*, Archaeopress, 56-66.
- TEJRAL, Jaroslav (1988). "Zur Chronologie der frühen Völkerwanderungszeit im mittleren Donaauraum", *Archaeologia Austriaca* 72, 223-304.
- TEJRAL, Jaroslav (1992). "Einige Bemerkungen zur Chronologie der späten römischen Kaiserzeit in Mitteleuropa". In: GODŁOWSKI Kazimierz; MADYDA-LEGUTKO Renata (eds). *Probleme der relativen und absoluten Chronologie ab Latènezeit bis zum Frühmittelalter*. Krakow, 227-248.
- VARSÍK, Vladimír (2020). "Germánske rezidenciena Slovensku". In: *Monumentorum Tutela* 31/20, 125-142.
- WATT, Margrethe (2009). "Sorte Muld. Past and Present". In: ADAMSEN, Christian, LUND HANSEN, Ulla; NIELSEN, Finn Ole; WATT, Margrethe (eds.). *Sorte Muld. Wealth, power and religion at an Iron Age central settlement on Bornholm*. Rønne, 16-27.

TIR-Greece: From map to gazetteer and back again

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ABSTRACT

The *Tabula Imperii Romani* project, as the name indicates, began as a map. However, due to the vast amount of archaeological data produced by numerous excavations in the areas of the Roman Empire, TIR volumes were converted into gazetteers. Maps gradually became a mere supplement to this index. More recently, with the aid of GIS mapping and databases, maps have regained importance.

The Academy of Athens has participated in the TIR project since 1972. The first volume (Philippi) was published in 1993. Over the last decade, an intense effort has been made to publish volumes devoted to the entire area of Greece. Six new volumes are now available, covering the area from Epirus and Thessaly to Attica and the Aegean Islands.

The TIR-Greece research group is currently exploring new ways of presenting and analysing archaeological, historical and spatial data. The first example of this process covers western Greece (Aitolia-Akarnania and Epirus). In this paper, we present changes in settlement patterns in western Greece after the Roman conquest and we attempt to address historical issues, such as the impact of the Roman presence on the area.

KEYWORDS: *Tabula Imperii Romani*, Greece, Epirus, Aitolia, Akarnania, Roman period.

1. INTRODUCTION (MAP 1)

The *Tabula Imperii Romani* project began in 1928 when O.G.S. Crawford, archaeological officer of the British Ordnance Society, proposed the creation of maps depicting the main geographic, historical and archaeological features of the Roman Empire (Gardiner 1973, 107). This was one of the first major attempts to visualise data on maps of the Roman Empire. The Academy of Athens published the first volume of the TIR-Greece in 1993. This volume covers a considerable part of northern Greece (eastern Macedonia and Thrace). It contains two sheets with a 1:500,000 scale and a 65-page pamphlet. The next volumes, all published from 2012 onwards, significantly differ from the first book. As demonstrated in the

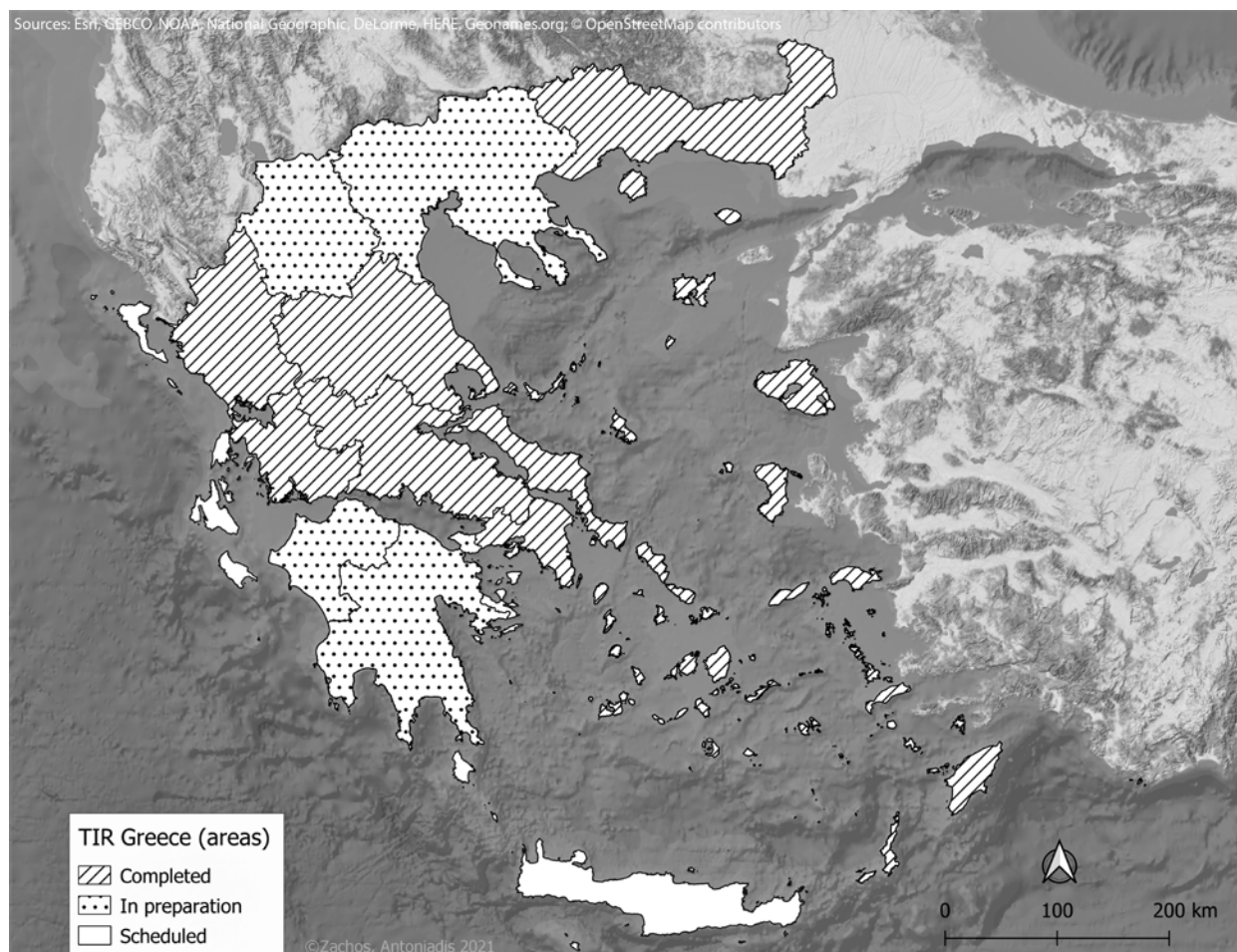
following table, they are extended gazetteers of sites with many corresponding maps included.

In a recent presentation on the various stages and inherent problems of the TIR, Richard Talbert (2019, 79-86) asserts that changing the format of the editions from one sheet accompanied by “a pamphlet containing a short commentary, bibliography and index of names” to a “fully annotated gazetteer (in one language), with town plans, area diagrams and other accessories... has resulted in a kind of delay that Crawford wished to avoid”. He concludes by pointing out that “the continuation of revived *TIR* may have served to discourage others from trying to map the Roman Empire more effectively” (Talbert, 85-86). Talbert, however, does not consider a major advantage of this new approach: by changing the project from simple maps accompanied by a pamphlet (e.g. K35, i: Philippi, in the case of TIR-Greece) to maps accompanied by a complete gazetteer (all

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TIR-Greece Authors	Year Publ.	No. Pages	No. Maps
Avramea, Karanastasi	1993	65	2
Karvonis, Mikedaki	2012	252	44
Antoniadis	2016	79	8
Zachos	2016	237	13
Karvonis	2016	352	11
Mikedaki	2019	128	7
Zachos	2021	130	8



MAP 1: The present state of the TIR program in Greece. Map made by the authors. QGIS, Basemap ESRI and STAMEN.

TIR-Greece volumes published after 2012), it was transformed from a cartographic into a topographic project. The amount of information now contained in the indexes allows any researcher of the Roman world to easily access the data needed for his or her own study.

Furthermore, with the aid of GIS mapping, the authors of the TIR volumes can now digitally process a significant amount of data. This process has converted the TIR project from a static into a dynamic one. The combined case study analysed below demonstrates the dynamic nature of the TIR-Greece project regarding the synthesis of different kinds of data. It was decided to present examples from two regions of western Greece (Aitolia-Akarnania and Epirus) because, in both regions, Rome imposed very important changes in the settlement pattern and hierarchical model. Two important Roman centres were created, Patras and Nicopolis. While the colony of Patras is outside the study areas, its establishment brought about dramatic changes in Aitolia. Likewise, the city of Nicopolis was the main driver of change in Epirus and Akarnania. Rome's interest in this part of western Greece is explained by the desire to exert political and economic control over the two areas of the Greek world closest to the Italian peninsula.

2. EPIRUS (MAP 2)

Before 168 BC, Epirus was inhabited by a number of different *ethne*, with Chaonians, Molossians, Thesprotians, and Cassopaians being the most important among them³. According to Polybius⁴, the Romans conquered the entire region of Epirus after the battle of Pydna in 168 BC. After a few months, the Romans decided to destroy 70 Epirote walled settlements and to enslave 150,000 people, mostly Molossians. In the 1st century BC, Thracian invaders and the Roman Civil Wars devastated the countryside and

cities such as Ambracia were looted⁵. This resulted in the desolation of the region. After the battle of Actium in 31 BC, Augustus founded Nicopolis, laying the foundations for the economic revival of southern Epirus.

Regarding the Epirote economy in the Late Hellenistic period, immediately after 167 BC people came from all over Italy to settle in Epirus and engage in agricultural, pastoral and commercial activities (Zoumbaki 2019). The TIR project's research in central and southern Epirus (Antoniadis 2016) suggests the first post-167 BC Roman settlements followed a pattern guided by their political and economic agenda, to which this research pays particular attention. In addition to residing in the Epirote cities devastated by the events of 168/7 BC, they settled in sites which they could defend easily against possible riots and, gradually towards the mid-1st century BC, they converted a few of these into *villae rusticae* and large farmsteads. These sites also provided the new rulers of the land with a great opportunity for extensive agriculture and pastoralism⁶.

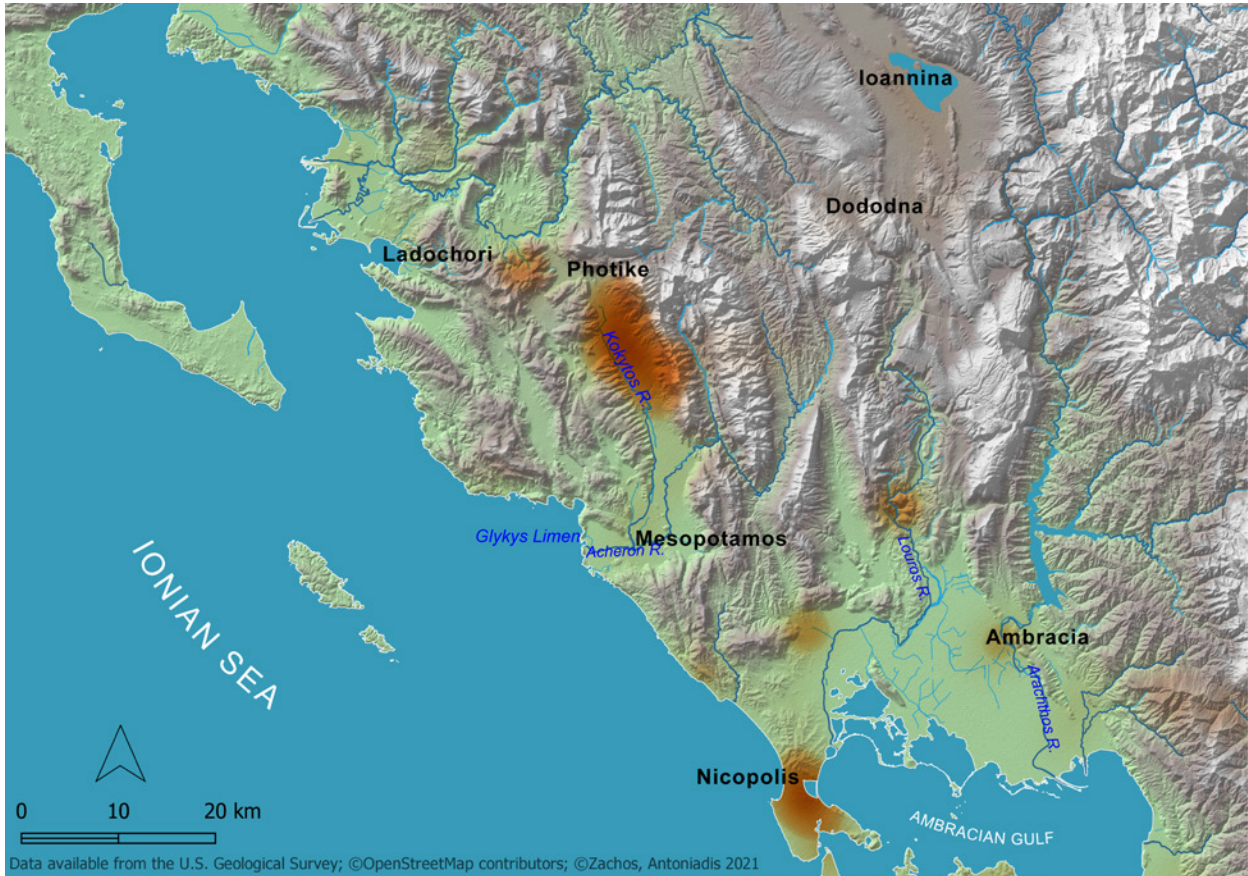
The most important sites for this period (167 to 31 BC) are located in the Kokytos and Acheron valleys, and near the Ionian coast of Thesprotia (Antoniadis 2019). The Roman villa from the mid-2nd century, built upon the destroyed walls of the Hellenistic fort at Agios Donatos, is one of the earliest examples of this process (Forsén, Reynolds 2011, 248-264). From this site, Romans could control the fertile valley of the Kokytos river and the small farmsteads and villages located in this area (Antoniadis 2016, 62-64). The fortified site at Mesopotamos, built close to the Acheron river and including the sanctuary of Necromanteion, was not converted into a villa but continued its complex function as a major agricultural centre after 167 BC. The villa at Mastilitza (Preka-Alexandri 1994, 427-429) was probably built on top of a Hellenistic house after the Roman conquest. A similar process must have occurred for the contemporary villa at Troube in Nea Seleukeia (Vaseiliadis et al 2018, 333). These two villas

3. This case study focuses on the present-day administrative region of Epirus in the north-west of Greece. This region corresponds to ancient central and southern Epirus. The region of Chaonia, located in present-day Albania, was not initially included in the TIR-Epirus volume.

4. Livy 45.34. Polybius 30.15.

5. Strabo 7.7.3, 7.7.9. Plutarch *Aemilius Paulus* 29.

6. Varro *De Re Rustica* 1.17.5; 2.1.2; 2.6.16; 2.9.3. For a detailed analysis of this settlement pattern in Epirus see Antoniadis 2021.



MAP 2: Map of sites dating from the Late Hellenistic to the Late Roman period in ancient southern and central Epirus. Map made by the authors.

from the mid-2nd century BC were both located on low hills, offering protection in case of an emergency.

In the other areas of southern and central Epirus, no such Early Roman structures have been recovered so far. In Molossis, very few small villages and isolated farmsteads in the Ioannina basin seem to have survived the Roman conquest. Most of them are located south of Pamvotis lake, at Episkopiko, Pedini, Serviana, and Dramesioi (Pliakou 2018, 133-151). In the same period, very few rural sites were located at Cassopaia and in the territory of Ambracia, a former Corinthian colony and capital of Pyrrhus and his dynasty. None of these rural sites seemed to attract the interest of the Romans. Only a handful of sites at Ambracia continued their function as small agricultural units from the Hellenistic to the post-167 BC period (Antoniadis 2016, 23-26).

After the battle of Actium and the *Pax Romana*, the Romans populating Nicopolis no longer feared riots or civil wars. Additionally, most of the population of the new city was made up of Greeks who had been forced to abandon their settlements in the surrounding areas. The centuriation of the Nicopolitan territory transformed the landscape of southern Epirus and small agricultural units began to appear all over the Agios Thomas peninsula. A late 1st-century BC *villa rustica* was discovered in the modern settlement of Taranas (Riginos 2012, 355). Most of the small farmsteads, however, date from the 1st century AD (Riginos, Sakkas 2018, 441-454). In this hitherto uncultivated area, the people of Nicopolis must have carried out a large number of economic activities apart from agriculture, such as aquaculture at Mazoma lagoon and the production of purple dye at Vathy bay (Stein 2001, 67-69).

The prosperous 1st century AD resulted in further economic growth and, from this period onwards, spacious *villae rusticae* began to appear all over central and southern Epirus, even in hitherto abandoned areas. In Molossis, these villas appear at Ktismata⁷ (Kleitsas 2010, 780-78), at Kranoula (Giannaki et al 2017), and perhaps at Kerasovo (Vlachopoulou-Oikonomou 2003, 157). At Cassopaia, most villas appear close to or on the coastal route of the Ionian Sea, the most important being at Riza and at Kastrosykia (Angeli, Katsadima 2001, 94-100). Other villas have been discovered at the Louros Springs (Zachos, Choinas 2006, 687) and at Chalikia (Zachos 2012, 344). In the Ambracia Gulf, an important *villa rustica* stood at Strongyli (Douzougli 1993, 282-285). *Villae rusticae* dating from the 2nd century AD have also been found in Thesprotia. The most important of these was discovered at Zavali (Lazari 2019, 403). This villa was located near the important Roman and Late Roman coastal settlement of Ladachori, where many workshops and port facilities were discovered (Antoniadis 2016, 67-69). This coastal settlement must have held particular importance for the largely unexplored colony of Photike, located in the heartland of Thesprotia (Forsén 2019, 28).

3. AITOLIA-AKARNANIA (MAP 3)

Aitolia and Akarnania represent a different settlement pattern, with a predominance of sites along communication routes facilitating Roman exploitation of the region.

Ancient literary sources, as well as modern investigation, have painted a picture of Aitolia and Akarnania as deserted during the Roman period. Cicero's *amissa*⁸ and Strabo's *ἐρημία*⁹ were common *topoi* (or rhetorical *tropoi*) in the discipline's terminology for this region (Alcock 1993, 26-27. Isager 2001. Isager 2009, 205-2010. Ljung 2012, 190-192). However, archaeological research in the last few decades has begun to overturn this general view. The data come from

7. This villa was probably constructed earlier, in the 1st century AD.

8. Cicero, *In Pisonem* 96.

9. Strabo 8.8.1.

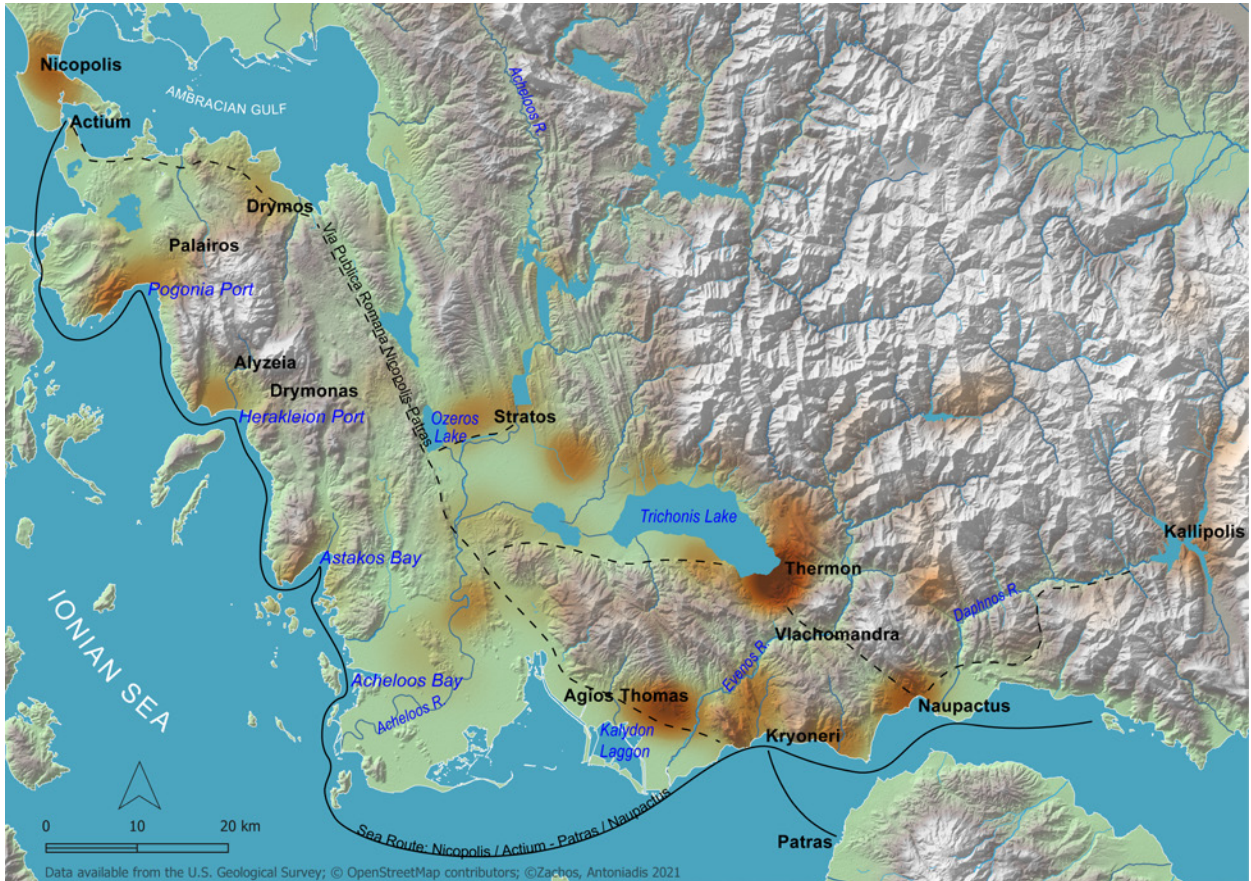
studies on the *via publica romana* that linked Patras to Nicopolis, the two major cities of western Greece, from sporadic finds in the rural countryside and from new sites coming to light in the course of recent large public works projects (especially the construction of the Ionian National Road). Based on this research, it seems that both areas were not as desolated as they appear to be from the sources.

It is true that the cities had already started to decline in the 2nd century BC, the final blow coming with the founding of the *Colonia Aroe Augusta Patrensis* and the *Actia Nicopolis*, and with the movement of the remnants of their population a few decades later. However, small cities managed to survive and new sites appeared on the coast and further inland (Ljung 2012, *passim*, esp. 185-190. Zachos, in press). In this section, this process will be illuminated by two bodies of data deriving from Roman literary sources: A) evidence concerning road networks and sea routes, and B) evidence concerning the financial exploitation of the region.

The first body of data includes the journeys made by Cicero in 51 and 50 BC from Actium to Patras and vice versa¹⁰ (Rizakis 1988, 454-456). The information from this source is quite illuminating because it comes from the period before the founding of Nicopolis and the colony of Patras and refers to a sea route that continued to be in use in Middle and Roman times, as depicted in *Itinerarium Antonini* and in *Tabula Peutingeriana* (Miller 1916, T.P. Strecke 79, It. Ant. 325). The *stationes* Perdioricto (in the narrow sea passage between Leukas and Akarnania), Halisso (ancient Alysia), Acheloum Fl. (possibly the Gulf of Astakos)¹¹, Eveno (the estuary of Evenos), Calidon (the port in Kryoneri) of the *Tabula Peutingeriana* are

10. Cicero, *Ad Atticum* 5.9, *Ad Familiares* 16.1-9.

11. Oeniadai was the main port of the Hellenistic period at the mouth of Acheloos R. The city's shipyards were destroyed in the Hellenistic period and the harbour probably fell out of use until the middle Roman period, silted up by deposits from the river. On the other hand, the Roman and Late Roman sites (among them an impressive *villa rustica* with mosaics and baths) around the nearby bay of Astakos are good evidence to locate the *statio* Acheloos of the *Tabula Peutinger* in this area (Zachos 2016, 203-204, 208-209).



MAP 3: Map of sites dating from the Late Hellenistic to the Late Roman period in Aitolia and Akarnania. Map made by the authors.

definitely parts of an *itinerarium maritimum* (Axioti 1980, 197-205).

One should bear in mind that a port is not simply the jetty but a place where ships and travellers can find supplies, water, fresh food and a resting place. As we can see on the digital map, farmsteads that would presumably serve these needs are always located close to the port.

Alyzia, for example, had a population of 30,000 in the time of Cicero¹². It is located on the mainland at the modern site of Kato Kandila but Strabo mentions a sacred port called Heraklion, with a *temenos* of the hero and sculptural works by Lysippus¹³. Although Alyzia became a dependency of Nicopolis after 31 BC, it retained its significance on the sea route from Nicopolis

to Patras. A burial monument of a rich landowner dated to the 2nd century AD was found on the shore (Flämig 2007, 144) and the temple in Drymonas Archontochoriou was repaired in the Roman period. Also, several *villae rusticae* were found on the north side of the bay on the shore of the Palairos peninsula. Dated to the Roman-Late Roman period, their products were probably transported from the old small harbour of Palairos at Pogonia to the port of Alyzia. A funerary inscription from the 3rd/4th century AD, found in the Pogonia port, mentions Aurelius Kyriakus, a freedman responsible for the *hierotato tameio* of the Familia Caesaris in Nicopolis (Zachos 2016, 205, 209-211. Antonetti 1996, 152).

Some of the *villae* on the Palairos peninsula and in Astakos bay (site: Agios Panteleimon) are characterised by luxury finds (i.e. mosaics),

12. Cicero, *Ad Familiares* 16.2

13. Strabo 10.2.2, 10.2.9, 10.2.21

suggesting wealth greater than that of a simple farm owner (Zachos 2016, 204). Bearing in mind the scattered nature of the information on Roman investors in western Greece (Zoumbaki 2011, Zoumbaki 2012), one can imagine that a villa near a port on a major sea route was an attractive location for someone who did not necessarily spend the entire year in the not so cosmopolitan Aitolia-Akarnania.

Another reason for mentioning a harbour in an *itinerarium maritimum* is its connection with the hinterland. Significantly, there are numerous habitation sites in the area of Kalydon (Gavrolimni area) and at the mouth of the Evinos river (Makyneia area), where a strong concentration of farmhouses, inns and villages has been found (Zachos 2016, 163-164, 184-185, Saranti, Georma 2018). It is from this area, specifically from Kryoneri (the port of Kalydon), that the paved road begins, a *via publica romana*, mentioned by Strabo that connects the colony of Patras with Nicopolis through the Aitolian-Akarnanian mainland (Axioti 1980, 191-197. Arnaud 2005, 178-179, 193 table 8, 194).

A milestone found in the area of the Agios Thomas settlement next to the public Roman baths attests to the presence of this road. The settlement was founded on the route of the *via publica romana*, replacing an adjacent Hellenistic settlement (Petropoulos 2007, 198-199. Zachos 2016, 192). The construction of the impressive *thermae* in the early 2nd century AD coincides with the repair of the road (Petropoulos 2004). Some architectural remains to the south of the monument must belong to a farmhouse. The region could therefore supply the ships or offer a place to rest for anyone wanting to travel inland. Inns may have provided food and accommodation along this route, as did the Late Roman building with bath facilities found in Drymos Vonitsas (Chamilaki, Delavinias, Goumplia 2018).

At the height of Lake Ozeros, this *via publica romana* met a secondary road leading to the territory of ancient Stratos, revived in the Roman-Late Roman period (Zachos 2016, 208, 212-213).

Amongst the goods transported along this *via publica romana* to the port of Kryoneri, and then to the large market of Patras, would have

been the fish caught in the lagoon of Kalydon (exploited by the Romans of Patras according to Strabo)¹⁴ (Rizakis 1995, no. 538, Rizakis 1996, 295), as well as products from Lake Trichonis (fish, vegetables, livestock products). The latter region, however, also had access to the coast via the road leading from Thermon, through the territory of the ancient *kome* in Vlachomandra, to the port of Naupactus (Zachos 2016, 197. Saranti 2018, 321-322), an important *statio* in the *itinerarium maritimum*.

As far as the region of Trichonis Lake is concerned, it is significant that although the old sites (sanctuaries, small towns) which survived the turbulent times of the 2nd and 1st centuries BC are scattered all along the perimeter of the lake, the highest density of sites is located on the south-east bank, exactly where the road coming from Naupactus ends. This site density consists almost exclusively of rural sites, farms and *villae rusticae* from the Roman-Late Roman period. The finds from these sites indicate that cultivating the plain around the lake and livestock farming in the hilly areas, as well as exploitation of the lagoon fishery, must have been the main activities for the inhabitants (Gerolymou 2013).

The Alyzia settlement pattern, with many farms located close to the city, is also observed in Naupactus (Saranti, Staikou 2013. Zachos 2016, 165-171). The territory of Naupactus was not exploited by the Roman colonists but rather by the Greeks of Patras, whose land had been given to the Roman settlers, according to Pausanias¹⁵ (Rizakis 1995, no. 364. Rizakis 1998, 281-284). The layers of grape seeds and the *lenoi* found at these rural sites confirm the preference (not, of course, as a monocrop) of the farmhouses around the cities for viticulture, since there was a constant demand for wine (Rizakis 2013, 38-39).

Naupactus not only survived in Roman times but also flourished in the Late Roman period (Papageorgiou 2004. Saranti 2018, 194-197). From the port of Naupactus, the surplus of the production not absorbed by the local market could be easily shipped to the opposite coast (Patras, Corinth) (Zachos, in press). Indeed, an urban centre with amenities and a halo of rural

14. Strabo 10.2.21.

15. Pausanias 10.38.9.

sites around it conforms to the classic model of a city that manages to survive into the new era (Rizakis 2018, 138-139).

In addition to the roads leading to Trichonis lake or the area of Kalydon, also starting from Naupactus, is the old road leading to Kallipolis, an important city for Hellenistic Aitolia. Kallipolis was transformed in Roman and Late Roman times to a mountain hub surrounded by a group of farming or pastoral communities, away from the geopolitical influence of Patras and Nicopolis (Zapheirpoulou 1982. Zachos 2016, 186-187. Zachos, in press).

The evidence of human activity on the plateau of Kallipolis suggests this mountainous road, leading from the coast of the Corinthian Gulf to the valley of Spercheios, never fell into disuse, although it may have been downgraded to a secondary route after the dissolution of the Aitolian League in the 1st century BC (Sotiriadis 1907, 303-320. Avramea 2002, 73).

CONCLUSIONS

Placing sites on maps for the TIR volumes is a rather complicated but very fruitful process. Especially in terms of topography, it provides greater insight regarding the motives of the Romans in settling specific areas of western Greece. A comparison of the maps of previous surveys with those of the TIR volumes confirms the dramatic decrease in sites but also reveals a new model of settlement that is directly related to the new geopolitical situation and economy established from the time of Augustus onwards. The coasts of Epirus, Akarnania and Aitolia became part of the larger network of sea routes between the Italian peninsula and the Greek mainland. These routes started from the Adriatic coast and passed through the channel between the Ionian islands (Zoumbaki 2018) and the western Greek mainland, ending at the major ports of the province of Achaia and, from there, connecting to the land route network leading inland. This story of trade and human activity is what lies behind the strange symbols on the TIR maps.

The examples of Epirus and Aitolia-Akarnania demonstrate the importance of the dialogue between the maps and the TIR Index,

each one informing the other. Thus the aim of the revived TIR is not just to place symbols on a map but to interpret these via the rich topographies of the Index.

BIBLIOGRAPHY

- ALCOCK, Susan (1993). *Graecia Capta*. Cambridge: Cambridge University Press.
- ANGELI, Anthi; KATSADIMA, Ioulia (2001). “Riza and Agia Pelagia: Two architectural assemblages Foundation of the Roman Era along the Coast of Southern Epirus”. In: ISAGER, Jacob (ed.). *Foundation and Destruction Nikopolis and Northwestern Greece: The archaeological evidence for the city destructions, the foundation of Nikopolis and the synoecism*. Athens: The Danish Institute at Athens, 91-108.
- ANTONETTI, Claudia (1996). “La diffusione dei nomi romani in Etolia e in Acarnania e la presenza romana nella regione”. In: RIZAKIS, Athanasios (ed.). *Roman Onomastics in the Greek East: Social and Political Aspects*. Athens: Research Centre for Greek and Roman Antiquity, 149-155.
- ANTONIADIS, Vyron (2016). *Tabula Imperii Romani, J34 - Athens: Epirus*. Athens: Academy of Athens.
- ANTONIADIS, Vyron (2019). “*Tabula Imperii Romani* Thesprotia: Mapping the Roman Presence and Activities”. In: PLIAKOU, Georgia; CHOULIARAS, Ioannis (eds.). *Thesprotia I, 1st International conference on the archaeology and history of Thesprotia*. Ioannina: Ministry of Culture, 389-402.
- ANTONIADIS, Vyron (2021). “Post-167 BC Romans in Central and Southern Rural Epirus: Analysing a Specific Settlement Pattern”. *Orbis Terrarum*, 19, forthcoming.
- ARNAUD, Pascal (2005). *Les routes de la navigation antique: Itinéraires en Méditerranée*. Paris: Errance.
- AVRAMEA, Anna (2002). “Land and sea communications, fourth-fifteenth centuries”. In: LAIOU, Angeliki (ed.). *The Economic History of Byzantium, from the Seventh through the Fifteenth Century*, I. Washington, D.C.: Dumbarton Oaks, 57-90.

- AVRAMEA, Anna; KARANASTASI, Pavlina (1993). *Tabula Imperii Romani, K35 Istanbul: K 35, I: Philippi*. Athens: Academy of Athens.
- AXIOTI, Kornilia (1980). “Ρωμαϊκοί δρόμοι της Αιτωλοακαρνανίας”. *Archaeologikon Deltion* 35, A, 186-197.
- CHAMILAKI, Katerina; DELAVINIAS, Panayiotis; GOUMPLIA, Ioanna (2018). “Λουτρικές εγκαταστάσεις σε κοσμικό συγκρότημα της Ύστερης Αρχαιότητας στον Δρυμό Βόνιτσας”. In: *To Αρχαιολογικό Έργο στη Βορειοδυτική Ελλάδα και τα νησιά του Ιονίου*, 1. Athens: Ministry of Culture / ARF, 649-660.
- DOUZOUGLI, Angelika (1993). *Archaeologikon Deltion*, 48, Chron. B'1, 282-285.
- FLÄMIG, Catharina (2007). *Grabarchitektur der römischen Kaiserzeit in Griechenland*. Rahden/Westf.: Verlag Marie Leidorf.
- FORSÉN, Björn (2019). “Disruption and Development: Tracing Imperial Vestiges in Epirus”. In: FORSÉN, Björn (ed.). *Thesprotia Expedition IV: Region Transformed by Empire*. Helsinki: Foundation of the Finnish Institute at Athens, 1-48.
- FORSÉN, Björn; REYNOLDS, Paul (2011). “Early Closed Deposit at the Roman Villa of Agios Donatos”. In: FORSÉN, Björn; TIKKALA, Esko (eds). *Thesprotia Expedition II: Environment and Settlement Patterns*. Helsinki: Foundation of the Finnish Institute at Athens, 247-267.
- GARDINER, R.A. (1973). “The International Map of the Roman Empire”. *The Geographical Journal*, 139, 107-111.
- GEROLYMOU, Victoria. (2013). “Αγροκία στα Σιπαράλωνα Αιτωλοακαρνανίας: αγροτική και εργαστηριακή παραγωγή”. In: RIZAKIS, Athanasios; TOURATSOGLU, Ioannis (eds). *Villae Rusticae: Family and Market-Oriented Farms in Greece under Roman Rule*. Athens: Research Centre for Greek and Roman Antiquity, 682-703.
- GIANNAKI, Vassiliki; GIOVANOPOULOU, Anastasia; LEONTARIS, Leonidas; STAMOU, Ioulia (2017). “Restoration proposal for the roman villa at Kranoula, Ioannina”. In: *To Αρχαιολογικό Έργο στη Βορειοδυτική Ελλάδα και τα νησιά του Ιονίου* 2, 2017 (conference abstract).
- ISAGER, Jacob (2001). “Eretria in Epirus and the Foundation of Nikopolis. Models of civilization in Strabo”. In: ISAGER, Jacob (ed.). *Foundation and Destruction Nikopolis and Northwestern Greece: The archaeological evidence for the city destructions, the foundation of Nikopolis and the synoecism*. Athens: The Danish Institute at Athens, 17-27.
- ISAGER, Jacob (2009). “Destruction or depopulation of cities in Pausanias. Nikopolis, Aetolia, and Epirus”. In: *Proceedings of the Danish Institute at Athens* 6, 217-221.
- KARVONIS, Pavlos (2016). *Tabula Imperii Romani, J 34-Athens: Attica*. Athens: Academy of Athens.
- KARVONIS, Pavlos; MIKEDAKI, Maria (with contribution of George ZACHOS), (2012). *Tabula Imperii Romani, J 35-Smyrna I: Aegean Islands*. Athens: Academy of Athens.
- KLEITSAS, Christos (2010). “Κτίσματα Πωγωνίου. Μια αρχαία θέση στα ελληνοαλβανικά σύνορα”. *Epirotika Chronika*, 44, 220-46.
- LAZARI, Kassiani (2019). “Αρχαιότητες στο χώρο του Νέου Λιμένα Ηγουμενίτσας. Τα νέα στοιχεία για μια παλιά έρευνα”. In: PLIAKOU, Georgia; CHOULIARAS, Ioannis (eds.). *Thesprotia I, 1st International conference on the archaeology and history of Thesprotia*. Ioannina: Ministry of Culture, 403-419.
- LJUNG, Emma (2012). *From Indemnity to Integration: Economic Decline in Late Hellenistic Aitolia*. Unpublished PhD Thesis, Princeton University.
- MIKEDAKI, Maria (2019). *Tabula Imperii Romani, J 34-Athens: Boetia*. Athens: Academy of Athens.
- PAPAGEORGIU, Vasiliki (2004). “Παλαιοχριστιανική Ναύπακτος: Όψεις της πόλης μέσα από τις ανασκαφικές μαρτυρίες”. In: PALIOURAS, Athanasios, B' Διεθνές Ιστορικό και αρχαιολογικό Συνέδριο Αιτωλοακαρνανίας, II. Agrinio: Ministry of Culture, 459-471.
- PETROPOULOS, Michalis (2004). “Ρωμαϊκές Θέρμες κοντά στο Μεσολόγγι”. In: PALIOURAS, Athanasios, B' Διεθνές Ιστορικό και Αρχαιολογικό Συνέδριο για την Αιτωλοακαρνανία, I. Agrinio: Ministry of Culture, 413-432.

- PETROPOULOS, Michalis (2007). “Νικόπολις- Πάτρα μέσω Αιτωλοακαρνανίας”. In: ZACHOS, Konstantinos (ed.). *Nicopolis B. Proceedings of the Second International Nicopolis Symposium, 11-15 September 2002*. Preveza: Actia Nicopolis Foundation, 175-211.
- PLIAKOU, Georgia (2018). “The basin of Ioannina in central Epirus, northwestern Greece, from the Early Iron Age to the Roman period”. *Archaeological Reports*, 64,133-151.
- PREKA-ALEXANDRI, Kalliopi (1994). *Archaeologikon Deltion* 49, Chron. B'1, 427-429.
- RIGINOS, Georgios (2012). “ΛΓ' Εφορεία Προϊστορικών και Κλασικών Αρχαιοτήτων”. In: ANDREADAKI-VLAZAKI, Maria (ed.). *2000-2010: Από το ανασκαφικό έργο των Εφορειών Αρχαιοτήτων*. Athens: Ministry of Culture, 355-358.
- RIGINOS, Georgios; SAKKAS, Dimitris (2018). “Ο Μείζων της Νικοπόλεως λιμένας στο Βαθύ. Οικιστική οργάνωση, ιστορική διαδρομή και χρήσεις του χώρου”. In: *Το Αρχαιολογικό Έργο στη Βορειοδυτική Ελλάδα και τα νησιά του Ιονίου*, 1. Athens: Ministry of Culture / ARF, 441-54.
- RIZAKIS, Athanasios (1988). “Le port de Patras et les communications avec l'Italie sous République”. *Cahiers d'Histoire*, 33.3.4, 453-473.
- RIZAKIS, Athanasios (1995). *Achaie I: Sources textuelles et histoire regionale*. Athènes: Centre de Recherches de l'Antiquité Grecque et Romaine / Fondation Nationale de la Recherche Scientifique.
- RIZAKIS, Athanasios (1996). “Les colonies Romaines des côtes occidentales grecques. Population et territoires”. *Dialogue d'Histoire Ancienne* 22, 255-324.
- RIZAKIS, Athanasios (2013). “Rural structures and agrarian strategies in Greece under the Roman Empire”. In: RIZAKIS, Athanasios; TOURATSOGLU, Ioannis (eds). *Villae Rusticae: Family and Market-Oriented Farms in Greece under Roman Rule*. Athens: NHR-IHR, 20-51.
- RIZAKIS, Athanasios (2018). “Η αγροτική οικονομία των ελληνικών πόλεων κατά την αυτοκρατορική εποχή: παράδοση και νεωτερισμοί”. In: DI NAPOLI, Valentina; F. CAMIA, Francesco et.o. (eds). *What's New in Roman Greece? Recent Work on the Greek Mainland and the Islands in the Roman Period*. Athens: NHR-IHR, 137-156.
- SARANTI, Ph. (2018). *Ναύπακτος: Τοπογραφική εξέλιξη του άστεως και της χώρας, από τους προϊστορικούς χρόνους μέχρι την Ύστερη Αρχαιότητα*, Unpubl. PhD Thesis, University of Ioannina.
- SARANTI, Ph.; GEORMA, Ph. (2018). “Αρχαία Μακύνεια Αιτωλίας: Η πολεοδομική οργάνωση ενός οικισμού μέσα από τα αρχιτεκτονικά του κατάλοιπα”. In: *Το Αρχαιολογικό Έργο στη Βορειοδυτική Ελλάδα και τα νησιά του Ιονίου*, 1. Athens: Ministry of Culture / ARF 531-544.
- SARANTI, Ph.; STAIKOU, V. (2013). “Αγροικίες ρωμαϊκών χρόνων στην περιοχή δυτικά της Ναυπάκτου”. In: RIZAKIS Athanasios; TOURATSOGLU Ioannis (eds). *Villae Rusticae: Family and Market-Oriented Farms in Greece under Roman Rule*. Athens: NHR-IHR, 718-733.
- SOTIRIADIS, Georgios (1907). “Ζητήματα Αιτωλικής ιστορίας και τοπογραφίας”. *Bulletin de Correspondance Hellénique* 31, 270-320.
- STEIN, C.A. (2001). “In the Shadow of Nikopolis: Patterns of Settlement on the Agios Thomas Peninsula”. In: ISAGER, Jacob (ed.). *Foundation and Destruction Nikopolis and Northwestern Greece: The archaeological evidence for the city destructions, the foundation of Nikopolis and the synoecism*. Athens: The Danish Institute at Athens, 65-79.
- TALBERT, Richard (2019). *Challenges of Mapping the Classical World*. London-New York: Routledge.
- VASEILIADIS, Stefanos; LAZARI, Kassiani; LAMPROU, Vassiliki; PALLI, Ourania (2018). “Η ρωμαϊκή παρουσία στη Θεσπρωτία μέσα από τα αρχαιολογικά ευρήματα της τελευταίας δεκαετίας”. In: *Το Αρχαιολογικό Έργο στη Βορειοδυτική Ελλάδα και τα νησιά του Ιονίου*, 1. Athens: Ministry of Culture / ARF, 331-340.
- VLACHOPOULOU-OIKONOMOU, Amalia (2003). *Επισκόπηση της τοπογραφίας της Αρχαίας Ηπείρου: Επισκόπηση Νομοί Ιωαννίνων-*

- Θεσπρωτίας και Νότια Αλβανία. Ioannina: University of Ioannina.
- ZACHOS, Georgios (2016). *Tabula Imperii Romani, J34-Athens: Achaia Phthiotis – Malis – Aenis – Doris – Eurytania – East & West Locris – Phokis – Aitolia – Akarnania*. Athens: Academy of Athens.
- ZACHOS, Georgios (2021). *Tabula Imperii Romani, J 34-Athens: Thessaly*. Athens: Academy of Athens.
- ZACHOS, Georgios (in press). “Roman Aitolia: The wind of change”. In: *Rural Economy in Western Greece in the Late Hellenistic and Roman periods*. Athens: NHR-IHR.
- ZACHOS, Konstantinos; CHOINAS, Nikos (2006). *Archaeologikon Deltion*, 61, 2006, Chron. B’1, 687.
- ZACHOS, Konstantinos (2012). “IB’ Εφορεία Προϊστορικών και Κλασικών Αρχαιοτήτων”. In: ANDREADAKI-VLAZAKI, Maria (ed.). *2000-2010: Από το ανασκαφικό έργο των Εφορειών Αρχαιοτήτων*. Athens: Ministry of Culture, 343-348.
- ZAPHEIROPOULOU, Photeini (1982): “Το Κάλλιο στην Ύστερη Αρχαιότητα”, *Archaeologiki Ephemeris*, 1-13.
- ZOUMBAKI, Sofia (2011). “The presence of Italiote and Romans in Aetolia, Acarnania and the adjacent islands from the 3rd c. BC to the beginning of the imperial age”. In: DE SENSI SESTITO, Giovanna; INTRIERI, Maria. (eds). *Sulla rotta per la Sicilia: L’Epiro, Corcira e l’Occidente*. Pisa: ETS, 523-538.
- ZOUMBAKI, Sofia (2012). “The exploitation of the local resources of Western Greece by Roman entrepreneurs (3rd-1st c BC)”. *Revue Belge de Philologie et d’Histoire*, 90, 77-92.
- ZOUMBAKI, Sofia (2018). “Where the East Meets West: Island Societies of the Ionian Sea Under Roman Rule”. In: KOUREMENOS, Anna (ed.), *Insularity and Identity in the Roman Mediterranean*, Oxford & Philadelphia, Oxbow Books, 77-107.
- ZOUMBAKI, Sofia (2019). “Ποιος σαλπάρει από ένα Ιταλικό λιμάνι για να μιλήσει για χοίρους; Διασχίζοντας την Αδριατική προς αναζήτηση ευκαιριών στη Θεσπρωτία”. In: PLIAKOU, Georgia; CHOULIARAS, Ioannis (eds.). *Thesprotia I, 1st International conference on the archaeology and history of Thesprotia*. Ioannina: Ministry of Culture, 373-388.

Le projet TIR-FOR et la Carte Nationale des Sites Archéologiques et des Monuments Historiques. Tunisie

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RÉSUMÉ

En 2017, l'Institut National du Patrimoine (Tunisie) a intégré la « *Tabula Imperii Romani* (TIR) et *Forma Orbis Romani* (FOR) » et adapté les données des sites archéologiques tunisiens publiées dans la Carte Nationale des Sites Archéologiques et des Monuments Historiques (CNSAMH).

Il s'agit ici de présenter l'état d'avancement de l'équipe tunisienne dans ce projet ; de présenter le projet de la CNSAMH et finalement de le comparer avec le Projet TIR-FOR.

MOTS-CLÉS: Carte archéologique, sites archéologiques, Institut National du Patrimoine, Tunisie.

The TIR-FOR project and the National Map of Archaeological Sites and Historical Monuments. Tunisia

ABSTRACT

In 2017 the National Heritage Institute (Tunisia) integrated the *Tabula Imperii Romani* (TIR) and the *Forma Orbis Romani* (FOR) and adapted the data of Tunisian archaeological sites published in the National Map of Archaeological Sites and Historical Monuments (CNSAMH).

This is to present the state of progress of the Tunisian team in this project; to present the CNSAMH project and finally to compare it with the TIR-FOR project.

KEYWORDS: Archaeological map, archaeological sites, National Heritage Institute of Tunisia.

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1. LE PROJET TIR-FOR ET LA CARTE NATIONALE DES SITES ARCHÉOLOGIQUES ET DES MONUMENTS HISTORIQUES DE LA TUNISIE

C'est en 2017 que l'Institut National du Patrimoine de la Tunisie (INP), sous la direction du professeur Faouzi Mahfoudh et sur proposition du professeur Abdelmajid Charfi, directeur général de l'Académie Tunisienne des Sciences, des Lettres et des Arts « Beit Al Hikma », et celle du professeur Josep Guitart i Duran, président de la Commission Internationale TIR-FOR, a intégré le projet de la carte de l'empire romain « *Tabula Imperii Romani - Forma Orbis Romani* ». Une équipe a été alors formée dont la tâche consistait à insérer les données des sites archéologiques tunisiens déjà publiées dans la Carte nationale des sites archéologiques et des monuments historiques sous la direction du professeur Sadok Ben Baaziz, directeur de recherche à l'INP.

C'est à Barcelone, à l'Institut d'Estudis Catalans, que les membres de cette équipe ont été initiés à la manipulation de la base de données et de l'application accessible en open-source sur le net.

1.1. Pourquoi les données de la carte archéologique ? (Fig. 1)

Il s'agit en réalité d'une reprise totale des données fournies depuis la fin du XIX^e siècle par les feuilles topographiques publiées alors par le ministère français de la Guerre, parfois accompagnées de brèves notices qui ne rendent aucunement la réalité du terrain et l'importance, ainsi



FIGURE 1. Capture d'écran du site web de l'INP.

que la densité des sites archéologiques. Par ailleurs, la couverture du territoire national était partielle³.

Ce n'est qu'au milieu des années 80 du siècle dernier qu'un ambitieux projet a été mis en place pour la réalisation d'un inventaire de l'ensemble du territoire le dénommé « Carte nationale des sites archéologiques et des monuments historiques à l'échelle 1/50 000e. La réalisation a été confiée au ministère de la Culture de Tunisie, à celui de la Défense nationale et à l'Office de la topographie et de la cartographie tunisien, et ce, dans le cadre d'un projet de coopération entre la Tunisie et le Programme des Nations Unies pour le développement, le Pnud. Ce n'est qu'en 1992 qu'un décret présidentiel confia la réalisation de ce projet uniquement au ministère de la Culture, qui le confia à son tour à l'Institut national du patrimoine sous la direction de Sadok Ben Baaziz.

Ce décret précisait :

Article 1^{er} – Il est institué une Carte nationale des sites archéologiques et des monuments historiques en terre et en mer dans le but d'établir l'inventaire général des lieux et des édifices qui constituent une partie du patrimoine culturel national.

Article 2^d – Pour le recensement des sites et des monuments, il sera procédé à l'établissement et à l'impression des documents suivants :

- Des cartes au 1/50 000e comportant la localisation des sites.

- Des plan au 1/2 000e comportant la localisation des monuments et des tissus urbains traditionnels. (Fig. 2)

- Un fichier comportant une description des sites et des monuments, une évaluation des superficies, une couverture photographique et, dans la mesure du possible, une enquête foncière préliminaire.

Quant aux objectifs de la Carte nationale des sites archéologiques et des monuments historiques ils comprennent essentiellement trois points :

- L'élaboration d'un outil efficace pour mieux gérer le patrimoine et garantir sa protection et sa sauvegarde.

- L'élaboration d'un outil d'aide à la décision pour l'aménagement du territoire.

- Enfin, l'élaboration d'un outil constituant un premier palier de la recherche scientifique.

3. AAT, 1893.

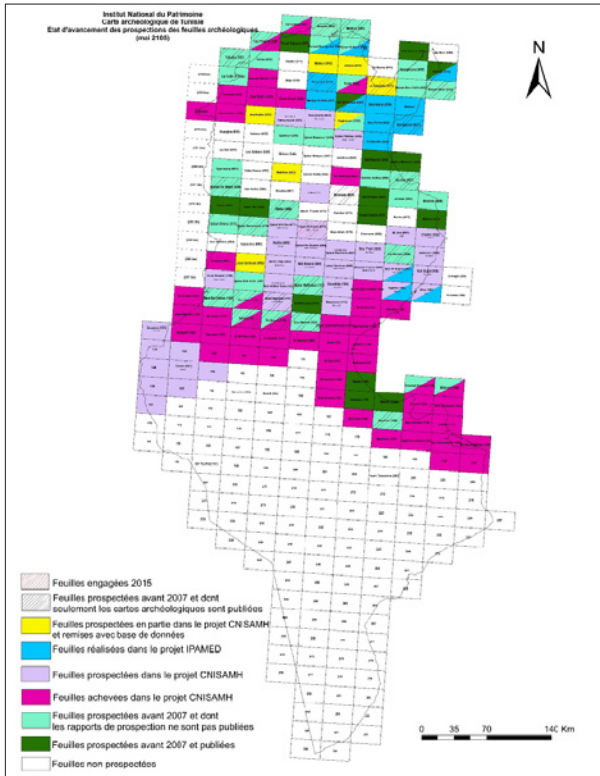


FIGURE 2. Carte de la Tunisie. État d'avancement de l'inventaire.

Mais devant les avancées technologiques, l'Institut national du patrimoine a décidé de recourir à l'outil informatique pour la poursuite de l'inventaire général à partir de 1999 grâce au projet européen de la Carte informatisée du patrimoine connu sous l'appellation d'Ipamed, et ce, dans le cadre d'Euromed Heritage. On a eu alors recours au Système d'information géographique (le SIG), à la télédétection, la topographie ou encore à la géologie, l'INP étant le coordonnateur. La formation d'une vingtaine de doctorants, chercheurs et techniciens de la rive sud de la Méditerranée a duré un peu plus de deux ans. Un manuel de procédure a été publié à la fin de la formation (fig. 3). Depuis, la couverture du territoire s'est faite à un rythme accéléré⁴.

Ainsi, 32 feuilles ont été achevées dont 18 furent publiées dans des fascicules bilingues en arabe et en français pour la plupart (fig. 4). La

4. Debaghi-Bejaoui-Ghaki, 2005.

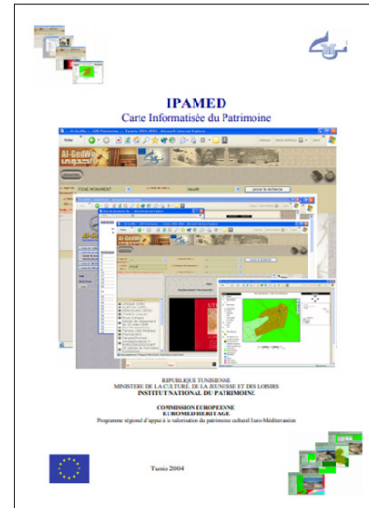


FIGURE 3. Couverture du manuel de PROCÉDURE Ipamed.

feuille comprend des notices pour chaque site, toutes périodes confondues, des illustrations, des cartes et des plans qui accompagneront le texte.

À cela il faudrait ajouter une trentaine de cartes prospectées selon les anciennes normes, par ailleurs actuellement en cours de révision. Cette tâche incombe à divers profils d'intervenants : des conservateurs du patrimoine, des chercheurs, des universitaires..., qui, de par leur niveau élevé de connaissances historiques et archéologiques, sont de ce fait les garants de la fiabilité des données recueillies sur le terrain.

Ce sont les résultats de plusieurs années de travaux, parfois dans des conditions difficiles, mais compensées par le bonheur de la découverte que nous avons commencé à introduire dans ce grand projet de la TABULA IMPERII ROMANI.

Il fallait alors s'adapter à la base de données de la Tabula, mais en même temps suggérer des champs supplémentaires en rapport avec quelques spécificités constatées dans le patrimoine archéologiques tunisien, à l'exemple des pressoirs à huile qui sont une constante du paysage rural africain, ou encore les cuves baptismales dans les domaines agricoles ou les bourgs antiques, et éventuellement les témoignages matériels des monastères.



FIGURE 4. Exemple de carte. Thala avec les sites majeurs.

2. ÉTAT D'AVANCEMENT DE LA CONTRIBUTION TUNISIENNE À LA TIR-FOR

L'équipe tunisienne a pu enregistrer et insérer 454 sites archéologiques dans la plateforme de la TIR-FOR (fig. 5).

Ces sites sont répartis sur trois feuilles suivant ainsi le découpage de la Carte nationale des sites archéologiques et des monuments historiques.

À ce jour, trois feuilles ont été enregistrées, qui couvrent diverses régions du pays, avec en même temps une différente densité d'occupation du sol du moins durant l'Antiquité :

1. Au nord, celle de Bir Mchrega (fig. 6) en Proconsulaire, province depuis la réforme administrative de l'empereur Dioclétien, avec 350 fiches. C'est l'une des plus denses du territoire national où se trouvent plusieurs sites majeurs

identifiés grâce aux vestiges de monuments, aux textes épigraphiques, mais aussi aux sources anciennes à l'exemple de la ville d'Uthina connue pour son amphithéâtre (fig. 7), son capitole et surtout ses mosaïques... Parmi les autres cités reconnues, on citera Sturnica, Agellum Zarithensem, Pagus Mercurialis, Pagus Fortunalis, Thibulli, Saltus Massipianus, Municipium Aurlium Commodum, Sidi Youssef...⁵

2. La deuxième est la feuille de Thala (fig. 8), située au centre-ouest tunisien (la Byzacène occidentale), avec ses 200 sites repérés dont la grande cité de Thala⁶, l'une des plus anciennes de la région et célèbre pour son rôle au cours des guerres entre les Numides et les armées romaines ; 108 sites archéologiques ont été enregistrés dans la TIR-FOR.

5. Maurin, 2003.

6. Ben Baaziz, 2005.

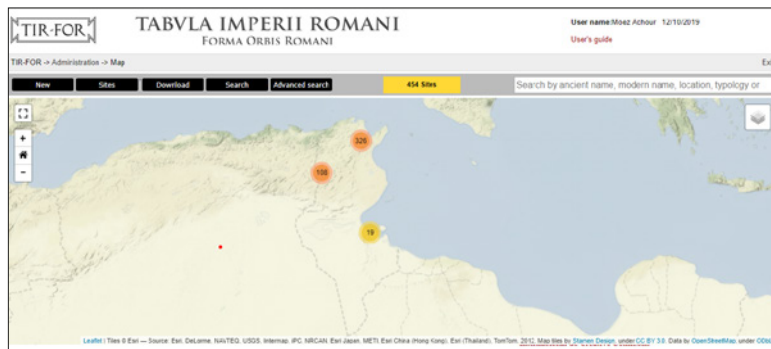


FIGURE 5. Répartition des sites enregistrés sur la plateforme de la TIR-FOR.

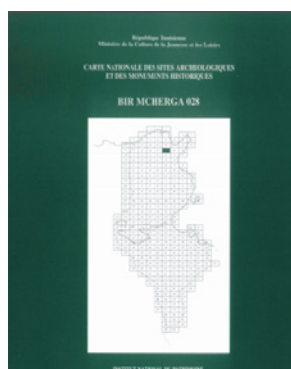


FIGURE 6. Couverture du fascicule consacré à la feuille de Bir Mcherga.



FIGURE 7. Vue de l'amphithéâtre d'Uthina.



FIGURE 9. Couverture du fascicule consacré à la feuille de Mareth.

3. Enfin, la troisième feuille est celle de Mareth⁷ en Tripolitaine, au sud du pays, où la densité, de par sa position géographique, est bien moindre (fig. 9) ; 19 sites archéologiques ont été répertoriés dans la TIR-FOR.

3. CONCLUSION

Pour conclure, il est à rappeler que l'Institut national du patrimoine s'est engagé à intégrer les données des sites archéologiques romains (publiés) qui se trouvent dans son territoire dans l'application TIR-FOR et que l'équipe tunisienne sera renforcée très bientôt afin de pouvoir parvenir à cet objectif dans les plus brefs délais.

7. Mrabet, 2000.

BIBLIOGRAPHIE

- AAT, 1893 : BABELON, E. ; CAGNAT, R. ; REINACH, S. (1893). Atlas Archéologique de la Tunisie. Paris.
- BEN BAAZIZ S. (2005). Thala (067), Carte nationale des sites archéologiques et des monuments historiques. INP. Tunis.
- DEBAGHI, A. ; BEJAOUI, F ; GHAKI, M. (2005). Ipamed : Carte informatisée du patrimoine. INP. Tunis.
- MAURIN, L. (2003). Carte Nationale des sites archéologiques et des monuments historiques. BIR MCHERGA 028.
- MRABET, A. (2000). Carte nationale des sites archéologiques et des monuments historiques. Mareth 158.

DIGITAL MAPS OF THE **R**OMAN WORLD
AND SPECIALISED APPLICATIONS

From ‘Flatland’ to the real world. Mapping the landscapes of Cappadocia in the digital age

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“I call our world Flatland, not because we call it so,
but to make its nature clearer to you, my happy readers,
who are privileged to live in Space”.

Edwin A. Abbott, *Flatland. A Romance of Many Dimensions*, London 1884.

ABSTRACT

While conducting research on the historical landscape of Cappadocia (central Anatolia, Turkey) and on its transformation over time (from the Graeco-Roman to the middle Byzantine periods), the need has arisen to approach the archaeological mapping of that territory from a different perspective and from different points of view than those traditionally adopted in the area so far. In particular, exploiting the potential of the ‘third dimension’ appears to be very useful.

Within this context, the aim of this paper is twofold: a) to discuss some case studies in which the application of a three dimensional approach to archaeological mapping has encouraged new ideas and hypotheses; b) to discuss the next steps taken by our research, devoted to applying a technological approach that aims to develop smart tools to share data among scholars, public bodies and the general public.

KEYWORDS: Cappadocia, digital cartography, Augmented Reality applications, webGIS.

1. INTRODUCTION

The research carried out on the historical landscape of Cappadocia (central Anatolia, Turkey) from the Graeco-Roman to the middle Byzantine periods, on the transformation it underwent over time and on the development of its road network, led to the archaeological mapping of that territory being approached from a different perspective and from different points of view than those traditionally adopted for the area so far. Indeed, the morphological features of Cappadocia – ranging from the mountainous slopes of the Taurus chain to the south, the volcanic massifs of

Melendiz Dağları, Hasan Dağı and Göllü Dağı at the heart of the region, the basin of the Kızılırmak river to the north, the thick, extensive tuffaceous deposits of volcano-sedimentary sequences of the ‘Fairy Chimneys’ area to the east of Nevşehir, and the extensive, fertile plains of the Anatolian plateau (Fig. 1) – encouraged investigation into the potential of the ‘third dimension’, whether in a 2.5D or real 3D GIS environment. This approach enabled all the Cappadocian morphological features to be ‘extruded’, enhancing their representation on maps and enabling a multi-parameter interpretation of the archaeological record and an evaluation of its relationship with the surrounding environment.

This paper focuses on some case studies related to the application of a ‘three-dimensional

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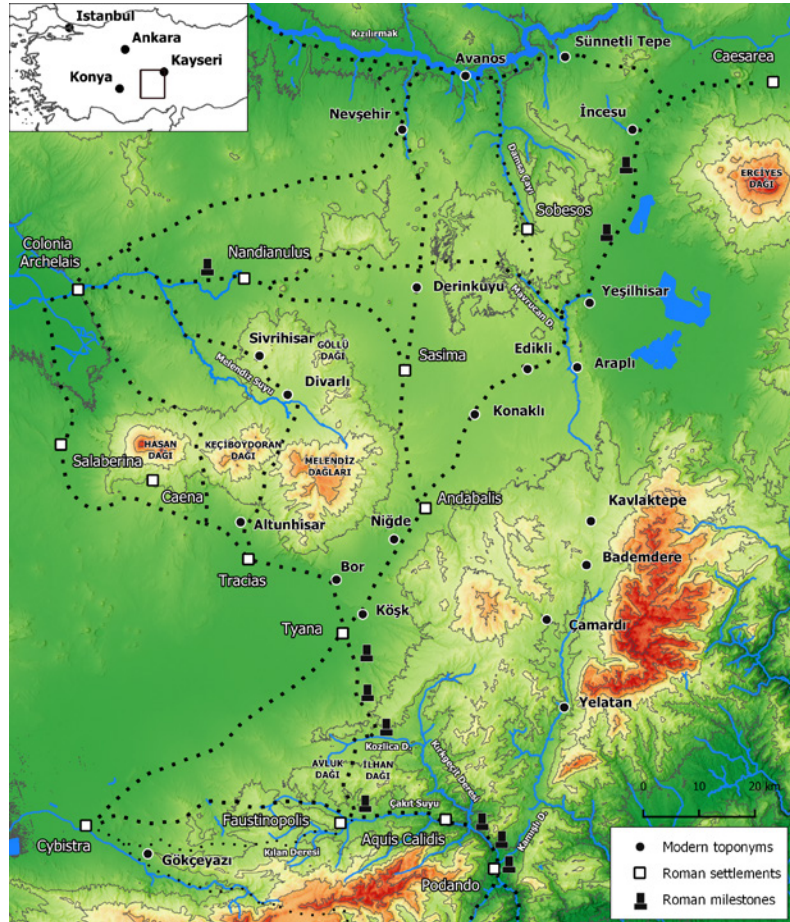


FIGURE 1. Roman Cappadocia (J. Turchetto).

approach’ in the analysis of the Cappadocian landscape, and on future research prospects in this sector of Anatolia.

2. CUBE-SHAPED CAPPADOCIA

An initial approach dealt with the southern sector of Cappadocia, attempting to analyse the layout of the Roman route recorded in both the *Itinerarium Burdigalense* (577, 7 - 578, 4, p. 93 Cuntz) and the *Itinerarium Antonini* (145, 1-4, p. 20 Cuntz), leading from the pass of the Cilician Gates (the only natural passageway between the Mediterranean coastal strip of Cilicia and the Anatolian plateau) to the colony of *Tyana* (corresponding to the modern town of Kemerhisar). The fact that this route would have run along the longitudinal valley of the Çakıt Suyu and would

have then turned northwards, passing through the col of the Avluk Dağı and avoiding the narrow, dangerous gorge in Kırkgeçit Deresi (meaning ‘the valley of the forty bends’), had already been suggested by archaeological and topographical evidence detectable *on* the ground (Turchetto, 2018a). In this case, the aim was to further validate this hypothesis at a GIS-driven level, via evidence *from* the ground and its specific features.

Such confirmation resulted from an analysis of a 3D simulation generated from ASTER GDEMS²,

2. The Terra Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Models (GDEMs) provide a global digital elevation model at a spatial resolution of 1 arc second (approximately a 30-metre horizontal posting at the equator) and 1 × 1 degree tiles. These DEMs are available free of charge and can be downloaded from *EarthExplorer*, the United States Geological Survey website (<https://earthexplorer.usgs.gov/>). ASTER GDEM is a product of METI and NASA.

whose cells had been previously aggregated (Fig. 2). The resulting output was effectively not a realistic simulation of the area but a 3D cubic representation of the territory which meant that the elevation data could be viewed as a series of steps along the two routes in question, running along the valleys of the Kırkgeçit Deresi (darker line) and of the Çakıt Suyu (lighter line). The former is forced to cross a series of drops and rises, which would have made it difficult to walk along, while the latter route, albeit in a mountainous setting, is easier to follow, both uphill and downhill; the steepness seems to remain more or less constant along most of the route and there are no sharp differences in height to tackle (Turchetto, Salemi, 2014).

3. VISIBLE AND INVISIBLE CAPPADOCIA

Furthermore, it appeared potentially interesting to investigate the central Cappadocia volcanic area between Aksaray and Kemerhisar, in which a series of fortresses had been built on the top of rocky spurs to escape the Arab incursions in Anatolia (mid-8th to mid-10th

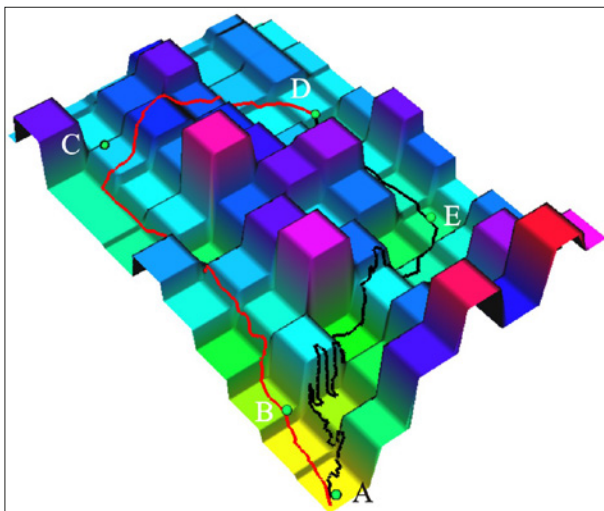


FIGURE 2. 3D cubic model of southern Cappadocia (view: from south-east). The darker line corresponds to the Kırkgeçit Deresi valley route, the lighter line to the Çakıt Suyu valley route. A = Tahta Köprü; B = Çiftehane/Aquis Calidis; C = Zeyve/Faustinopolis; D = Eminlik; E = Başmakçı (J. Turchetto).

centuries AD), “...directed almost entirely at the border districts of the empire and their hinterland [and] aimed chiefly at the collection of booty and at damaging Byzantine morale...” (Haldon, Kennedy, 2004: 145; see also Métivier, 2008; Kennedy, 2010: 175-178; Eger, 2014). In particular, our aim was to better understand the relationship between those same defensive structures and the routes crossing the district, as well as the role played by the landscape within the settlement strategies of the Byzantine empire.

In this respect, the *Analysis of Visibility* (Murrieta-Flores, 2014; Llobera, 2015), which would have enabled us to define the width and extension of the ‘in-view’ areas provided by each fortress regarding the territory beneath them, seemed to fit our purposes well (Turchetto, Salemi, 2017). Indeed, by applying a cumulative *Viewshed Analysis*³ (with a 4 km buffer)⁴, a series of binary viewshed raster maps were processed for each fortress, which acted as a lookout against Arab attacks. In this way, we managed to gain information about which portions of the landscape were visible from these lookouts and the stretches of the roads that could be monitored visually from the fortresses themselves.

As a result, the subsequent application of a directional visibility analysis, aimed at investigating the degree of control exercised by the fortresses in relation to eight main directional zones (north, north-east, east, south-east, south, south-west, west and north-west), produced a series of ‘cones of visibility’ that offered the chance to determine the dominant (or preferred) direction in which each fort provided a better and more effective view.

The results confirmed what the Byzantine written sources record regarding the strategy to

3. In this case, the QGIS viewshed analysis plugin elaborated by Zoran Čučković was applied (<https://www.zoran-cuckovic.from.hr/QGIS-visibility-analysis/>).

4. Such a radius falls within the visual range suggested by similar archaeological studies (Murrieta-Flores, 2014, with earlier bibliography) and, as has been directly verified in the field in Cappadocia, this fits well with the aims of the research and the features of the landscape in question. Further analyses were carried out by means of *Fuzzy Viewshed Analysis*, aimed at determining the different degrees of visibility of the roads from the fortresses and thereby the gradually increasing degree of control exercised over the route as it approached the fortress (Titti, Turchetto, Salemi, 2018, with previous bibliography).

be adopted against Arab raids. Indeed, the GIS-based analysis (Fig. 3) revealed the centrality of these fortresses and the importance of the garrisoning system within the Arab/Byzantine guerrilla tactics, in which the careful observation of enemy movements without being seen proved to be strategic and essential. The directional viewshed analysis highlighted the fact that settlement choices related to the forts were not determined by chance. On the contrary, they reflected what the new offensive/defensive strategy required; i.e. to provide the largest possible view of the whole territory and, in particular, of any access points which would enable enemies to enter that mountainous area and use the routes running across it.

4. HISTORICAL AND POTENTIAL PATHS

A third geomatic exercise was represented by the application of the *Least Cost Path Analysis* (Turchetto, 2018a, 131-143). As is known, on the basis of a raster map that determines the ‘cost’ of travelling across its cells, this GIS-based analysis enables the identification of the least cost path (or LCP; i.e. a potential route) between two points, a source and a destination (Herzog, 2014).

Within this framework, we carefully generated the cost surface, modelling this according to different parameters, including attractors (such as settlements or springs) and detractors (lacustrine or marshy areas); facilitators (such as slopes) and obstacles (mainly rivers) (Citter, Arnoldus-Huyzendveld, 2011: 86-99; Arnoldus-Huyzendveld, Citter, Pizziolo, 2016; Patacchini, Nicatore, 2016).

The first two parameters “...act at a distance...”, in the sense that they help to determine the layout of the pathway by attracting or diverting the route and making it more or less direct and short. The last two factors, on the other hand, act “...directly on the ground”, conditioning the itinerary at every single cell of the cost surface (Patacchini, Nicatore, 2016: 671). Each of these parameters can be properly rasterised and added to the others via the GIS *Raster Calculator* tool, which can also be used to determine the percentage (and therefore the relative weight) of each factor within the final calculation. The

result is represented by a cumulative cost surface, “...whose cells express the degree of advantage or disadvantage to moving in that context”. In other words, the higher the values of the cells, the more expensive the path passing through them (Patacchini, Nicatore, 2016: 671).

Once the ‘potential route’ was obtained, we followed a postdictive approach: instead of asking *whether* a connection existed between two points, the key question was to grasp *why* the potential routes followed those precise paths. By modulating the relative weights of the different parameters considered and comparing the routes reconstructed on a historical/archaeological basis with the GIS-driven paths, we could better understand which factors (anthropic or natural) played a major role in determining the roads’ layout. Such an approach, in fact, allowed us to investigate why a potential path did (or did not) match with the corresponding archaeo-historical route. Moreover, as our intention was not to discover or identify the path of a road but, more simply, to compare the results of a traditional approach with those obtained via a GIS analysis, the various criticisms arising from the challenge of investigating the past (its landscape, cultural aspects and perceptions) by means of a modern tool could be avoided. As has been well highlighted, “...we are not obliged to choose between enthusiastic acceptance and paralysing scepticism. We can use these merely as tools, out of a set of many” (Patacchini, Nicatore, 2016: 671).

As far as the Cappadocian road system is concerned, a set of ASTER GDEM (Global Digital Elevation Models) was used to create the cost surface. The values of the slope raster maps were reclassified and divided into 7 discrete classes in order to adapt the gradients to real movements and to operational cognitive maps of past social actors (indeed, it is well-known that slight changes in slope are not even perceived when walking or, generally speaking, moving along a track). A finer-graded subdivision was made for the 0% to 20% range and a coarser classification was given to the 20%-40% slope values, whereas with a value over 40% the path was considered impracticable; no further distinctions were considered necessary. Additionally, each type of slope was assigned a specific cost, ranging from 1

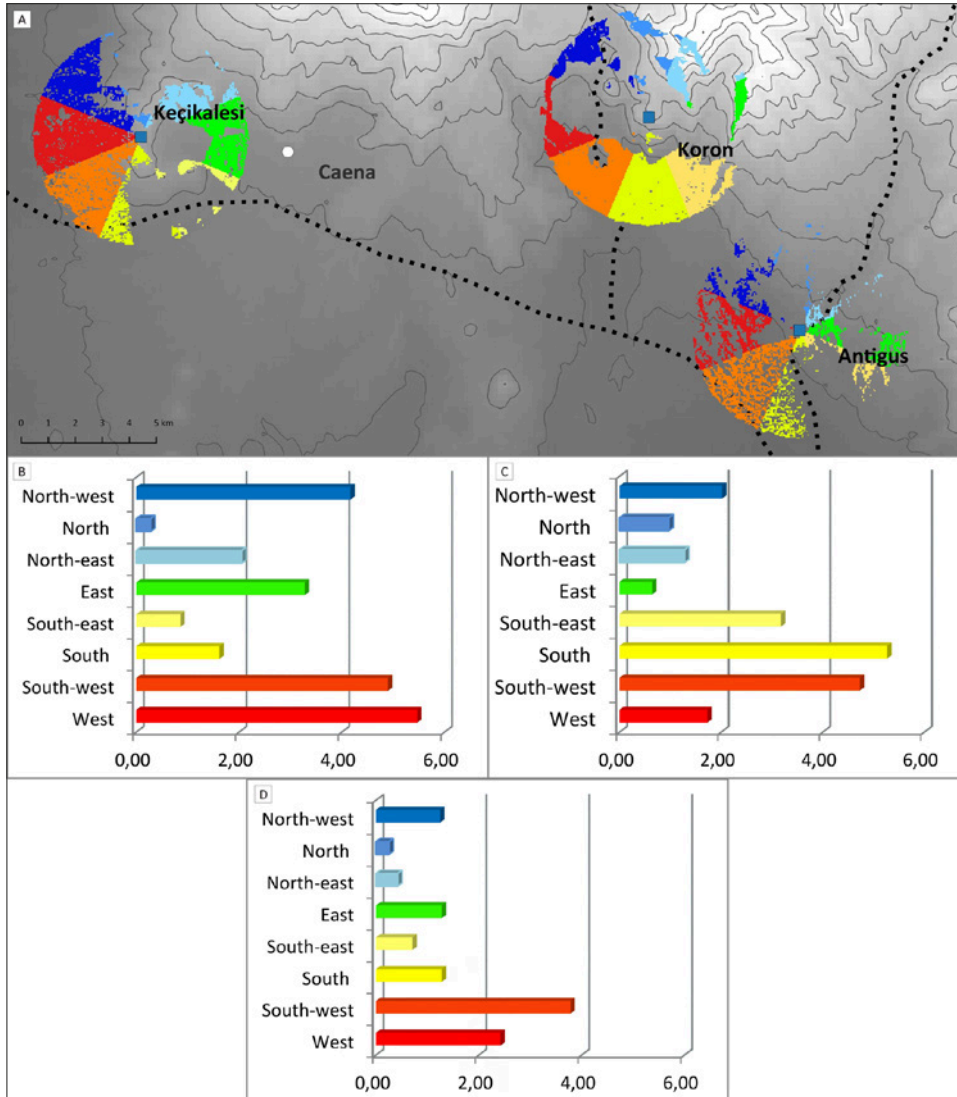


FIGURE 3. A = Directional visibility cones generated from the fortresses of Keçikalesi, Koron and Antigus; B, C and D = Graphs of the visible square kilometres within each cone of visibility, generated, respectively, from the fortress of Keçikalesi, Koron and Antigus (modified from Turchetto, Salemi 2017).

(equivalent to the least costly value) to 100 (the costliest value).

At first, the least cost paths were generated as a connectivity network between the main settlements of central-southern Cappadocia, considering exclusively natural factors (slope, presence of marshy or lacustrine areas and rivers). Afterwards, anthropic elements (for example, settlements which acted as attractors within the landscape) were added as well, in order to verify how these might alter the level

of correspondence between the potential paths and historical routes.

Most of the least cost paths, generated on the basis of natural parameters only, followed more or less the same direction as their respective historical routes. All this confirms, from my point of view, the existence of natural corridors which, maintaining their role as a route over time, became traditional pathways whose relevance was constantly highlighted by long-lasting settlement patterns and choices. This is

the case, for example, of the potential path linking Aksaray and Kayseri, which passes close to Nevşehir and Avanos, running in close proximity to the mid-course of the Kızılırmak river (Fig. 4, black line); or to the least cost path connecting Kayseri to Kemerhisar, which traverses the Yeşilhisar plain, passes by Araplı and continues along the eastern sector of the plain of Niğde (Fig. 5, black line).

In both cases, a more accurate matching between historical and potential routes could depend on other parameters which, in my view, are not exclusively represented by the ancient settlements or stopping places distributed along the roads. Obviously, if we add these to the cost surface (as dots on a map), the GIS-derived results will perfectly match the itineraries proved by archaeo-topographical data; it is simply a matter of connecting points, one after the other. It is necessary, however, to emphasise that settlement location choices may differ greatly from the factors taken into consideration when planning a major important road, especially during the Roman period. In fact, during that period important centres (*civitates* or *municipia*) were often not located on the most important thoroughfares but a certain distance away, being connected to these via a series of link roads.

Returning to the main issue and considering what might have played a specific role in determining the precise road layout, one possible answer could be the attraction exercised by a series of highly selective natural passage points that could funnel human movement and improve interconnectivity between the different sectors of central and southern Cappadocia as well as stretches of the various routes of the Cappadocian road network.

Rather than focusing on a single route, it could therefore be more useful to think about a hierarchically networked system of communication (shifting from a local to a regional perspective), which a given road was part of. In this respect, with reference to the Aksaray-Kayseri road, attributing a certain weight to the settlement of Nevşehir (to be plausibly identified with the fortress of *Hisn Sundus* mentioned by the Arabic sources, located at the northern opening of the natural valley

linking the Derinkuyu basin with the Kızılırmak; Turchetto, 2018b: 208) and one to the *tumulus* of Çeç (marking a pivotal point along the southern bank of the Kızılırmak and the road to *Ancyra*/Ankara; Thierry 2016), the resulting cost path appears to be more in line with the historical route we have proposed (Fig. 4, grey line). Similarly, with regard to the Kayseri-Kemerhisar route, what probably makes the difference and allows for a closer match between the historical and potential paths is the attraction exercised by the Mavrucan Deresi valley, which permitted an effective connection with the Derinkuyu basin and central Cappadocia (Fig. 5, grey line). Not by chance, the valley's eastern 'entrance' was safeguarded and protected by the Byzantine fortress of Zengibar Kalesi (Hild, Restle, 1981: 219-221; Cassia, 2004: 156-157), still visible in the 19th century when it was mentioned as the 'Black Camel Castle' by William Francis Ainsworth on the occasion of a journey he made on horseback across central Cappadocia, between Aksaray and Yeşilhisar (Ainsworth, 1842, I: 210).

5. FUTURE PROSPECTS

With reference to the next steps to be taken by the research we are still carrying out (or planning to carry out) as part of the *Cappadocia Landscape Archaeology Project* (CLAP), most of the activities are related to an attempt to disseminate our results among scholars but also (and especially) among the general public. In this respect, we have been developing some tools which can help users to experience history and archaeology in a more direct, stimulating and involving way, fostering the potential of digital interactive technologies and deepening our knowledge of the Cappadocian historical landscape.

One initial digital product is the *Peutinger mApp*, an Augmented Reality (AR) application for mobile devices which can be used to 'decipher' one of the most fascinating, and not easily understandable, pictorial representations of the ancient world, the *Tabula Peutingeriana* or Peutinger Map. This is the medieval copy of an original map which can be dated back to the 5th century AD, representing all the territories



FIGURE 4. Historical and potential paths between Aksaray and Kayseri. The dotted line is the path reconstructed on an archaeological and topographical basis; the black line is the LCP generated via a cost surface with the cells' values defined by the slope; the grey line is the LCP generated via a cost surface combining natural and anthropic factors (slope 50%; tumulus of Çeç 25%; Nevşehir 25%) (J. Turchetto).

known at that time with evident macroscopic cartographic distortions due to the parchment used to make the map, which is 34 centimetres wide and nearly 7 metres long (Bosio, 1983; Rathmann, 2018).

Our smartphone/tablet application will act as a lens through which it will be possible to visualise the modern place names, making them pop up on top of and in correspondence with the vignettes and their ancient toponyms; and to find out today's geographical features in correspondence with the ones depicted on the map (mountain chains, lakes, rivers, forests, etc.). This textual layer, moreover, will also be implemented via images, photographs and 3D models which, in a certain way, will link the features of the Peutinger Map to those of 'the real world', thereby helping to take the observer on a virtual tour of Cappadocia and its changing landscapes.

Again in terms of engaging the public through the application of smart technologies, a second output from our research will provide a scaled 3D printed model of central and

southern Cappadocia. Instead of using complex (and often expensive) immersive systems, this solid, touchable object will represent the bare surface over which a series of virtual models will be displayed and visualised by means of an AR app for personal mobile devices. Our aim, indeed, is to develop different 'informative layers' which can be selected or adjusted to meet the user's degree of knowledge/curiosity, including: a) a realistic characterisation of the morphological features of the Cappadocian landscape; b) an updated distributive map of the main archaeological sites and findings; c) a dynamic evolution of the road network from the Roman to the Seljuk period; d) the integration of a series of 3D models of significant archaeological and architectural evidence, virtually reconstructed to enable the user to view them within their topographical context (for example, the Roman aqueduct of *Tyana*/Kemerhisar, a selection of Byzantine fortresses in the Melendiz Dağları area, the medieval Seljuk caravanserais of Doğala Han and Dolay Han, whose remains are still visible today on the plain of Derinkuyu).

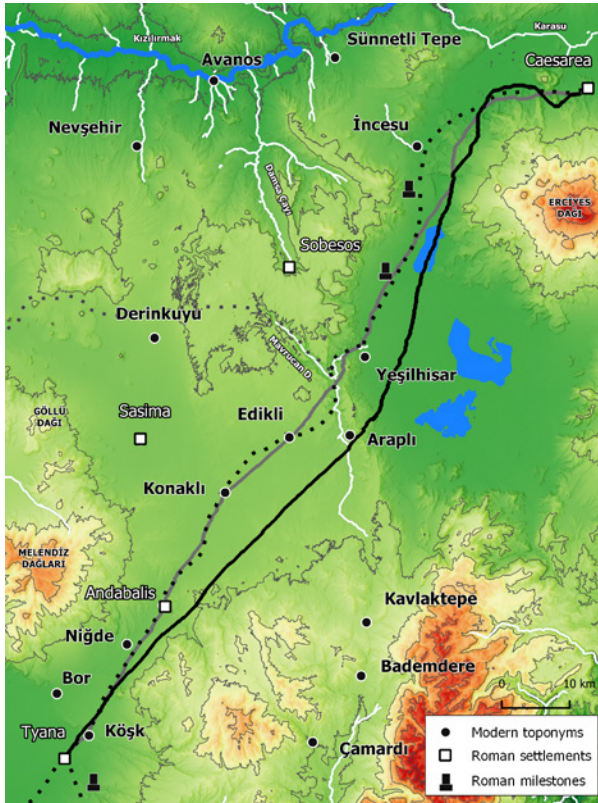


FIGURE 5. Historical and potential paths between Kayseri and Kemerhisar. The dotted line is the path reconstructed on an archaeological and topographical basis; the black line is the LCP generated via a cost surface with the cells' values defined by the slope; the grey line is the LCP generated via a cost surface combining natural parameters and the 'attraction' exercised by the Mavrucan Deresi valley (slope 85%; marsh area 5%; attractor 10%) (J. Turchetto).

Finally, a third aspect, strictly related to and integrated with the ones just mentioned, is represented by the development and implementation of the CLAP webGIS through the open-source software Lizmap. This platform will interactively display the archaeo-topographical data gathered during our research and share these with scholars, Turkish public institutions, tourists and also the general public. To date, it consists of a series of layers containing data on a) the main settlements of the Graeco-Roman period within the territory of the modern provinces of Aksaray, Nevşehir, Kayseri and Niğde (a basic database with toponyms, typology of the archaeological evidence, their chronology,

their visibility/accessibility, a brief description of what can be seen today and a list of general bibliographical references); b) the Roman milestones of Cappadocia; c) the tracks of the routes which, following our reconstructions, made up the road network of Graeco-Roman Cappadocia. A future step will address the integration of data on the archaeological heritage of pre-Roman, Byzantine and Seljuk Cappadocia, the historical cartography of the area (for example, the *Map of Asia Minor to illustrate the Journeys of W. I. Hamilton Esqr. 1836-1837*, by John Arrowsmith, 1844; the *Spezialkarte der Asiatischen Turkey* by Joseph Grassl, 1860 and the *Soviet Military Topographic Maps* of the 1970s) and relevant information on the landscape, roads and communication networks, traditions and aspects of daily life that can be gathered from the travelogues of the English, French and German explorers who travelled across the Anatolian plateau between the 15th and 20th centuries (Turchetto, 2018a: 71-88).

6. FINAL CONSIDERATIONS

The digital cartography applications developed within the framework of our research in Cappadocia will be openly shared, following a technological approach to cultural heritage (and, in general terms, to education) which is widespread nowadays and whose potential can no longer be questioned (Luna, Rivero; Vicent, 2019).

Hopefully, the outputs we have been developing will be useful to researchers and scholars who could also contribute to the further implementation of the datasets, but also useful for Turkish public bodies which will have at their disposal a series of tools for more conscious landscape planning and a better strategy to develop the region in terms of sustainable tourism.

These digital cartography applications will enhance both our knowledge and the appeal of the cultural heritage of less well-known areas of Cappadocia. In this respect, they will help to promote alternative tourism which can move beyond the traditional destinations, nowadays exclusively limited to the overcrowded areas of

the 'Fairy Chimneys' whose volcanic-ignimbrite formations are now being destroyed at a frantic pace due to the mass tourism initiatives offered to millions of people visiting the region in the summer (Mosser, 2020).

BIBLIOGRAPHY

- AINSWORTH, W.F. (1842). *Travels and Researches in Asia Minor, Mesopotamia, Chaldea, and Armenia*. Vol. I-II. London: John W. Parker.
- ARNOLDUS-HUYZENDVELD, A.; CITTER, C.; PIZZILOLO, G. (2016). "Predictivity - Postdictivity: a Theoretical Framework". In: CAMPANA, S.; SCOPIGNO, R.; CARPENTIERO, G.; CIRILLO, M. (eds.). *Keep the revolution going: Proceedings of the 43rd Annual Conference on Computer Applications and Quantitative Methods in Archaeology (Siena, 30 March-3 April 2015)*. Oxford: Archaeopress, 593-598.
- BOSIO, L. (1983). *La Tabula Peutingeriana, una descrizione pittorica del mondo antico*. Rimini: Maggioli Editore.
- CASSIA, M. (2004). *Cappadocia romana. Strutture urbane e strutture agrarie alla periferia dell'Impero*. Catania: Edizioni del Prisma.
- CITTER, C.; ARNOLDUS-HUYZENDVELD, A. (2011). *Uso del suolo e sfruttamento delle risorse nella pianura grossetana nel Medioevo. Verso una storia del parcellario e del paesaggio agrario*. Rome: Artemide.
- EGER, A. (2014). *The Islamic-Byzantine Frontier. Interaction and Exchange Among Muslim and Christian Communities*. London: I.B.Tauris & Co Ltd.
- HALDON, J.F.; KENNEDY, H. (2004). "The Arab-Byzantine Frontier in the Eighth and Ninth Centuries: Military Organisation and Society in the Borderlands". In: BONNER, M. (ed.). *Arab-Byzantine Relations in Early Islamic Times*. London: Routledge, 141-178.
- HERZOG, I. (2014). "A review of case studies in archaeological least cost analysis". *Archeologia e Calcolatori*, 25, 223-239.
- HILD, F.; RESTLE, M. (1981). *Tabula Imperii Byzantini 2. Kappadokien* (Kappadokia, Charsianon, Sebasteia und Lykandos). Vienna: Verlag der Österreichischen Akademie der Wissenschaften.
- KENNEDY, H. (2010). *Gli eserciti dei califfi. Militari e società nello Stato islamico delle origini*. Pordenone: Libreria Editrice Goriziana.
- LLOBERA, M. (2015). "Working the digital: some thoughts from landscape archaeology". In: CHAPMAN, R.; WYLIE, A. (eds.). *Material evidence: learning from archaeological practice*. Abingdon: Routledge, 173-188.
- LUNA, U.; RIVERO, P.; VICENT, N. (2019). "Augmented Reality in Heritage Apps: Current Trends in Europe". *Applied Sciences*, 9, 13, 2756: <https://doi.org/10.3390/app9132756>
- METIVIER, S. (2008). "L'organisation de la frontière arabo-byzantine en Cappadoce (VIIIe-IXe siècle)". In: CUOZZO, E. et alii (eds.). *Puer Apuliae. Mélanges offerts à Jean-Marie Martin*. Vol. 2. Paris: CNRS, 433-454.
- MOSSER, M. (2020). "Patrimonio mondiale dell'umanità e museificazione nell'era del turismo di massa. Riflessioni critiche e proposte". In: BOSCHIERO, P.; LATINI, L. (a cura di). *Güllüdere e Kızılcukur: la Valle delle Rose e la Valle Rossa in Cappadocia*. Treviso: Antiga, 213-225.
- MURRIETA-FLORES, P. (2014). "Developing computational approaches for the study of movement: assessing the role of visibility and landscape markers in terrestrial navigation during Iberian Late Prehistory". In: POLLA, S.; VERHAGEN Ph. (eds.). *Computational approaches to the study of movement in archaeology. Theory, practice and interpretation of factors and effects of long term landscape formation and transformation*. Berlin/Boston: De Gruyter, 99-132.
- PATACCHINI, A.; NICATORE, G. (2016). "Potential Paths and Historical Road Network between Italy and Egypt: from the Predictive to the Postdictive approach". In: CAMPANA, S.; SCOPIGNO, R.; CARPENTIERO, G.; CIRILLO, M. (eds.). *Keep the revolution going: Proceedings of the 43rd Annual Conference on Computer Applications and Quantitative Methods in*

- Archaeology (Siena, 30 March-3 April 2015)*. Oxford: Archaeopress, 669-681.
- RATHMANN, M. (2018). *Tabula Peutingeriana. Die einzige Weltkarte aus der Antike*, Mainz: wbg Philipp von Zabern.
- THIERRY, N. (2016). “Le Tumulus d’Avanos et la ville sainte du grand Zeus Ouranos”. In: HENRY, O.; KELP, U. (eds.). *Tumulus as Sema. Space, Politics, Culture and Religion in the First Millennium BC*. Berlin: De Gruyter, 649-656.
- TITTI, G.; TURCHETTO, J.; SALEMI, G. (2018). “Genetic algorithms based road analysis in Cappadocia, Turkey”. *Rendiconti Online della Società Geologica Italiana*, 46, 67-73: (<https://doi.org/10.3301/ROL.2018.54>)
- TURCHETTO, J. (2018a). *Per Cappadociae partem... iter feci. Graeco-Roman Routes between Taurus and Halys*. Pisa-Rome: Fabrizio Serra Editore.
- TURCHETTO, J. (2018b). “From Loulon to Hisn Sundus. Territorial markers for the reconstruction of the itineraries of Arab incursions in Cappadocia”. *Atlante Tematico di Topografia Antica*, 28, 201-210.
- TURCHETTO, J.; SALEMI, G. (2014). “Distance and slope analysis in southern Cappadocia (Turkey): geomatic approach for archaeological research”. *Agri Centuriati*, 10 (2013), 63-75.
- TURCHETTO, J.; SALEMI, G. (2017). “Hide and seek. Roads, Lookouts and Directional Visibility Cones in Central Anatolia”. In: TAVERNARI, C.; CITTER, C. (eds.). *Uncovering Historical Routes for Sustainable Mobility: Methods, Tools and Case Studies. Open Archaeology*, 3. Berlin: De Gruyter, 69-82.

Reconstructing medieval landscapes: the Austrian research project *Tabula Imperii Byzantini* and its work in Western Anatolia

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ABSTRACT

The research project *Tabula Imperii Byzantini* (TIB) of the Austrian Academy of Sciences in Vienna is dedicated to the historical geography of the Byzantine Empire; i.e. to the space, landscapes and settlements of the Eastern Mediterranean, mainly between the 4th century AD and the middle of the 15th century AD. The project was founded by Professor Herbert Hunger in 1966 and deeply inspired by the work of the well-respected project *Tabula Imperii Romani* (TIR) whose investigation period usually ends in the late 3rd century AD. Thirteen volumes of TIB have been published to date, the first one in 1976 and the last one just recently in April 2020. The majority of the books are dedicated to landscapes in Anatolia, the Aegean Sea and the Balkan Peninsula, to the core areas of the Byzantine Empire, but an additional volume with nearly 2,700 pages focuses on Northern Syria. This paper begins with basic information on the origins of the research project, its history and developments, including methodological improvements. Following this, the article will focus on the work in Anatolia and finally present some new observations concerning the situation in late antique and medieval Western Asia Minor.

KEYWORDS: Historical geography, cartography, Late Antiquity, Byzantium, Anatolia.

1. THE EARLY DAYS OF THE *TABULA IMPERII BYZANTINI* RESEARCH PROJECT

The research project entitled *Tabula Imperii Byzantini*, meaning “Atlas of the Byzantine Empire” has existed for more than fifty years. Professor Herbert Hunger (1914-2000), in later years president of the Austrian Academy of Sciences in Vienna (1973-1982), presented the concept of a research project dedicated to the historical geography of Byzantium at the 13th International Congress of Byzantine Studies in Oxford in September 1966. On this occasion, he emphasised the exemplary function of the congeneric *Tabula Imperii Romani* project that had been founded in 1928 with the intention to create a map of the whole Roman Empire, based

on the International Map of the World (IMW) and at a scale of 1:1,000,000. In his presentation, Professor Hunger also underlined the need for local maps with a more precise scale for areas with a high density of relevant historical places².

Two months later, on 23 November 1966, the Austrian Academy of Sciences established a research institution for Historical Geography of the Eastern Mediterranean, the *Commission of the Tabula Imperii Byzantini*. This was the official birth of the research project which is now in its 55th year. Professor Hunger was appointed head of the Commission and among its members were such admirable scholars as the classical philologist Albin Lesky (1896-1981), the archaeologist Hermann Vetters (1915-1993), the art historian Otto Demus (1902-1990), the geographer Hans Bobek (1903-1990) and the

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2. Hunger 1967, 481. Külzer 2019a, 85-86. Külzer 2020, 14.

cartographer Erik Arnberger (1917-1987)³. In December 1966, Professor Hunger gave a precise description of the general approach and scientific aims of the project. The general map should be at a scale of 1:1,000,000 and the local maps at a scale of 1:200,000. The atlas should mention not only cities and larger settlements but also villages and estates, rivers, lakes and mountain ranges with historical importance, documented by either literary sources or archaeological remains between the late 3rd/early 4th century AD and the middle of the 15th century AD. A special volume providing a detailed catalogue of lemmata, a gazetteer of all the mentioned toponyms, should accompany each map. Each lemma must follow an accurately defined structure, starting with a precise description of the location of the historical site and a list of all its historical name variants, documented not only in Greek and Latin sources but also, if available, in Slavonic, oriental or western vernacular languages. In this process, priority is always given to the Greek variant; the Greek term is the relevant one for positioning the site within the catalogue. For the sake of completeness, places whose historical name remains unknown but which have archaeological remains that reveal their former importance, should be included in the gazetteer as well, classified under their current name.

Afterwards, each lemma should note, in a separate chapter, important historical events connected with the individual sites, including historical events related to religion, culture and society, paying particular attention to the oldest and most recent evidence in the period under observation. Another chapter should list the relevant monuments connected with the individual sites, such as fortifications, fortresses, major houses, palaces, churches and monasteries, as well as bridges and preserved road sections; at the end, there should be a catalogue of the notable academic literature⁴.

However, the single volumes are more than just compilations of data. They also have an analytical function, focusing particularly on

historical events and church history, trade and economics, based on the information given by the sources. The main roads and, in coastal areas, also the trans-regional network of sea routes have to be presented. Each volume is completed with information concerning the geography and climate, vegetation and natural resources. In this way, regional and historical narratives emerge that have relevance not only for scholars dealing with the eastern Mediterranean in late Antiquity and the Byzantine period but also for a wider community of academics focusing on historical geography, landscape archaeology and cultural history in general⁵. It was clear from the start that such a project could not be carried out by bookish academics working exclusively from their desks in Vienna; regular field trips into the individual areas of operation were (and are) an absolute necessity.

Obviously, these areas of operation needed a more precise definition. The decision was to delimit the individual geographical regions and working areas for the *Tabula Imperii Byzantini* project based on the division of the Late Roman provinces, as recorded by the geographer Hierocles in the 6th century AD. His compendium *Synekdēmos*, which translates as “Travelling companion” and is essentially based on older documents dating back to the early 5th century AD, mentions 923 settlements in 64 provinces⁶. This accurate administrative division has no equivalent in later centuries of the Byzantine period. An initial proposal to use the system of *Themata* that had developed from the 7th century AD onwards was soon discarded, since their boundaries cannot always be determined nowadays; furthermore, some settlements such as Smyrna (İzmir) and Adramyttium (Edremit) in Western Anatolia, to mention just a few, belonged simultaneously to different *Themata*⁷. The requirements for absolute accuracy that are essential in creating a scientific atlas were not met by this system of

3. Hunger 1966, 51-52. Külzer 2019a, 88-89. Külzer 2020, 15.

4. Hunger 1966, 52-53. Hunger 1979, 115. Hunger 1991, 275. Külzer 2019a, 88-89.

5. Hunger 1979, 111-112. Hunger 1991, 275. Külzer 2020, 17.

6. Honigmann 1939. See also <http://awmc.unc.edu/awmc/applications/bam/modules/hierokles> (11.02.2021). Jones 1971, 514-521.

7. Külzer 2019a, 91, 118 Fig. 1. Concerning the *Themata*, see Haldon 2005, 68-73, 105, 128, 130. Koder 2017, 14-16.

classification. It was therefore indispensable to take Hierocles and the arrangement he had recorded as the basis for research. Responsible for this classification was Johannes Koder, in those days assistant Professor of Professor Hunger, and in later years his successor in the function as chair of the Commission.

The research work started with an analysis of selected Byzantine written sources, mainly the writings of medieval historians and geographers. Already in the autumn of 1965, one year before the initiation of the project, students of Byzantine Studies and related disciplines had begun to look through these writings in search of valuable topographical information. By July 1968, they had annotated more than 12,000 index cards and, by 1970, the number of cards exceeded 45,000⁸. Most of these cards still exist, preserved in the archive rooms of the project after careful evaluation of the information provided.

2. METHODOLOGICAL DEVELOPMENTS

A research project can only exist for several decades if it constantly reviews its methods and, if necessary, extends and improves them. In the beginning, the research consisted of evaluating four types of sources: Firstly, the *literary sources* composed in late antiquity and the Middle Ages. Besides historical and geographical writings, hagiographical texts, documents, sea charts and itineraries are also included, as well as inscriptions and seals. Most of the material is written in Greek but in some cases it is in Latin, Slavonic, Oriental or western vernacular languages. Secondly, the *archaeological material*. This comprised not only the larger structures of a site, preserved either physically or documented in the literature, but also its ceramics and small finds, which are often important to determine its age in general. Thirdly, the *onomastic sources*, the toponyms which transfer memories of a former function or building. A place called “Manastır” for example, indicates the former presence of a monastery⁹. Fourthly, the *physical*

or *geographical realities* of individual sites, including their climatic conditions, water resources, ground conditions and geological structures¹⁰. The geographical reality of a site changes constantly. There is a continuous transformation of space due to political, social or geomorphological factors such as changes in settlement, sedimentation and sea level fluctuation, changing river courses, soil salinisation, drawdowns and much more. Researchers must reconstruct the *former* landscape and its special conditions and never use the current territory for academic theories. In our case, this approach has led to a vital methodological enhancement; since at least the 1980s, the *Tabula Imperii Byzantini* has taken into account scientific results from dendrochronology and pollen analysis, from paleo-climatology and geomorphology, to mention just a few disciplines, insights from environmental history in general which have enriched the former practice that was exclusively focused on Humanities¹¹.

This methodological innovation helps to bring us closer to the historical reality and the volumes accompanying the maps benefitted immensely from this diversification. The same applies to the settlement theories that have been included into the project since the mid-1980s¹². The statements of literary sources in particular provide a kind of historical snapshot, with particular interest in the lives of the upper classes, especially those living in the capital Constantinople. In most cases, the late antique and medieval authors were not interested in the countryside or the local matters of daily life and commonplace events. To get such information, researchers can resort to the concrete data from archaeological excavations, already analysed since the beginning of the project, as well as the theoretical details gained from two research theories: *Location Theory* and *Central Place Theory*. Using a combination of both, historians can reconstruct more details concerning villages and marketplaces, the cultivation of agricultural goods, land use, the distribution of fields and

10. Koder 2010, 15-21. Külzer 2010, 174-180.

8. Bulletin 1968, 42. Bulletin 1971, 18. Hunger 1972/1973, 82-83.

9. This toponym has been attested several times in north-western Anatolia, see TIB 13, 1178.

11. For example, see Koder 2010, 15-17. Külzer 2018a, 75-81. Telelis 2000, 223-243. Telelis 2005, 41-50.

12. Koder 1986, 155-187. Koder 1996, 84. Koder 2006, 159-183.

arable land and the pastures and wooded areas around individual sites, as well as local trade and commodities. However, these results are only relevant to complete the picture; the information provided by the four types of sources mentioned above takes priority as it is more reliable.

Furthermore, the time frame for the period under discussion has developed and been extended, in both directions. According to the concept of Professor Hunger, the individual maps of the *Tabula Imperii Byzantini* should depict the situation between the late 3rd/early 4th century AD and the mid-15th century AD. However, in line with the idea of settlement continuity, the Roman period became more relevant for the project. Several places and villages mentioned in literary sources from the 1st or 2nd century AD, for example in the writings of Strabo of Amaseia (ca 63 BC-23 AD) or Plinius Secundus (23-79 AD), were probably inhabited until the 4th century and the beginning of the early Byzantine period. Therefore, it was decided to incorporate these places into the maps and describe them in the volumes as well. This development was especially important for scholars dealing with Antiquity and the maps of the research project became even more relevant to them.

The upper time limit was also redefined and significantly extended up to the 19th century, Christian and Jewish sacred buildings from the post-Byzantine period marked, with only few exceptions, the location of an older equivalent. Only in the reign of Sultan Abdül-Mecid I (1839-1861) did the religious minorities of the Ottoman Empire get permission to build churches or synagogues on sites where none had existed before, such as the Haṭṭ-i Şerif of Gülhane, dated 3 November 1839 and, in a later addition, the Haṭṭ-i Hümayûn, dated 18 February 1856. Therefore, sacred buildings erected before the mid-19th century should be included in the volumes in order to represent the historical reality of the Byzantine Empire more accurately¹³.

From 1984 onwards, the volumes of *Tabula Imperii Byzantini* were enriched with photographs in order to document special landscapes and monuments in the individual working areas and to record their status. This measure was of particular

importance due to the immense decline experienced by medieval monuments in scientific terms since the late 1970s/early 1980s. Earthquakes and other natural disasters have always caused destruction in the eastern Mediterranean and there has been a continuous loss of buildings and architectural masterpieces over the centuries. However, the increased industrial development of the landscapes that started in the 1970s increased this destruction even further. Construction work for roads and dams, urban sprawl and the shifting of villages, but also illegitimate excavations by treasure hunters, have been responsible for these alterations and demolitions, whose real extent was unknown. These facts show the importance of documentation and the project's photographic archive has grown with each field trip. To date, the archive contains more than 52,000 slides, about 25,000 monochrome pictures, and more than 15,000 digital photos. Only a small sample of this material can be published but, as a whole, it constitutes a valuable historical inventory prepared for the scientific community and ready for further research¹⁴.

According to the original concept, the individual maps of *Tabula Imperii Byzantini* should be presented at a scale of 1:1,000,000. Already in the autumn of 1970, however, it was decided, mainly at the suggestion of Viennese geographers and cartographers, to change the scale to 1:800,000 to facilitate lemmata and inscriptions. The project dismissed the idea of borrowing from the International Map of the World and, with this new scale, established a criterion of its own. To improve the accuracy of the maps, the *Global Positioning System* (GPS) has been used more and more since the beginning of the 21st century. This has opened the door to the new and manifold possibilities offered by digital cartography and we will talk about this later. Furthermore, the use of Digital Humanities, especially in the form of *Historical Geographical Information Systems* (HGIS), improve the accuracy of the individual maps and enrich the data material presented¹⁵.

14. Polloczek 2020, 183-196. See also the comparison of the situation now and then in Külzer, Polloczek, Popović 2020, 219-238.

15. Kelnhofer 1976, 5. Popović 2020, 157-181. Doukas, Demoula 2015, 791-812.

13. Koder 1996, 80-81. Külzer 2020, 23-24.

3. *TABULA IMPERII BYZANTINI* AND THE MAPPING OF ANATOLIA

The academic tradition of mapping Anatolia and its historical situation was already active in the 19th and early 20th centuries. Among others, one can refer to Heinrich Kiepert (1818-1899) and Alfred Philippson (1864-1953), both of whom created several maps which are still useful today¹⁶. However, in some cases recent research has enriched the historical and geographical knowledge depicted in these works and numerous landscapes and areas appear, today, in a completely different way. This explains the need for new maps of Asia Minor that reflect our current scientific knowledge. Unfortunately, there is no single map of Anatolia within the project of *Tabula Imperii Romani* at present. Therefore, the research work of *Tabula Imperii Byzantini* into these extensive landscapes is significant for scholars interested in the ancient period and also in Late Antiquity (Fig. 1).

The first field trip to Anatolia was carried out in 1969 and a second in 1971. The first volume of *Tabula Imperii Byzantini* appeared in 1976 and was dedicated to Hellas and Thessalia, central regions of modern Greece¹⁷. One year later, in 1977, the first volume dealing with Anatolian matters appeared. It was dedicated to the road system in Cappadocia and part of a subseries, entitled *Veröffentlichungen der Kommission für die Tabula Imperii Byzantini* (VTIB), whose aim was to provide the opportunity to discuss certain issues in more detail. The analytical approach of the regional communication networks developed here became exemplary for later publications¹⁸. Another VTIB volume published in 1979 discussed the early Byzantine architecture in Cappadocia¹⁹. Two years later, in 1981, the second volume of *Tabula Imperii Byzantini* appeared, this being the first one to deal with the countryside of Anatolia. The book describes Cappadocia and neighbouring landscapes²⁰. Together with a volume of 338 pages, four maps were presented to the public: a topographical map and a thematic

map of the region, both at a scale of 1:800,000 and two local maps showing micro-landscapes of special interest, both at a scale of 1:5,000.

The lemmata on the thematic map represent settlements, fortresses and sacred buildings and distinguish between fortified settlements, unfortified ones and unfortified ones with a fortified acropolis; between smaller and bigger fortresses and legionary camps; between monasteries, single churches in a landscape, chapels and so-called *hagiasmata*, places with a holy spring or fountain. The operational phases of the individual sites are expressed by different colours, distinguishing between a use in the 4th-7th century, the 7th-10th century, the 10th-13th century and the 13th-15th century. Other colours can represent continuous use from the 4th-15th century or vacancy that lasted for some time (Fig. 2). Different colours indicate whether a notation or place name is an old or modern one. A decreasing value for the lemmata (from settlements to fortresses, from monasteries to single buildings) ensures clarity and prevents too many entries at the same site; the complete stock of buildings beyond the lemma in question is explained in the individual lemmata of the volume²¹.

This lemma concept was applied without major changes during the following decades. In 1984, the next volume on Anatolia appeared, dedicated to Galatia and Lycaonia; i.e. the landscapes around the Turkish capital Ankara and its wider hinterland. This includes two maps at a scale of 1:800,000: a thematic one and a topographical one, and altogether 69 figures, five in the text and 64 at the end of the volume. Two years later, a new book in the VTIB series introduced Cilicia²² and, in 1990, the complete volume on that important region of Asia Minor appeared²³. Besides the two usual maps at a scale of 1:800,000, this includes a local map of the area of Seleucia at a more detailed scale of 1:200,000, as well as 402 figures documenting numerous details of the region. In the same year, a volume with two maps at a scale of 1:800,000 also appeared, focusing on the historical provinces of

16. Among others, Kiepert 1890-1892. Philippson 1910. Philippson 1912.

17. TIB 1.

18. Hild 1977.

19. Restle 1979.

20. TIB 2.

21. TIB 2, 12-14.

22. Hellenkemper-Hild 1986.

23. TIB 5.

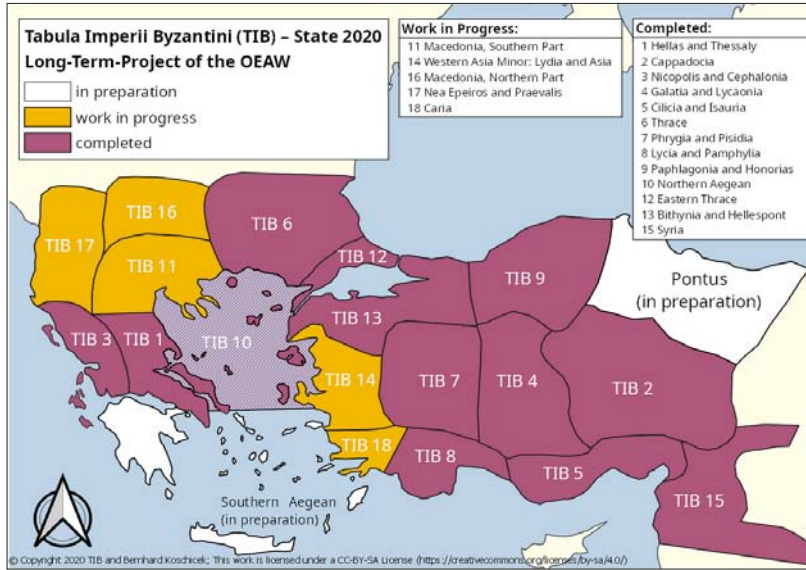


FIGURE 1. *Tabula Imperii Byzantini*, State of Research 2020.

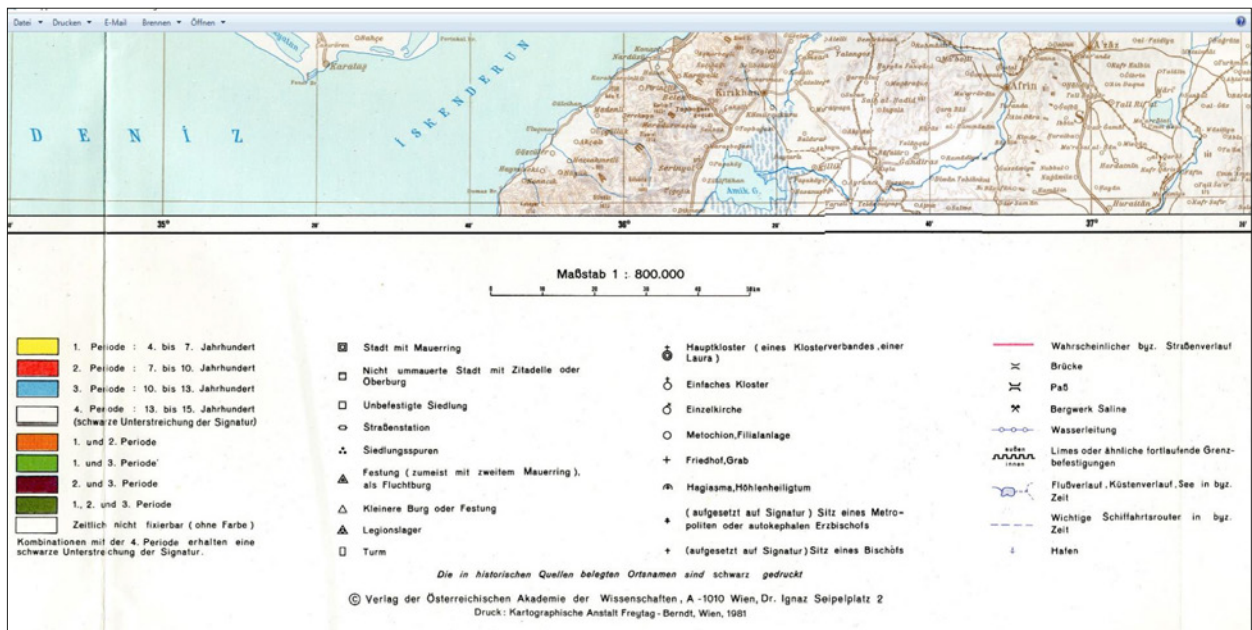


FIGURE 2. *Tabula Imperii Byzantini* “Cappadocia”, map legend.

Phrygia and Pisidia. This contains 462 pages and 161 figures were attached²⁴. Among other sites, the volume describes the history and archaeological remains of important settlements such as Dorylaion (Eskişehir), Hierapolis (Pamukkale) and Laodikeia (Denizli).

The next volume of *Tabula Imperii Byzantini* appeared in 1996, dedicated to the former

24. TIB 7.

provinces of Paphlagonia and Honōrias, creating a narrative from the late antique and medieval Black Sea region to the northern borders of Galatia. In combination with the older volumes, at this point all the parts of central Anatolia between the Mediterranean Sea and Black Sea had been mapped at a scale of 1:800,000²⁵.

25. TIB 9. Concerning Eastern Anatolia, the landscapes that belonged to the former province of Pontos have yet to be adapted within the context of the project.

Since that date however, the tradition of two maps at a scale of 1:800,000 has been abandoned. From this point on, only the thematic map survived while the topographic map disappeared, mainly due to financial reasons²⁶. However, this fact was less serious because the Viennese publishing house Freytag & Berndt published a Map of Turkey in 1992, developed in close cooperation with the staff of *Tabula Imperii Byzantini*. This map has been reprinted several times up to the present day and forms the topographical basis of all the maps of western and central Anatolia²⁷.

In the year 2000, a new volume of the VTIB series exemplified the constant engagement of the project *Tabula Imperii Byzantini* with methodological considerations and improvements; its basis were selected papers presented at a conference held in Vienna in December 1997²⁸. The volume on Pamphylia and Lycia that appeared in 2004 is comprehensive, with more than 1,200 pages and 452 figures. Together with the thematic map at a scale of 1:800,000 which also offers various addenda to the southern parts of Phrygia, it contains three local maps. Two of these, using a scale of 1:400,000, focus on central Lycia and north-west Lycia, while one map at a scale of 1:200,000 shows the wider coastal area of west Lycia²⁹. The latest volume of *Tabula Imperii Byzantini* appeared recently, in 2020, after long, intensive research work that started back in 1996 and has resulted in over 1,200 pages and 325 figures³⁰. This contains a thematic map at the usual scale of 1:800,000, two local maps at a scale of 1:400,000 depicting the east coast of the Propontis and the Troad, and one map at a scale of 1:100,000 focusing on the Bosphorus. Due to fact that this volume has taken so long to produce, the Global Positioning System and other digital cartography tools that have become important for the project as recently as the early 21st century were used only occasionally. The locations and placing of significant items between the north-east Aegean and the south-western parts of the Black Sea are mainly

presented in a traditional format, without using the great potential of modern techniques. The project started to engage seriously with digital cartography in 2003 when the staff of the *Tabula Imperii Byzantini* visited a workshop at the University of Birmingham dedicated to the subject³¹. Two years later, the archaeologists Vince and Helen Gaffney gave an inspiring lecture concerning the possibilities of modelling routes and communications in former landscapes, at a second methodological workshop organised by the research project in Vienna³². This marked the beginning of digital cartography and the use of digital humanities by the project.

Nevertheless, due to the efforts of *Tabula Imperii Byzantini* a huge part of Anatolia has been mapped in the last few decades, proceeding from the eastern landscapes to the west. This great scientific achievement represents a valuable addition to the stock of maps from its sister project, the *Tabula Imperii Romani*.

4. CURRENT RESEARCH INTO WESTERN ANATOLIA

The research work into Western Anatolia started early in 2009. This project focuses on the late antique provinces of Asia and Lydia, a region of about 35,000 square kilometres³³. Within this huge area, Ephesus (Selçuk), Smyrna (Izmir), Pergamum (Bergama) and Assos (Behramkale) are among the historically significant places in Asia, and Sardis (Sart), Thyatira (Akhisar) and Philadelphia (Alaşehir) among those in Lydia. Extensive evaluation of historical writings, of academic literature, archaeological and geographical material and also six field trips between 2013 and 2018 provided numerous significant insights. These concern the location of historical sites mentioned in late antique and Byzantine sources, the discovery of settlement sites, medieval fortresses, harbour facilities, road sections and more. In north-east Lydia, it was possible to reconstruct several former communication routes running

26. TIB 9, 7-8.

27. Türkei 1992.

28. Belke, Hild, Koder, Soustal 2000.

29. TIB 8.

30. TIB 13.

31. A publication of the papers appeared three years later; cf. Haldon 2006.

32. Gaffney, Gaffney 2010, 79-91. For the conference in general, see Kislinger, Koder, Külzer 2010.

33. TIB 14.

through the Göl dağ and Simav dağları (Fig. 3). In central Lydia, various historical settlements were discovered in the region between Settae (Sidas kale) and Satala (Adala or Karataş), further to the west. In the former province of Asia, good evidence was unearthed for a dense settlement system within the Erythrai Peninsula (Çeşme Yarımadası) during the Byzantine period, refuting the previously prevailing idea of a sparsely inhabited landscape. And these are just some of the results produced³⁴. The gazetteer of Western Asia Minor already has more than 700 entries and it is still growing.

Important in our context is the fact that the Global Positioning System has been used since the early days of the sub-project; this volume is the first to be dedicated to Anatolian landscapes with continuous accurate localisations; there are no ambiguities anymore, for instance regarding the information on distance from selected fixed points. This ensures that visitors can find the sites under discussion with minimum effort.

The geographical database GeoNames can easily enrich the material obtained in the field. After transferring the data to Excel files, these can be viewed in geoinformatic systems such as QGIS (Fig. 4). We used Google Earth to visualise our data and Web 3.0 technologies. First we use Google Maps, import data from an XLS file and then export to a KMZ file. This allows us to create dynamic, expandable maps which, unlike printed maps, have no editorial deadline. In addition, dynamic information is received via updates in an interactive, visual format. The Google Maps platform was chosen for its efficiency and ease of use, as it enables users to import data from a file via its web interface rather than entering them manually. It was therefore easy to produce a KMZ file (KMZ is the zipped version of a KML file) which was inserted into Google Earth, creating a 3D map. The KMZ file was uploaded to Google Drive (by creating a new “Project”), allowing anyone with the link to edit the map in real time, making any changes visible to the owners. One of the most significant benefits of this process is the

34. Among others, see Külzer 2016, 288-290. Külzer 2018, 741-748. Külzer 2019b, 150-157.

ability to access the maps from anywhere (for instance, from a smartphone)³⁵. These systems also make it easier to measure distances and recreate former communication routes. The next step will be to create a databank in the Open Atlas system, which will enable us to present the material in greater detail. The first area to be processed will be the region of Smyrna and its wider hinterland, including the river mouth of the ancient Hermus, modern Gediz çayı, a landscape for which a lot of information and data exist.

The Historical Geographical Information Systems (HGIS) was extremely useful for the Smyrna area as well. An analytical investigation of several 19th-century maps provided significant clues as to the location of villages and estates whose traces are hard to find today because of densely built-up urban areas. Of particular note are the maps made by L. S. Dawson 1888 and W. J. L. Wharton 1893, both based on surveys undertaken by Captain R. Copeland in the 1830s³⁶, and the famous map of the Lembos monastery by A. M. Fontrier, published in 1892³⁷.

The cartographic work of the *Tabula Imperii Byzantini* project in Anatolia has therefore been carried out on two levels. On the one hand, traditional cartography at a scale of 1:800,000, the generic criterion of the series, will continue. There will be a map of Western Anatolia using this scale, based on the topographical map mentioned above. The template exists and is pending the entry of data. On the other hand, however, there will also be a digital map of the whole region. This map will be integrated within the website of *Tabula Imperii Byzantini*³⁸. As already mentioned, this has the great advantage of being able to update the map at any time and editorial deadlines that used to result in a *status quo* of each printed work will lose importance. The latest research results can be offered to the scientific community directly, avoiding the often-feared “obsolescence” of maps.

35. In this context, I would like to thank Mag. Georgia Theochari, Aristotle University of Thessaloniki, for her support.

36. Dawson 1888. Wharton 1893.

37. Fontrier 1892, Carte du Monastère de Lembos et de ses dépendances auprès de Smyrne au XIII siècle.

38. <https://tib.oeaw.ac.at/index.php> (22.02.2021).



FIGURE 3. The network of communication roads in the hinterland of Ephesus (Külzer 2019b, 150). Purple: traditional data // red: new data, results of the project work.

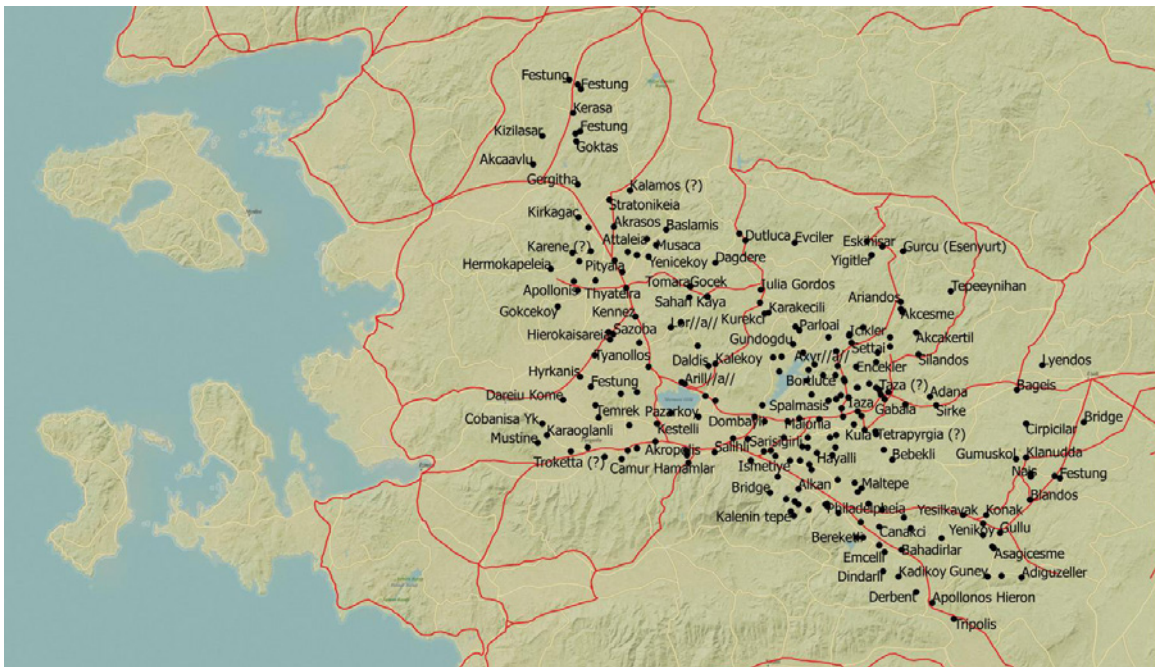


FIGURE 4. Lydia, QGIS 2.18 © Andreas Külzer, 2020.

BIBLIOGRAPHY

- BELKE, K.; HILD, F.; KODER, J.; SOUSTAL, P. (Hgg.) (2000). *Byzanz als Raum: Zu Methoden und Inhalten der historischen Geographie des östlichen Mittelmeerraumes*. ÖAW, phil.-hist. Kl., *Denkschriften* 283. Vienna.
- BULLETIN (1968). N. N. "L'activité scientifique des Comités Nationaux. Autriche. Association Internationale des Études Byzantines". *Bulletin d'information et de coordination* 4, 40-43.
- BULLETIN (1971). N. N. "Activité scientifique des Comités Nationaux. Autriche. Association Internationale des Études byzantines". *Bulletin d'information et de coordination* 5, 16-19.
- DAWSON (1888). *Smyrna Harbour*, by Captain R. Copeland R. N. 1834. Corrections and additions by Captain T. Spratt C. B. R. N. 1859-60, and by Commander L. S. Dawson, R. N. 1887. London.
- DOUKAS, I. D.; DEMOULA, S (2015). "Historical GIS (HGIS): An amply mature high-tech tool, to the decisive and effective help in the historical research". In: ARVANITIS, A., BASBAS, S. (eds.). *Cartographies of Mind, Soul and Knowledge*. Thessaloniki, 791-812.
- FONTRIER, A. M. (1892). "Le Monastère de Lembos près de Smyrne et ses possessions au XIII^e siècle". *Bulletin de Correspondence Hellénique* 16, 379-410 u. pl. XVIII.
- GAFFNEY, V.; GAFFNEY, H. (2010). "Modelling routes and Communications". In: KISLINGER, KODER, KÜLZER (2010), 79-91.
- HALDON, J. (2005). *The Palgrave Atlas of Byzantine History*. Basingstoke, Hampshire.
- HALDON, J. (2006). *General Issues in the Study of Medieval Logistics: Sources, Problems and Methodologies*. *History of Warfare* 36. Leiden-Boston.
- HELLENKEMPER, H.; HILD, F. (1986). *Neue Forschungen in Kilikien*. (VTIB 4). ÖAW, phil.-hist. Kl., *Denkschriften* 186. Vienna.
- HILD, F. (1977). *Das byzantinische Straßennetz in Kappadokien* (VTIB 2). ÖAW, phil.-hist. Kl., *Denkschriften* 131. Vienna.
- HONIGMANN, E. (1939). *Le Synekdemós d'Hiérokès*. Brussels.
- HUNGER, H. (1966). "Communications d'Intérêt Scientifique. Principes pour l'élaboration de la *Tabula Imperii Byzantini* (T.I.B.)". Association Internationale des Études Byzantines. *Bulletin d'information et de coordination* 3, 51-53.
- HUNGER, H. (1967). "Das Institut für Byzantinistik der Universität Wien". In: HUSSEY, J. M.; OBOLENSKY, D.; RUNCIMAN, S. (eds.). *Proceedings of the XIIIth International Congress of Byzantine Studies*. Oxford 5-10. September 1966. London-New York-Toronto, 479-481.
- HUNGER, H. (1979). "Neue Forschungsprojekte". In: Association Internationale des Études Byzantines, *Actes du XV^e Congrès International d'Études Byzantines*. I *Chronique du Congrès*. Athens, 111-115.
- HUNGER, H. (1991). Bericht über die *Tabula Imperii Byzantini*. Entstehung – Aufbau – Fortschritte, *XVIIIth International Congress of Byzantine Studies*. *Major Papers*. Moscow, 275-279.
- JONES, A. H. M. (1971). *The Cities of the Eastern Roman Provinces*, 2nd rev. ed. Oxford.
- KELNHOFER, F. (1976). *Die topographische Bezugsgrundlage der Tabula Imperii Byzantini*. Mit 12 Tabellen und 16 Abbildungen im Text. ÖAW, phil.-hist. Kl., *Denkschriften*, Beiheft zum 125. Band. Vienna.
- KIEPERT, H. (1890-1892). *Specialkarte vom westlichen Kleinasien, nach seinen eigenen Reisen und nach anderen größtenteils noch unveröffentlichten Routenaufnahmen*. Maßstab 1:250.000. Eine Karte in 15 Blättern. Berlin
- KISLINGER E.; KODER, J.; KÜLZER, A. (2010) (eds.). *Handelsgüter und Verkehrswege. Aspekte der Warenversorgung im östlichen Mittelmeerraum (4. bis 15. Jahrhundert)*. ÖAW, phil.-hist. Kl., *Denkschriften* 388. Vienna.
- KODER, J. (1986). "The Urban Character of the Early Byzantine Empire: Some Reflections on a Settlement Geographical Approach to the Topic". In: *The 17th International Byzantine Congress*. *Major Papers*. New Rochelle, N.Y., 155-187.

- KODER, J. (1996). "Perspektiven der *Tabula Imperii Byzantini*. Zu Planung, Inhalt und Methode". *Geographia Antiqua* 5, 75-86.
- KODER, J. (2006). "Land-use and settlement: theoretical approaches". In: HALDON, J. F. (ed.). *General Issues in the Study of Medieval Logistics: Sources, Problems and Methodologies. History of Warfare* 36. Leiden-Boston, 159-183.
- KODER, J. (2010). "Handelsgüter und Verkehrswege: Problemstellung, Quellenlage, Methoden". In: KISLINGER, KODER, KÜLZER (2010), 13-24.
- KODER, J. (2017). "Historical Geography". In: NIEWÖHNER, Ph. (ed.). *The Archaeology of Byzantine Anatolia. From the End of late Antiquity until the Coming of the Turks*. Oxford, 9-27.
- KÜLZER, A. (2010). "Möglichkeiten zur Rekonstruktion historischer Landschaften: Die Historische Geographie". In: GASTGEBER, Ch.; GLASSNER, Ch.; HOLZNER-TOBISCH, K.; SPREITZER, R. (eds.). *Fragmente. Der Umgang mit lückenhafter Quellenüberlieferung in der Mittelalterforschung*. ÖAW, phil.-hist. Kl., *Denkschriften* 415. Vienna, 173-184.
- KÜLZER, A. (2016). "Byzantine Lydia: Some Remarks on Communication Routes and Settlement Places". In: MAGDALINO, P.; NECIPOĞLU, N. (eds.). *Trade in Byzantium: Papers from the Third International Sevgi Gönül Byzantine Studies Symposium*. İstanbul, 279-295.
- KÜLZER, A. (2018a). "Reconstructing the Past in a changing Landscape: Reflections on the Area of Ephesus and other Sites in Western Asia Minor", *Gephyra* 16, 75-90.
- KÜLZER, A. (2018b). "Dornröschen erwacht... Neue Forschungen auf der Halbinsel Erythraia (Çeşme Yarımadası) im westlichen Kleinasien". In: DRAUSCHKE, J.; KISLINGER, E.; KÜHTREIBER, K.; KÜHTREIBER, Th.; SCHARRER-LIŠKA, G.; VIDA, T. (eds.). *Lebenswelten zwischen Archäologie und Geschichte. Festschrift für Falko Daim zu seinem 65. Geburtstag*. II. Mainz, 741-748.
- KÜLZER, A. (2019a). "Herbert Hunger und die Historische Geographie: Geschichte, Gegenwart und Zukunft der *Tabula Imperii Byzantini*". In: KÜLZER, A. (ed.). *Herbert Hunger und die Wiener Schule der Byzantinistik: Rückblick und Ausblick. Studies in Historical Geography and Cultural Heritage* 2. Vienna-Novi Sad, 85-121.
- KÜLZER, A. (2019b). "Roads and Routes: Communication Networks in the hinterland of Ephesos". In: LADSTÄTTER, S.; MAGDALINO, P. (eds.). *Ephesus from Late Antiquity until the late middle Ages. Proceedings of the International Conference at the Research Center for Anatolian Civilizations, Koç University, Istanbul 30th November - 2nd December 2012*. Vienna, 149-160.
- KÜLZER, A. (2020). "Ein historischer Atlas zum byzantinischen Reich: Anfänge und Entwicklung der *Tabula Imperii Byzantini* (TIB)". In: KÜLZER, POLLOCZEK, POPOVIĆ, 2020, 11-30.
- KÜLZER, A.; POLLOCZEK, V.; POPOVIĆ, M. (eds.) (2020). *Raum und Geschichte. Der historische Atlas Tabula Imperii Byzantini (TIB) an der Österreichischen Akademie der Wissenschaften. Studies in Historical Geography and Cultural Heritage* 3. Vienna-Novi Sad.
- PHILIPPSON, A. (1910). *Topographische Karte des westlichen Kleinasiens*. Maßstab 1:300.000. Blatt I und III (Gotha 1910).
- PHILIPPSON, A. (1912). *Topographische Karte des westlichen Kleinasiens*. Maßstab 1:300.000. Blatt II und IV (Gotha 1912).
- POLLOCZEK, V. (2020). "Vom Bildarchiv zur Diathek der TIB". In: KÜLZER, POLLOCZEK, POPOVIĆ, 2020, 183-196.
- POPOVIĆ, M. St. (2020). "Das Langzeitprojekt TIB im 21. Jahrhundert: Bestandaufnahme, Adaptierung und Methodenerweiterung in der Historischen Geographie des byzantinischen Raumes". In: KÜLZER, POLLOCZEK, POPOVIĆ, 2020, 157-181.
- RESTLE, M. (1979). *Studien zur frühbyzantinischen Architektur Kappadokiens. Mit 219 Abbildungen auf Tafeln und 63 Plänen (VTIB 3)*. ÖAW, phil.-hist. Kl., *Denkschriften* 138 Vienna.
- TELELIS, I. G. (2000). "Medieval Warm Period and the Beginning of the Little Ice Age in

- Eastern Mediterranean. An Approach of Physical and Anthropogenic Evidence”. In: BELKE, HILD, KODER, SOUSTAL, 2000, 223-243.
- TELELIS, I.G. (2005). “Historical-Climatological Information from the Time of the Byzantine Empire (4th - 15th Centuries AD)”. *History of Meteorology* 2, 41-50.
- TIB 1: KODER, J.; HILD, F. (1976). *Hellas und Thessalia. Register von P. Soustal* (TIB 1). ÖAW, phil.-hist. Kl., *Denkschriften* 125, Vienna.
- TIB 2: HILD, F.; RESTLE, M., *Kappadokien* (1981). (*Kappadokia, Charsianon, Sebasteia und Lykandos*) (TIB 2). ÖAW, phil.-hist. Kl., *Denkschriften* 149, Vienna.
- TIB 4: K. BELKE, mit Beiträgen von M. RESTLE (1984). *Galatien und Lykaonien* (TIB 4). ÖAW, phil.-hist. Kl., *Denkschriften* 172, Vienna.
- TIB 5: HILD, F.; HELLENKEMPER, H. (1990). *Kilikien und Isaurien* (TIB 5). ÖAW, phil.-hist. Kl., *Denkschriften* 215. I-II. Vienna.
- TIB 7: BELKE, K.; MERSICH, N. (1990). *Phrygien und Pisidien* (TIB 7). ÖAW, phil.-hist. Kl., *Denkschriften* 211. Vienna.
- TIB 8: HELLENKEMPER, H.; HILD, F. (2004). *Lykien und Pamphylien* (TIB 8). ÖAW, phil.-hist. Kl., *Denkschriften* 320. I-III. Vienna.
- TIB 9: BELKE, K. (2020). *Paphlagonien und Honōrias* (TIB 9). ÖAW, phil.-hist. Kl., *Denkschriften* 249. Vienna.
- TIB 13: BELKE, K. (2020). *Bithynien und Hellespont* (TIB 13). ÖAW, phil.-hist. Kl., *Denkschriften* 513. I-II. Vienna.
- TIB 14: KÜLZER, A. (in preparation). *Westkleinasien (Asia und Lydia)* (TIB 14). ÖAW, phil.-hist. Kl., *Denkschriften*. Vienna.
- TÜRKEI (1992). *Autokarte Türkei, City Plan, touristische Informationen*, Ortsregister, 1: 800 000. Vienna, 1992, often reprinted.
- WHARTON (1893). *Asia Minor: Island of Khios and Gulf of Smyrna*, surveyed by Captain R. Copeland, Lieut. T. Graves and the Officers of H. M. Surveying Ships Beacon and Mastiff, 1835-37. With additions and corrections to 1892, republished in 1893 under the superintendence of Captain W. J. L. Wharton RN FRS London.

Adriatlas – Atlas informatisé de l’Adriatique antique

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RÉSUMÉ

Cette note présente l’Atlas informatisé de l’Adriatique antique – Adriatlas, webSIG qui est à la fois un atlas et une encyclopédie de l’espace adriatique entre le XI^e s. av. J.-C. et le milieu du VIII^e s. apr. J.-C. Il est le produit d’une collaboration internationale entre 21 centres de recherche.

MOTS-CLÉS: WebSIG, carte numérique, Adriatique, géoportail.

Adriatlas - Computerised atlas of the ancient Adriatic

ABSTRACT

This note presents the Computerised Atlas of the Ancient Adriatic, Adriatlas, which is both an atlas and an encyclopaedia of the Adriatic region between the 11th century BC and the middle of the 8th century AD. It is the product of an international collaboration between 21 research centers.

KEYWORDS: WebSIG, digital map, Adriatic, geoportal.

AdriAtlas est un webSIG reliant une base de données multilingue PostgreSQL à une carte numérique ; il est issu d’un projet ANR (Agence nationale de la recherche, France) qui a été mis en ligne en novembre 2013 et est ouvert à tout public. AdriAtlas n’oublie pas qu’il a été précédé par la *Tabula Imperii Romani*, avec les feuilles de *Tergeste*, éditée par Giuseppe Lugli en 1961 (*TIR L33*), et celle de *Naissus*, éditée par Jaro Šašel en 1976 (*TIR K34*)². Tout comme la TIR-FOR actuellement en ligne, il est l’héritier de cette grande et belle entreprise internationale. Voici ses caractéristiques en quelques mots :

- **Une adresse** : on ouvre le portail www.adriaticummare.org et on consulte AdriAtlas en

cliquant soit sur l’onglet « Base de données », soit sur celui de « Géoportail » ; un troisième onglet « Bibliographie » permet de consulter directement la bibliographie AdriAzot.

- **Un but** : répertorier tous les sites mentionnés dans les sources antiques et du haut Moyen Âge, ainsi que les sites archéologiquement importants entre le XI^e s. av. J.-C. et le milieu du VIII^e s. apr. J.-C. dans l’aire adriatique. Celle-ci correspond à la ligne de partage des eaux pour la péninsule italienne, puis elle couvre l’Emilie-Romagne, la Vénétie, le Frioul-Vénétie Julienne, le bassin de Ljubljana, l’Isrie, la Dalmatie et l’actuelle Albanie. (Fig. 1)

- **Une œuvre collective rassemblant 21 centres de recherche** : Universités de Bari, Bologne, Chieti, Ferrare, Foggia, Lecce, Macerata, Padoue, Pula, Rijeka, Trieste, Vérone, Zadar et Université catholique de Zagreb, Instituts archéologiques de Ljubljana et de Tirana, École française

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2. *TIR L33* et *K34*.

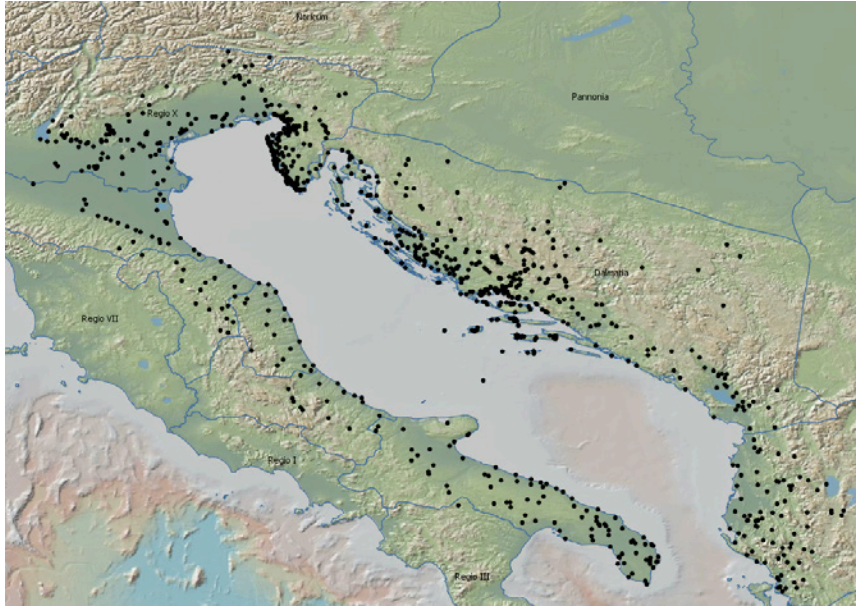


FIGURE 1 : AdriAtlas, Géoportail : vue d'ensemble des 1003 sites.

de Rome, et 4 UMR (unités mixtes de recherches Universités/CNRS) : Institut Ausonius (Université Bordeaux Montaigne), Centre Camille Jullian (Aix - Marseille Université), Chrono-environnement (Université de Franche-Comté - Besançon) et Artheis (Université de Bourgogne - Dijon).

Depuis 2017, l'Adriatique fait l'objet de rencontres thématiques annuelles, publiées par Ausonius Éditions dans une série *AdriAtlas* de la collection *Scripta antiqua*.

En 2020, les différents centres de recherche se sont fédérés pour former le *Centro internazionale di studi sulla storia e l'archeologia dell'Adriatico* - CISA, hébergé à l'université de Macerata.

Le WebSIG est suivi par une équipe d'Ausonius regroupant Nathalie Prévôt (ingénieure en humanités numériques), Clément Coutelier (ingénieur géomaticien), Yolande Marion, Alberto della Rosa et Francis Tassaux. Le site est hébergé par le TGIR Huma-Num, la très grande infrastructure de recherche des humanités numériques du CNRS à Lyon, sous la responsabilité de Gérard Foliot.

• **1 003 notices** de sites ont été créées jusqu'ici ; certaines ne contiennent encore qu'un minimum d'informations, d'autres sont complètes et comptent alors 12 rubriques dans une fiche-mère : *Identité, Chronologie, Description, Histoire de*

la recherche, Sources littéraires antiques, Sources épigraphiques, Autres sources, Bibliographie, Images, Sites Web, Protection/Conservation et Mise en valeur. Des fiches-filles par période reprennent la même structure que la fiche-mère avec, toutefois, une rubrique supplémentaire, *Analysis*, permettant une recherche systématique à l'aide de mots-clés dans des menus déroulants. La bibliographie est liée à AdriaZot, bibliographie collaborative en ligne Zotero, et elle compte à ce jour 3 000 fiches.

Chaque notice possède un DOI et un URL.

À titre d'exemple, l'Istrie est l'une des régions les mieux représentées, parce qu'elle a été dès le départ une zone test pour une équipe internationale de chercheurs croates, français, italiens et slovènes, habitués à travailler ensemble depuis deux décennies. Elle compte aujourd'hui 140 sites. Sur la côte occidentale, les villas romaines se succèdent avec une fréquence de 1 à 3 km. (Fig. 2)

AdriAtlas est donc très voisin de TIR-FOR dans son esprit comme dans sa présentation, avec cependant deux différences : d'une part, une place importante est réservée à la protection des sites et à leur valorisation ; d'autre part, dans la rubrique *Sources épigraphiques* on trouve toutes les références de l'épigraphie lapidaire d'un lieu ainsi que celles d'une partie



FIGURE 2 : AdriAtlas, Geoportail : les sites istriens.

de l'*instrumentum inscriptum* (timbre sur amphores et sur tuiles).

Par exemple, à *Tergeste*, C. Zaccaria signale les différents *corpora* et mises à jour, à savoir :

- CIL*, V, 1 (1872), 2 (1877) (Th. Mommsen)
- Suppl.It.* I (1884) (E. Pais)
- Inscr.It.*, X, 4 (1950), Tergeste (P. Sticotti)
- Suppl.It.*, n.s. 10 (1992), Tergeste et ager Tergesti adtributus (C. Zaccaria)
- Notiziario Epigrafico, in *Aquileia Nostra*, 59 (1988) - 63 (1992), 65 (1994), 67 (1996), 69 (1998), 72 (2001) (C. Zaccaria, F. Mainardis) (1996 - 1998 on line : http://www.univ.trieste.it/~epilab/i_notiz.html).

Vidulli Torlo, Mainardis 2001.

Epigrafi tergestine on line :

- 1) Civici Musei di Storia ed Arte di Trieste, Orto Lapidario (con foto) :

<http://www.museostoriaeartetrieste.it/orto-lapidario/>

- 2) Civici Musei di Storia ed Arte di Trieste, Lapidario Tergestino (con foto) :

<http://www.museostoriaeartetrieste.it/lapidariotergestino/>

- 3) EDR – Epigraphic Database Roma : <http://www.edr-edr.it> (Urbs antiqua : Tergeste)

- 4) Ubi erat Lupa (con foto) : <http://www.ubi-erat-lupa.org> (Fundort : Trieste)

- 5) EDCS - Epigraphik-Datenbank Claus - Slaby : <http://www.manfredclaus.de> (Ort : Tergeste)

Bolli laterizi : Zaccaria, Župančič, 1993.

Au total, AdriAtlas est à la fois un atlas et une encyclopédie, un instrument de recherche et de publication, en open access pour consultation, ouvert à toutes les collaborations ; il reflète l'évolution de la recherche internationale, considérant désormais l'Adriatique comme un objet historique à part entière³.

BIBLIOGRAPHIE

- TIR L 33*. Tergeste (Trieste), Lugli, Giuseppe, (éd.) (1961), Roma.
- TIR K 34*. Naissus. Dyrrachion. Scupi. Serdica. Thessalonike, Šašel, Jaro, (éd.) (1976), Ljubljana.
- ZACCARIA, Claudio (2015). « Presenza dell'Adriatico nella storiografia contemporanea sul mondo antico : luci e ombre ». In: MARION, Y. ; TASSAUX, F., (éd.). *AdriAtlas et l'histoire de l'espace adriatique du VI^e s. a.C. au VIII^e s. p.C. (Actes du colloque international, Rome, 4-6 novembre 2013)*. Ausonius Éditions - Scripta Antiqua 79. Bordeaux, 13-35.

3. Zaccaria, 2015.

Aquitaviae, projet de carte dynamique participative des voies de l'Aquitaine romaine

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Aquitaviae, a participatory dynamic map project of the roads of Roman Aquitania

ABSTRACT

The purpose of this article is to present the concept and the state of progress of a project aimed at providing researchers with an instrument to study the roads of ancient Aquitaine: the Aquitaviae project.

KEYWORDS: Roman roads, dynamic map, France, circulation.

L'étude de la circulation antique, et en particulier des voies qui la supportaient, constitue un des domaines où la recherche dispose d'un potentiel majeur grâce aux nouveaux outils de la connaissance et du traitement de l'information. Ce renouveau est en particulier illustré par de récents travaux portant sur l'ensemble de l'Empire romain. Il se caractérise par un aspect multiforme des recherches³. La présente communication a pour objet de présenter le concept et l'état d'avancement d'un projet visant à fournir aux chercheurs un instrument d'étude des voies de l'Aquitaine antique : le projet Aquitaviae.

1. AUX ORIGINES DU PROJET AQUITAVIAE

Le projet Aquitaviae est né d'un constat : les publications sur le réseau des routes parcourant la vaste province romaine d'Aquitaine⁴ (fig. 1 et 2),

en dépit du sérieux des recherches et malgré d'indéniables qualités, souffrent d'insuffisances graves.

Au 19^e s., en effet, les premiers viographes n'avaient pour les guider dans la reconstitution du réseau antique de l'Aquitaine que les indications sommaires des géographes antiques et des quelques documents routiers de cette lointaine période parvenus jusqu'à nous. Ces derniers ne sont, ni complets, ni très fiables : ainsi, la carte de Peutinger est-elle amputée de son premier volet, où figurait notamment tout le sud-ouest de l'Aquitaine. De même, nous savons que l'Itinéraire d'Antonin est loin de décrire toutes les voies existantes (la voie Bordeaux-Périgueux n'y figure pas) et que les distances indiquées sont parfois erronées⁵. Par ailleurs, les cartes d'état-major réalisées entre 1825 et 1881 sont publiées à une échelle de 1/80 000^e qui montre les chemins, mais oblitère de nombreux détails (fig. 4). Dans ces conditions il faut admirer la production de cartes comme celle de C. Jullian représentant les voies

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3. En dernier lieu Kolb (2019).

4. On considère l'Aquitaine dans les limites qu'on lui attribue à l'époque de sa création, sous Auguste, c'est-à-dire un territoire s'étendant de la Loire aux Pyrénées et de l'Atlantique aux monts du Forez.

5. La distance entre *Caesaraugusta* (Saragosse) et *Benearnunum* (Lescar) est donnée à 112 milles (168 km), alors qu'à vol d'oiseau on compte 194 km, et que le franchissement des Pyrénées ne peut pas s'effectuer en ligne droite! Bost (à paraître), p. 123.



FIGURE 1 : La province d'Aquitaine dans l'Occident romain sous le Haut-Empire, CAO C. Coutelier.

Cités antiques de la province d'Aquitaine



FIGURE 2 : L'Aquitaine romaine : les cités et leurs capitales. Données J.-P. Bost et F. Tassaux, CAO C. Coutelier.



FIGURE 3 : La carte de Belleyme (18e s.) à Saint-Selve (Gironde) note « vestige d'une ancienne levée dite Chemin Gallien ». C'est la voie antique Bordeaux-Agen.

antiques vers 1890 (fig. 5), qui fait toujours référence moyennant quelques modifications⁶. Cependant l'espace représenté (le département de la Gironde) ne correspond pas au découpage territorial de l'époque antique, et l'échelle adoptée conduit nécessairement à un tracé très schématique. Il faut en outre considérer qu'au 19^e s. les déplacements qui, malgré des progrès certains, restaient coûteux et malcommodes, n'encourageaient pas à la recherche de terrain.

Au 20^e s. et jusqu'à aujourd'hui, ont été accomplis des progrès significatifs dans les connaissances, principalement grâce à une documentation plus diversifiée et plus accessible : cartes topographiques plus précises – au 1/25 000^e – de l'IGN, photographies verticales commercialisées. Le processus s'est accéléré avec la mise en

ligne de portails en accès libre comme Géoportail, celui-ci permettant de consulter des cartes anciennes comme la carte de Cassini (18^e s.) et les matrices de la carte d'état-major (19^e s.). D'autres plates-formes numériques donnent accès à des cartes anciennes spécifiques à l'Aquitaine comme celle de Belleyme ou celle de Masse, où l'on peut retrouver de précieuses indications (fig. 3). Le cadastre napoléonien (premier 19^e s.) est également en ligne, fournissant un état du parcellaire avant les remembrements. De plus, les progrès de la mobilité ont favorisé le développement de la recherche de terrain, tant pédestre qu'aérienne, qui permet de retrouver les traces matérielles de routes fossilisées, qu'elles soient connues par les sources (fig. 6), ou seulement par la tradition comme le Chemin de Sainte Quitterie⁷ de Lescar

6. Ainsi faut-il supprimer le détour par La Teste entre *Losa* et *Boios*, comme le démontre la fig. 6.

7. Didierjean (2000).



FIGURE 4 : La Leve de Médoc sur la carte d'état-major du 19^e s. L'échelle reste un peu réduite pour un tracé précis.

à Aire-sur-l'Adour (fig. 7). La recherche est aussi rendue plus aisée par le regroupement des informations archéologiques anciennes dans la Carte archéologique de la Gaule, département par département. Ainsi se trouve facilitée la réalisation de synthèses comme celle publiée pour la région Aquitaine en 1992⁸ (fig. 8). Progrès supplémentaire : le *Barrington Atlas*, qui représente le réseau routier à l'échelle de l'Empire romain, devient accessible en ligne grâce à la numérisation (fig. 9).

Cependant, la publication des données sur un vaste territoire se heurte à des limitations à la fois techniques et méthodologiques : l'édition traditionnelle ne permet de représenter qu'un nombre très limité de caractéristiques des routes. Par exemple, la carte publiée dans les *Racines de l'Aquitaine*, évoquée plus haut, se limite à différencier les sources par lesquelles elles sont connues. Plus gênante encore est la contradiction entre le besoin d'une échelle réduite pour

8. Maurin *et al.* (1992), p. 51-71.

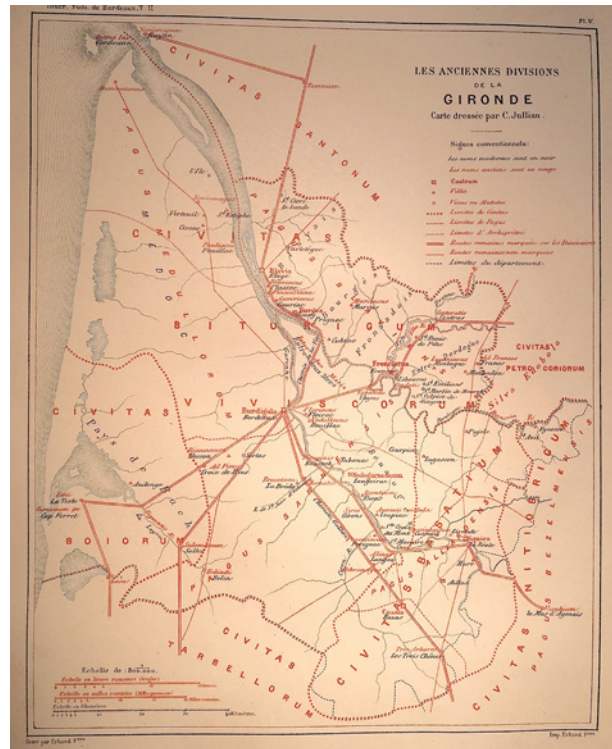


FIGURE 5 : Carte des voies antiques de Gironde par C. Jullian en 1887. Source : *Les inscriptions romaines de Bordeaux*.

représenter un territoire étendu, et la nécessité d'une grande échelle pour une indication précise du tracé (fig. 10)⁹.

De là, est née l'idée d'un nouvel outil, qui permette une représentation multiscalaire, qui satisfasse le besoin de précision grâce au géoréférencement des données, qui intègre une multiplicité de critères, en particulier celui de la fiabilité des informations, qui ouvre accès aux sources documentaires et qui soit utilisable par une communauté de recherche, à la fois pour la consultation et pour l'édition sous contrôle de données nouvelles.

2. LA MISE EN PLACE DU PROJET

La réalisation d'un tel outil passe d'abord par la création d'une équipe : celle-ci s'est constituée

9. Coulon (2013), p. 63. L'auteur y explique l'impossibilité de publier une carte générale dans le cadre de son ouvrage sur les voies romaines en Gaule.

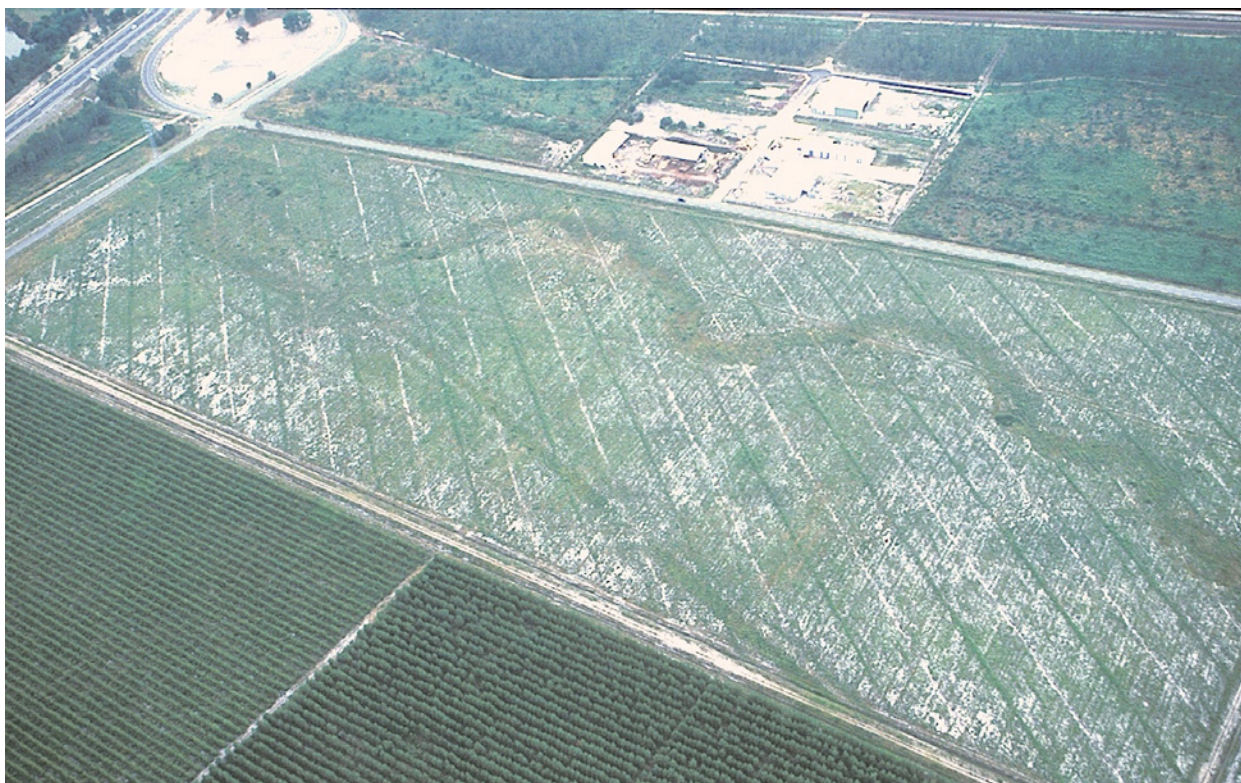


FIGURE 6 : La voie littorale Dax-Bordeaux près de *Boios* (Lamothe) apparaît comme une bande sombre dans une pinède labourée. Elle se dirige vers le sud et non vers le sud-ouest Cl. F. Didierjean 1989.

au sein de l'institut Ausonius sous l'impulsion de deux chercheurs : d'une part, Sara Zanni, post-doc qui a bénéficié d'une bourse Marie Skłodowska-Curie¹⁰ au sein d'Ausonius entre 2016 et 2018, et qui maîtrise aussi bien les méthodes traditionnelles de la viographie que l'utilisation des outils numériques récents; d'autre part, Clément Coutelier, ingénieur géomaticien en poste à Ausonius depuis 2012, où il intervient dans la mise en place de nombreux S.I.G., qui a conçu l'architecture de l'outil, a mené à bien sa réalisation technique et en opère la maintenance.

Autour d'eux, l'équipe s'est étoffée rapidement, par l'apport de chercheurs impliqués dans l'étude des voies (F. Didierjean, F. Tassaux) pouvant d'ores et déjà fournir des données sur certaines parties de la Nouvelle-Aquitaine, soit par eux-mêmes, soit par leurs contacts avec le réseau des équipes de chercheurs locaux (par exemple la

Société d'Archéologie et d'Histoire de la Charente-Maritime, et la Société des Archéologues du Lot-et-Garonne). S'y ajoute de façon plus ponctuelle l'intervention de professionnels de l'archéologie préventive, au sein d'entreprises publiques (INRAP) ou privées (Hadès).

Quand la carte participative a été opérationnelle, les premiers essais d'utilisation ont été menés, tant sur des territoires (cité des Santons), que sur des itinéraires (voies *De Hispania in Aquitaniam*). Ils ont validé le concept et permis de compléter et de préciser les rubriques à renseigner, travail qui a débouché sur la rédaction d'un guide d'utilisation.

La phase suivante a été la mise en place d'un réseau de référents couvrant tout l'espace de l'Aquitaine augustéenne. Choisis pour leur compétence et leur connaissance du territoire, ils sont chargés, dans le domaine qu'ils ont accepté de gérer, qu'il s'agisse d'un secteur géographique, d'une période ou d'un thème :

- d'alimenter la base de données à partir de leurs connaissances

10. Projet RecRoad – From *Aquileia* to *Singidunum*, reconstructing the paths of the Roman travelers.



FIGURE 7 : La voie Aire-Lescar, dite « Chemin de Sainte Quitterie ». Cl. F. Didierjean 1984.

- d'inciter d'autres chercheurs à y intégrer leurs données
- de contrôler la validité des données proposées et de procéder à leur intégration.

À ce stade, les questions de l'accès à la carte et de la protection des données ont commencé à se poser.

Pour l'accès, il a été décidé de présenter deux versions de la carte : la première est une version provisoire, ouverte à ceux qui en font la demande, moyennant l'attribution d'un accès, et peuvent consulter la carte sans la modifier. La seconde, qui permet les modifications, est la version définitive. Son accès est réservé aux référents, à qui les consultants doivent transmettre leurs propositions pour qu'ils les intègrent à la carte définitive, après validation.

Pour la protection des données, le choix est celui d'une licence Creative Commons type CC BY-NC-SA 4.0 qui permet l'utilisation non commerciale des données de la carte avec l'autorisation du ou des auteurs, qui doivent être cités¹¹.

Dernier (mais non ultime) élément de la mise en place du projet : l'organisation à Bordeaux de rencontres à différentes échelles permettant de confronter le projet à des réalisations similaires, de s'informer sur d'autres approches, de dresser avec des chercheurs locaux un état de leurs travaux propre à valoriser ceux-ci : ainsi la table ronde internationale « La route antique et médiévale : nouvelles approches, nouveaux outils » en 2016, le colloque international « Tiens bien la route! » en 2017, tous deux organisés par Sara Zanni. Ils ont été suivis par la journée d'études « Tracer la route » et le séminaire d'Ausonius « Voies romaines en Gironde » en 2020. Ces rencontres ont créé une dynamique utile et nécessaire au progrès de notre carte participative.

3. LA CARTE DYNAMIQUE ET PARTICIPATIVE

Pour permettre de consulter et de compléter le réseau routier sur l'Aquitaine romaine, nous avons mis en place la carte sous une forme dynamique et accessible par navigateur internet (fig. 11).

L'objectif du projet est d'obtenir une cartographie toujours plus complète du réseau viaire de l'Aquitaine romaine, avec l'aide des spécialistes qui contribuent directement à enrichir la carte en ligne, par les outils de dessin numérique.

L'outil conçu devait être simple d'utilisation pour que chaque utilisateur puisse se l'approprier sans devoir être un spécialiste en SIG (système d'information géographique).

3.1. Les fonds de carte, apport indispensable pour tracer les voies

Cette carte dynamique offre une vision multiscalaire, donnant la possibilité de zoomer à une échelle très fine pour positionner à l'endroit exact les informations liées aux voies (fig. 12).

11. Référence : <https://creativecommons.org/licenses/by-nc-sa/4.0/>



FIGURE 8 : Carte des voies antiques de la région Aquitaine. Source : *Racines de l'Aquitaine* 1992.



FIGURE 9 : Carte des voies antiques du Sud-Ouest de la France, selon le *Barrington Atlas* (2000).



FIGURE 10 : Imprécision des tracés due à l’emploi d’une petite échelle : les voies vers Bordeaux selon le *Barrington Atlas* convergent nettement au nord de la ville antique.

Ces déplacements d’une échelle globale vers un niveau local présentent un grand intérêt pour l’étude des voies, car l’utilisateur peut s’appuyer sur des éléments visibles dans le paysage pour identifier de possibles indices. L’image aérienne est consultable à une échelle très précise, permettant alors au spécialiste de mener un travail de prospection informatique pour détecter d’éventuelles anomalies dans l’espace observé.

Pour améliorer le repérage des tracés par l’équipe de recherche, nous avons intégré un certain nombre de fonds de carte complémentaires entre eux, qui augmentent la variété des informations spatiales.

Nous avons ainsi ajouté le fond de carte topographique de l’IGN, l’Institut national de l’information géographique et forestière chargé par l’État français de produire, mettre à jour et diffuser l’information géographique sur le territoire. Ce fond contient notamment les lieux-dits, une toponymie parfois très évocatrice, donnant des indices de passage de voies romaines. Les termes comme « Caussade », « Chaussée », « Cami », « Cauchy » font par exemple référence à une voie avec chaussée, mais il reste à déterminer si celle-ci est bien d’époque antique¹².

12. Rouche (1980).

Nous avons également intégré des fonds de carte qui apportent des informations historiques. Ainsi, la carte de Belleyme, citée plus haut, couvre le territoire de la Guyenne, ancienne province correspondant au sud de la Nouvelle-Aquitaine actuelle. Réalisée par Pierre de Belleyme, ingénieur géographe du roi Louis XVI à partir de 1783, elle est d’une grande précision pour l’époque, avec une échelle de 1/43 200^e.

Nous allons continuer à intégrer des fonds pertinents pour les voies, comme la carte d’État-major qui date du 19^{ème} siècle avec une échelle au 1/80 000^e.

3.2. Conception de la base de données

La base de données du projet a pour rôle de réunir tous les indices possibles relatifs aux voies, quelle que soit leur origine, leur forme, leur fiabilité. Ces indices sont représentés sur la carte (fig. 11, côté gauche) à partir des couches suivantes :

- Les tronçons de voie : un tronçon est un morceau de route soit connu, soit observable, soit les deux à la fois. Chaque tronçon est une portion de voie homogène car attesté par une même source.
- Les points d’observation de voie antique : ils localisent tout élément de voie ponctuel

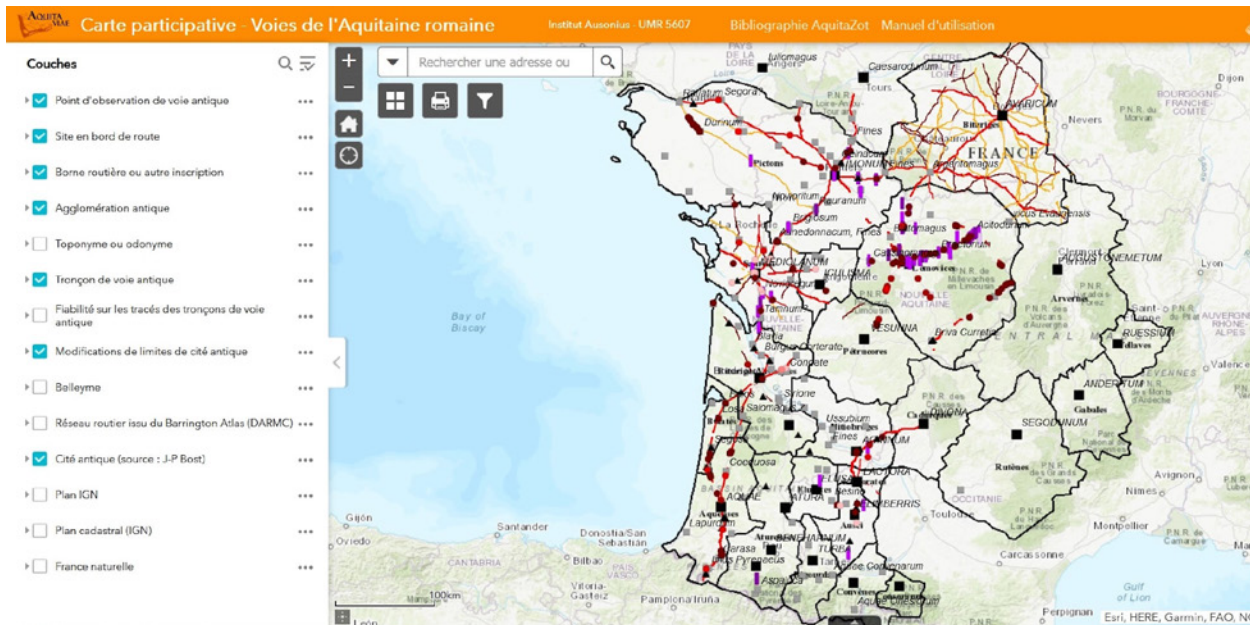


FIGURE 11 : La carte participative des voies de la province d'Aquitaine : état à la fin de 2020.

actuellement observable, ou qui a été observé par le passé, notamment à l'occasion d'une fouille. Le spécialiste positionne un point à cet endroit sur la carte. À chaque point peuvent être associés une description, une photo, un document type PDF, stockés dans la base de données.

- Les sites en bord de route : cette couche contient les sites aménagés en lien avec la route. On y trouve les relais routiers, les sanctuaires, les piles funéraires, les habitats isolés, les camps militaires et autres édifices.
- Les bornes routières : localisent les bornes routières, milliaires et leugaires. Ces dernières donnent les mesures en lieues gauloises.
- Les odonymes et toponymes : les noms de lieux sont une source très précieuse, car ils se révèlent être parfois des témoins d'une histoire ou d'une activité passée. Les identifier sur la carte apporte une information pouvant influencer les hypothèses de recherche sur des tracés.
- Les agglomérations : les agglomérations étaient, comme encore aujourd'hui, les points d'ancrage du réseau de routes qui maillait le territoire.

Les entités géographiques sont enrichies de descriptions, dont l'ensemble constitue une base de données spatiales que nous avons voulue la plus complète possible. Les tronçons de voies comprennent par exemple 35 rubriques à remplir. Ces rubriques permettent notamment de préciser les sources d'information sur les indices de voie, qu'elles soient des prospections aériennes, des prospections pédestres, des fouilles, des images satellites, le lidar, des sources textuelles, pour ne citer que les principales. La description intègre également les possibles utilisations des voies aux périodes antérieures et postérieures à l'Antiquité. Nous souhaitons en effet qu'une voie connue à la période protohistorique ou médiévale puisse figurer sur la carte, surtout s'il y a des signes de son utilisation à l'époque antique. La fiche descriptive de chaque entité géographique, qu'il s'agisse des tronçons, des sites en bord de route ou des points d'observation, apparaît d'un clic de souris, avec éventuellement un document associé (fig. 13).

Lier les références bibliographiques, si elles existent, à chaque élément de la carte est essentiel pour faciliter les recherches et optimiser le partage de connaissances entre les spécialistes des voies. Pour cela, nous avons consacré des ru-



FIGURE 12 : La voie Poitiers-Nantes à hauteur de Gourgé (Deux-Sèvres). L'utilisation de plusieurs échelles permet de répondre à des besoins différents. IGN.

briques à la saisie de références bibliographiques sur tout élément de la carte.

De plus, un groupe appelé AquitaZot a été créé sur l'outil bibliographique Zotero, gratuit, libre et open source. Ce groupe est alimenté régulièrement en nouveaux documents par l'équipe de recherche, et un lien avec la carte permet d'accéder à cette documentation saisie dans Zotero quand on interroge un point ou un tracé de voie sur la carte. L'implémentation de mots-clés sur chaque référence dans Zotero permet d'afficher une sélection de publications en lien direct avec l'entité de la carte interrogée. Par exemple, en sélectionnant un tronçon de voie se trouvant sur l'itinéraire Bordeaux – Dax, toute la bibliographie rassemblée ayant un lien avec ce tronçon apparaît.

3.3. La prise en compte des incertitudes

Dans ce projet de cartographie viaire, nous avons mené une réflexion sur la notion de fiabilité, d'incertitude.

Bien que la recherche ait pour objectif de réduire les incertitudes sur nos connaissances, ces incertitudes demeurent inhérentes aux données produites en histoire et en archéologie. L'incertitude accompagne la donnée en sciences humaines et sociales, et doit être considérée,

non pas comme le signe d'une défaillance, mais comme un élément à part entière du processus de la connaissance¹³. Elle permet de mesurer la valeur à accorder aux connaissances. C'est pourquoi nous avons fait le choix d'intégrer ce facteur dans le projet Aquitaviae et de tenter de l'évaluer.

Ainsi, nous avons choisi d'inclure des niveaux de fiabilité sur l'existence d'une voie (« Quel est le degré de certitude que ce tracé ait bien existé ? »), sur la précision géographique des tracés (« Quel est le degré de certitude que son tracé soit exactement positionné ici ? »), ainsi que sur la période historique d'utilisation (« Quel est le degré de certitude que cette voie ait été utilisée durant l'Antiquité ? »).

Nous avons alors déterminé 6 niveaux de fiabilité, allant d'« assuré » quand l'objet a été archéologiquement prouvé à « hypothétique » quand on ne détient aucun indice fiable. Nous avons défini ces niveaux comme suit :

Assuré :

- archéologiquement prouvé.
- attesté sur le terrain.

Hautement probable :

- tronçon reliant deux points d'observation à faible distance.

13. Fusco *et al.* (2014).

- prolongement ou continuité de tronçons dont la fiabilité est assurée.

Probable :

- série d'indices (limites administratives, toponymie) avec absence d'attestation.

Faiblement documenté :

- un seul type d'indice avec absence d'attestation.
- documentation de fiabilité moyenne.

Hypothétique :

- aucun indice fiable.

Non renseigné :

- choix du niveau de fiabilité encore indéterminé.

Les points d'observation sont également associés à ces mesures de fiabilité. Les sites en bord de route, les bornes routières et les agglomérations possèdent une valeur d'incertitude différente, cette fois liée à leur localisation. Le chercheur doit indiquer la précision du placement du point : endroit exact, lieu-dit, commune.

L'utilisateur de la carte dynamique peut distinguer facilement ces niveaux de fiabilité à travers un dégradé de couleurs sur les données de la carte.

3.4. La hiérarchie des voies

On peut classer les voies selon des critères variés : statut juridique, mention par les sources, équipement routier et autres. Nous avons choisi le critère fonctionnel, selon l'importance de la liaison opérée, qui nous semble le plus pertinent pour analyser l'organisation territoriale de la province. Il en résulte une hiérarchie à cinq niveaux : la route impériale, la liaison inter-cités, la route secondaire, la voie de desserte locale, et la voie dont la place dans la hiérarchie n'est pas renseignée. Ils sont définis comme suit :

Route impériale : elle peut se définir par trois critères :

- mentionnée dans les itinéraires antiques : Table de Peutinger, Itinéraire d'Antonin, Itinéraire de Bordeaux à Jérusalem.
- jalonnée de bornes routières / milliaires / bornes leugaires.
- construite selon un mode caractéristique. Par exemple, une chaussée large de 6 m pour que deux chariots puissent se croiser, bordée de deux fossés de drainage, et

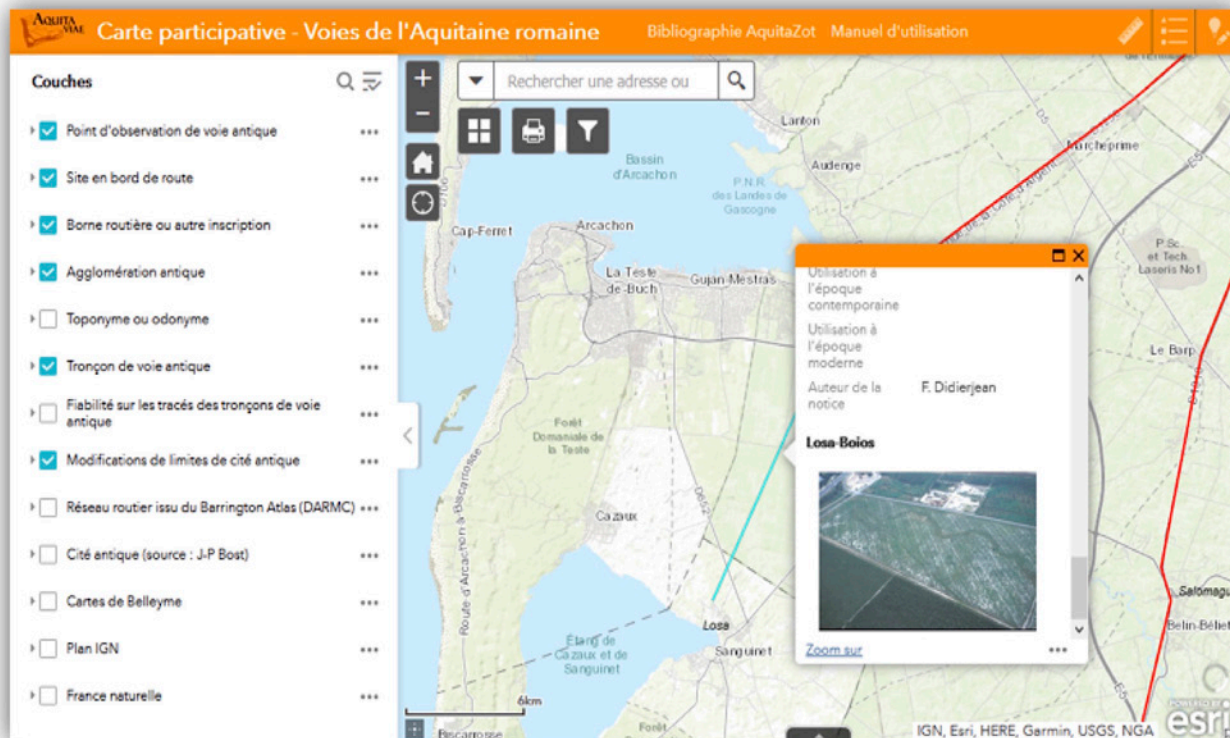


FIGURE 13 : Fiche descriptive d'un tronçon avec document associé (voir Figure 6).

parfois de deux fossés de limitation du territoire routier¹⁴ ; équipée d'ouvrages d'art importants.

Liaison inter-cités : route non mentionnée par les itinéraires et qui relie deux chefs-lieux de cités.

Route secondaire : route reliant une agglomération secondaire au chef-lieu de sa cité, ou deux agglomérations secondaires entre elles.

Desserte locale : route permettant d'accéder à un habitat isolé, villa ou ferme ; ou encore à un habitat groupé, mais dont on ignore le point de départ ; dans quelques cas, l'épigraphie mentionne un *iter privatum*, une *via privata*.

Non renseignée :

- Statut en attente ou indéterminé.
- Route, piste ou chemin ancien, de datation incertaine.
- Autre critère : on ne comprend pas le parcours de la route par rapport à l'organisation générale du réseau de la *civitas*.

La hiérarchie des voies est représentée sur la carte par un dégradé de couleurs allant du rouge au jaune.

Nous avons adopté cette typologie, qui correspond à l'usage actuel, bien qu'elle ne soit pas complètement satisfaisante. C'est une question qui pourrait faire l'objet de rencontres futures entre archéologues et historiens.

3.5. Les fonctionnalités avancées

Des fonctionnalités ont été ajoutées à la carte afin d'améliorer le travail de recherche du spécialiste. Il est ainsi possible de saisir et mettre à jour les données antiques sur la carte de manière simple, de superposer les fonds de carte, de modifier leur ordre d'affichage, de les croiser en jouant sur la transparence, d'effectuer des mesures, d'annoter la carte par des commentaires et dessins personnels. Les données descriptives sont présentées, on l'a vu, sous forme de tableau attributaire qu'il est possible de modifier pour visualiser les entités selon un ordre souhaité.

Parmi les autres fonctionnalités développées dans la carte dynamique, il est possible de filtrer les données selon des critères choisis par l'utili-

sateur grâce à un outil dédié. Quelques filtres préconstruits permettent de modifier l'affichage des données historiques en quelques clics. Et des paramètres avancés supplémentaires, demandant une plus grande maîtrise technique, rendent totalement modulable l'affichage des données sur la carte en fonction des besoins.

Pour terminer, des outils d'impression et d'édition permettent d'exporter des extraits de la carte.

La carte est évolutive. D'autres fonctionnalités peuvent être rajoutées en fonction des besoins de l'équipe de recherche. Les fonctionnalités actuelles ainsi que les critères de définition des fiabilités et de la hiérarchie sont présentés dans un manuel téléchargeable depuis la carte.

3.6. Recherche sur les voies depuis le terrain

Notre recherche sur les voies se poursuit également sur le terrain. La carte dynamique est maintenant consultable sur smartphone et tablette tactile. Ses intérêts principaux sont de pouvoir se repérer au cours de missions de prospection pour se rendre sur un tronçon de voie déjà cartographié grâce aux fonctions de localisation du téléphone, ou encore de pouvoir dessiner directement sur la carte depuis le terrain en fonction des observations faites.

Le matériel de l'Institut Ausonius permet de réaliser des missions de collecte de données très précises sur le terrain. Un GPS différentiel autorise la cartographie de voies avec une très haute précision, de l'ordre du centimétrique, aussi bien en planimétrie qu'en altitude. Nous pouvons en effet mesurer les différences de relief qui forment les voies par rapport à leur environnement, fournissant ainsi des indices précieux sur le tracé exact des routes. Récemment, Ausonius a fait l'acquisition d'un drone, qui peut être utilisé aussi bien pour couvrir de petites surfaces en prospection que pour enregistrer des tronçons connus, fournissant un état de situation des vestiges qui peut s'avérer très utile dans l'avenir, notamment pour leur protection (fig. 14).

Ces outils permettent d'obtenir à volonté des profils en coupe et en long du monument. Ils améliorent ainsi la précision dans la connaissance des tracés et des modes de construction, en

14. Chevallier (1998), p. 96.



FIGURE 14 : La voie Agen-Cahors, dite « Na Bruniquel », vue prise depuis un drone.
Cl. C. Coutelier 2019.



FIGURE 15 : Tracé de la voie intérieure Dax-Bordeaux, largement oblitérée par l'aménagement du campus universitaire de Bordeaux. BD Ortho – IGN 2018.

lien avec le statut de la route. Face aux menaces de destruction, une cartographie de plus en plus précise et documentée permet d'organiser la protection du patrimoine routier dans le cadre d'une archéologie préventive.

4. LES ACTIONS À VENIR

Le projet Aquitaviae est dans une dynamique de construction, avec des actions prévues dans plusieurs directions.

Il faut compléter la carte, qui présente encore des lacunes importantes dans les parties sud et est du vaste territoire considéré. Pour y parvenir, il est nécessaire d'intensifier la dynamique régionale et interrégionale que nous avons initiée, en impliquant les citoyens, les spécialistes académiques du monde romain, les opérateurs d'archéologie préventive, publics et privés. Aquitaviae souhaite devenir une référence en matière d'information et de connaissance sur les voies antiques.

Il faut également avancer la réflexion sur l'ouverture de la carte informatisée pour les décideurs et les aménageurs du territoire, après publication des données et des résultats des recherches sur certains tronçons. Le but ici est d'utiliser Aquitaviae pour améliorer la protection des vestiges existants et assurer leur sauvegarde. Nous avons d'ores et déjà référencé nos travaux sur la plateforme régionale PIGMA, qui a pour objectif de mutualiser les données et de favoriser les échanges entre les différents gestionnaires territoriaux de la Nouvelle-Aquitaine.

À plus long terme, Aquitaviae pourra être utilisé comme instrument pour promouvoir la valorisation de vestiges routiers antiques existants, comme nous tentons de le faire à propos de la voie qui traversait le campus universitaire de Bordeaux (fig. 15).

Dès maintenant, la carte participative est intégrée à un projet plus vaste d'Ausonius appelé AquiPoTer (Pouvoir, territoire et société dans l'Aquitaine antique), qui a pour objectif de mener une réflexion sur la société des Aquitains dans ses aspects juridiques, administratifs, économiques et culturels. Notre démarche s'inscrit dans le cadre

d'une collaboration internationale avec les différents programmes en cours (Viator-e, refonte du CIL XVII), et en liaison avec les grandes plateformes de géographie historique comme Pleiades, Pelagios, Trismegistos et bien sûr la TIR-FOR.

BIBLIOGRAPHIE

- BOST, J.-P. (1998). « Les routes d'Aquitaine dans les itinéraires antiques ». In : ARNAUD, P. ; COUNILLON, P. (dir.). *Geographica Historica*. Bordeaux : Ausonius, 208-220.
- BOST, J.-P. (à paraître). « Sur la voie romaine de la vallée d'Aspe ». In : *Tracer la route*, journée d'études Ausonius 2020. *Aquitania*, 37, 117-128.
- CHEVALLIER, R. (1998). *Les voies romaines* (rééd.). Paris : Picard.
- COULON, G. (2013). *Les voies romaines en Gaule*. Paris : Errance.
- DIDIERJEAN, F. (2000). « Le chemin de Sainte Quitterie », *Aquitania*, 17, 233-258.
- FUSCO, G. ; BERTONCELLO, F. ; CANDAU, J. ; EMSELLEM, K. ; HUET, T. ; LONGHI, C. ; POINAT, S. ; PRIMON, J.-L. ; RINAUDO, C. (2014). « Faire science avec l'incertitude : réflexions sur la production des connaissances en Sciences Humaines et Sociales ». In : *Incertitude et connaissances en SHS*. Nice : MSHS Sud-Est. <https://halshs.archives-ouvertes.fr/halshs-01166287>
- JULLIAN, C. (1887). *Les inscriptions romaines de Bordeaux*. Bordeaux : Archives Municipales de Bordeaux.
- KOLB, A. (éd.) (2019). *Roman Roads. New Evidence - New Perspectives*. Berlin : De Gruyter.
- MAURIN, L. ; BOST, J.-P. ; RODDAZ, J.-M. (dir.) (1992). *Les racines de l'Aquitaine*. Bordeaux : Centre Ch. Higounet - Centre P. Paris.
- ROUCHE, M. (1982). « L'héritage de la voirie antique dans la Gaule du Haut Moyen Âge (V^e-XI^e s.) ». In : *L'homme et la route en Europe occidentale, au Moyen Âge et aux Temps Modernes*. Flaran 2. Auch : Commission d'histoire de Flaran, 1332.

El estudio y diseminación de las vías romanas en la era posdigital: el proyecto Viator-e

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RESUMEN

En 2019 empezó el proyecto Viator-e² con la función de recopilar, digitalizar, analizar y diseminar en una plataforma online los datos trazados de las vías romanas de la parte occidental del Imperio romano. Este artículo pretende presentar de forma escueta el proyecto Viator-e, sus objetivos y las motivaciones detrás de su diseño e implementación. También se trata en este artículo sobre el estado actual de desarrollo y sus actuaciones futuras planificadas. Entre las distintas partes de este artículo, se incluye un estado de la cuestión sobre la diseminación actual de las vías romanas en lo que se determina como la Era Posdigital y una comparación de los datos que ofrece Viator-e con otros recursos digitales libres. Finalmente, también se describe la metodología y los propósitos de este proyecto para convertirse en un elemento central dentro de los Linked Open Data.

PALABRAS CLAVE: Vías romanas, Linked Open Data, análisis de redes, arqueología.

The study and dissemination of Roman roads in the post-digital era: the Viator-e project

ABSTRACT

In 2019, the Viator-e project began with the aim of collecting, digitising, analysing and disseminating, via an online platform, data on the Roman roads of the western territories of the Roman Empire. This article has been designed to briefly present the Viator-e project, its objectives and the motivations behind its design and implementation. The article also covers the current state of its development and planned future actions, as well as a state of the art on the current spread of Roman roads in the post-digital era and a comparison between the data provided by Viator-e and other free digital resources. Finally, the methodology and aim of this project to become a central element within Linked Open Data are also described.

KEYWORDS: Roman roads, Linked Open Data, network analysis, archaeology.

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2. El proyecto Viator-e. Redes de comunicación y organización territorial del Imperio romano de Occidente. El Network Analysis aplicado al transporte en la antigüedad (RTI2018-098905-J-I00) está cofinanciado por el Ministerio de Economía, Industria y Competitividad y la Unión Europea, dentro del Programa Estatal de I+D+i Orientada a los Retos de la Sociedad 2018.

1. INTRODUCCIÓN

Ya entrados en la segunda década del siglo XXI, podemos afirmar que la mayoría de los investigadores en arqueología del paisaje conocen y utilizan en sus proyectos las tecnologías digitales que asombraban y deslumbraban las presentaciones en arqueología hace más de 20 o 30 años. Como predijo Negroponte (1998), lejos nos queda ese momento en el que un mapa con SIG parecía ofrecer una pátina de excelencia e innovación aceptada con poco espíritu crítico; la tecnología digital es ahora un elemento cotidiano de la investigación. De este modo, durante la evolución en el uso e investigación con estas tecnologías, se han ido incorporando discursos críticos acerca de la aplicación metodológica como los datos geográficos utilizados, la densidad de los *rasters*, el origen y la morfología de los datos arqueológicos analizados, etc. A pesar de ello, es cierto que, a nuestro modo de ver, la presión por publicar en revistas de marcado carácter científico está generando una amplia literatura arqueológica en la que puede observarse una falta de planteamientos académicos en los objetivos de la investigación, así como de reflexión y conclusiones históricas, que al fin y al cabo deberían ser nuestra meta.

En la actualidad, podemos afirmar que los estudios sobre el paisaje y, en este caso sobre el trazado de las vías romanas, se encuentra en una fase muy favorable en la que los investigadores disponen de muy buenas fuentes de información arqueológica, datos geográficos detallados y accesibles, así como de herramientas potentes para el análisis de estos elementos arqueológicos. Con todo ello, los resultados que se han generado en los últimos años han ofrecido trazados viarios detallados e interpretaciones muy valiosas. Sin embargo, según nuestra opinión, toda esta generación de datos sigue anclada en la concepción de diseminación de la Era Digital, que continuaba limitada por el marco de difusión de la investigación de eras predigitales. De este modo, los resultados de todos los recientes proyectos de investigación se han traducido en publicaciones (tesis doctorales, artículos y capítulos de libro) y en conferencias científicas, obviamente objetivos necesarios para justificar la correcta evolución de una prolífica carrera científica. El problema de esta difusión es que, a pe-

sar de todos los medios actuales para la diseminación y compartición de información y datos, estas investigaciones *solo* ofrecen la descripción de los resultados y mapas más o menos generales. Las referencias geográficas en estas publicaciones son distintamente representadas dependiendo de si se utiliza como base de las infografías, mapas topográficos, mapas de relieve o mapas con algún topónimo.

El impacto de estas publicaciones en la investigación sucesiva genera inevitablemente una importante dedicación de tiempo y esfuerzos en adaptar toda esa información publicada. Los futuros investigadores que necesitan recopilar toda la información sobre un territorio deben documentar todos los datos previos y, en la mayoría de los casos, volver a digitalizar los trazados a partir de esos mapas y de esas descripciones, pudiendo incurrir en errores de interpretación o digitalización de las vías. Bien es cierto que actualmente existe una actitud más abierta por parte de los investigadores en cuanto a compartir los datos, aunque en muchas ocasiones, sobre todo si el trabajo que se busca se elaboró en el pasado cercano, los datos son irrecuperables o se encuentran en formatos caducos. Sea como fuere, en la mayoría de los casos cuando no es posible contactar personalmente con el investigador responsable, la reutilización de los datos pasa irremediablemente por recurrir a la diseminación predigital de publicaciones en papel y proceder a su redigitalización.

Por este motivo, el proyecto Viator-e pretende instituirse como una herramienta indispensable para la documentación y diseminación de las vías romanas enmarcada en la Era Posdigital (Cramer 2015). Este periodo actual aplicado a la investigación se conceptúa, a mi modo de ver, a partir de la combinación de dos conceptos que Fuller (Fuller y Jandrić 2019) sintetiza claramente a partir de Jandrić *et al.* (2018): la superación de la pátina de innovación y prominencia de lo digital y después de que lo digital se convierta en la narrativa maestra de nuestro mundo. En otras palabras, el proyecto Viator-e intenta responder a la necesidad de diseminación de los resultados científicos sobre vías romanas en una época en la que la tecnología digital se ha convertido en extremadamente cotidiana, globalizada y presente en todos los aspectos de nuestra sociedad.

2. ANTECEDENTES

En 2016, a raíz del desarrollo del proyecto *Mercator-e: Quantifying the impact of transport infrastructures: network analysis applied to the diachronically study of the Iberian peninsula (from Roman times to XIXth Century)*³, un proyecto Marie Curie financiado por la Comisión Europea⁴, digitalizamos por completo la red viaria de la Hispania romana a partir de principalmente los datos publicados y ocasionalmente de datos cedidos (ya digitalizados) por otros equipos de investigación. Al publicar la red resultante en un visor online, nos sorprendió la gran cantidad de grupos de investigación y proyectos que nos pidieron permiso para reutilizar nuestros datos. El acceso directo y digital con datos georreferenciados y detallados de los posibles trazados viarios representaba un elemento básico de mucho valor para numerosos equipos. Su utilización se entendía como el acceso a un conjunto de datos que potenciaba su investigación, reducía tiempos prácticos de ejecución y permitía focalizar sus esfuerzos en su objeto real de estudio.

Las redes de Mercator-e fueron distribuidas en más de 20 ocasiones durante el desarrollo del proyecto, tanto a investigadores particulares o equipos de investigación, como a otros interesados. Destaca por ejemplo su uso en el mapa digital del Imperio romano DARE⁵ (*Digital Atlas of the Roman Empire*), su uso en el proyecto TIR-FOR⁶ o su conversión en un infograma inspirado en las líneas de metro por Trubetsky⁷ (figura 1). En relación con la investigación, las redes viarias romanas de Mercator-e se utilizaron como base para analizar procesos de migraciones a través de la epigrafía (Claire Holleran, Exeter Univ.), la distribución de productos de *Bracara Augusta* (Natalia Botica, Univ. do Minho) o el estudio del urbanismo en la Península ibérica en época romana (Peter Houten, Univ. Nottingham)⁸ entre otros.

3. <http://fabricadesites.fcsh.unl.pt/mercator-e/>

4. This project received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 706260 <https://cordis.europa.eu/project/id/706260>

5. <https://imperium.ahlfeldt.se/>

6. <https://tir-for.iec.cat/>

7. <https://sashamaps.net/docs/maps/roman-roads-of-iberia/>

8. Houten (2021)

En paralelo a esta actividad de reutilización de las vías digitalizadas en este proyecto, también se pudo comprobar la buena disponibilidad de otros investigadores en compartir los datos digitalizados de sus propios proyectos para componer una red de vías romanas más detallada y actualizada. En primer lugar, cabe destacar el papel del proyecto de las vías romanas de Castilla y León (Isaac Moreno) que facilita el trazado de las vías en formato digital en su propia web del proyecto. Otros investigadores también colaboraron activamente en la cesión de sus datos: el Dr. César Parcero-Oubiña contribuyó con las vías de Galicia, así como la Dra. María José de Almeida y el Dr. Joan Negre aportaron los datos sobre sus recientes tesis doctorales.⁹

En resumen, el desarrollo de Mercator-e trascendió sus resultados científicos para mostrar una importante doble necesidad en el almacenaje y diseminación de los datos arqueológicos. En primer lugar, como directorio de información arqueológica detallada y accesible y, en segundo lugar, como un repositorio donde ubicar los datos producidos para que puedan ser conocidos y reutilizados.

3. VIATOR-E

El detalle y la densidad de la red viaria digitalizada durante el proyecto Mercator-e en la Península ibérica romana fue uno de los resultados más valorados. A pesar de ello, la diferencia de esos datos con la calidad de los datos disponibles para el resto de los territorios del Imperio romano limitaba enormemente su utilización para proyectos geográficamente más amplios. Así en 2019, se nos concedió un proyecto I+D+i del Ministerio de Ciencia, Innovación y Universidades para recopilar, digitalizar y analizar la red viaria de la parte occidental del Imperio romano, así como crear una herramienta digital para su difusión y acceso libre de toda la comunidad científica. Este proyecto, con una duración de 3 años, tiene el ambicioso objetivo de documentar y estudiar las vías romanas de un extenso territorio.

9. Parcero-Oubiña *et al.* (2017); Almeida (2017); Negre (2013).



FIGURA 1. Detalle de las vías de Mercator-e en el *Digital Atlas of the Roman Empire* y el diseño de vías romanas como un mapa de metro (S. Trubetsky).

Viator-e pretende crear un mapa de las vías romanas dinámico y participativo, que crezca, evolucione y mejore a medida que investigadores vayan reusando sus datos, comparando sus trazados y encontrando posibles alternativas justificadas arqueológicamente. La primera fase del proyecto se focaliza en la recopilación y digitalización de la información sobre las redes del Imperio romano. Debido al vasto territorio a estudiar y al enorme volumen de vías romanas a digitalizar, se priman los estudios arqueológicos que han estudiado territorios romanos antes que proyectos centrados en una sola vía. En el caso de la Península ibérica, por ejemplo, han sido particularmente útiles los excelentes trabajos de Magallón (1987) para las vías romanas de Aragón, de Sillières (1990) para el sur, de Corzo y Toscano (1992) en Andalucía, de de Soto (2010) en Catalunya, de Moreno (2011) sobre Castilla y León, o Argüelles (2016) en Cantabria, por citar solo unos pocos en la Península ibérica; o Benoit (1964) en Provenza o Nouvel *et al.* (2016) y en Arvernes para el territorio de la *Gallia*. El proyecto tiene diseñado recopilar y digitalizar las vías romanas de las provincias de *Hispania*, *Gallia*, *Britannia*, *Germania*, *Italia*, *Mawretania*, *Numidia* y *Africa*.

Hasta la actualidad se han digitalizado las vías romanas de seis provincias romanas, tres de *Hispania* (*Tarraconense*, *Lusitania* y *Baetica*) y tres de *Gallia* (*Narbonense*, *Aquitania* y *Lugdunense*), que suman un total de casi 77.000 km de calzadas. Como resultado de este proceso, aún sin completar, puede observarse el claro aumento del número de vías en la Península ibérica, y una pequeña mejora de la red gala, respecto al principal recurso accesible de vías romanas del Imperio romano ofrecido por el proyecto Ancient World Mapping Center.¹⁰ AWMC¹¹ es una iniciativa desarrollada bajo el amparo de la University of North Carolina at Chapel Hill y que ofrece de forma gratuita la red viaria romana aparecida en el *Barrington Atlas of the Greek and Roman Empire* (Talbert 2000). Es interesan-

10. Existen en la actualidad otros proyectos que están empezando a ofrecer datos sobre el viario romano online como el proyecto Aquitaviae (<https://ausonius.u-bordeaux-montaigne.fr/recherche/axes-de-recherche/espaces-fabrique-usages-representations/9-axes/147-aquitaviae>), Vici.org (<https://vici.org/>) o Vías romanas de Castilla y León (<https://viasromanas.net/>)

11. <https://awmc.unc.edu/wordpress/>

te evaluar las redes resultantes a partir de la comparación del número de vías romanas digitalizadas por provincia y su densidad por km² (gráfico 1). Como puede observarse, Viator-e ha incrementado notablemente el número de vías romanas de la provincia Tarraconense, equiparando su densidad al del resto de provincias romanas. De este modo, las densidades de vías romanas por provincia en Viator-e se encuentran entre 60 y 96 m por km², en comparación con AWMC que digitalizó entre 23 y 67 m/km². Es importante remarcar que el aumento del entramado viario no ha sido proporcional en todas las provincias. Si bien se han podido aumentar significativamente las densidades de las provincias ibéricas, las mejoras en las provincias galas han sido mucho menores, debido seguramente al distinto volumen de datos sobre el viario romano procedente del *Barrington Atlas*. De hecho, es fácilmente observable la diferente densidad de vías digitalizadas en la zona ibérica y en la zona gala (figura 2; gráfico 1).

A partir de la digitalización de las vías romanas de la parte occidental del Imperio romano, Viator-e tiene previsto crear un sistema digital online que permita la consulta y descarga accesible y gratuita de todos los trazados viarios para su uso en investigación científica y diseminación. Cada tramo viario tendrá su propia información y actuará como un elemento independiente que podrá ser usado para vincular los datos de otros proyectos (Linked Open Data). La información que contendrá cada elemento permitirá su identificación, su atribución cronológica, así como también un campo donde incluir una descripción, datos sobre el creador de ese recurso e información bibliográfica sobre la que se basó su identificación. La inclusión del campo de autoría es esencial para garantizar que todos los autores que colaboran en este proyecto tienen sus aportaciones correctamente acreditadas, juntamente con el campo de la bibliografía relacionada con el tramo viario, donde se podrán incluir todas aquellas obras que hayan ofrecido información.

La base del proyecto Viator-e serán los tramos viarios. Estos tramos representan conexiones más o menos extensas entre ciudades, núcleos urbanos o intersecciones. De este modo, Viator-e pretende diferenciar entre tramos viarios y grandes rutas viarias, que también se

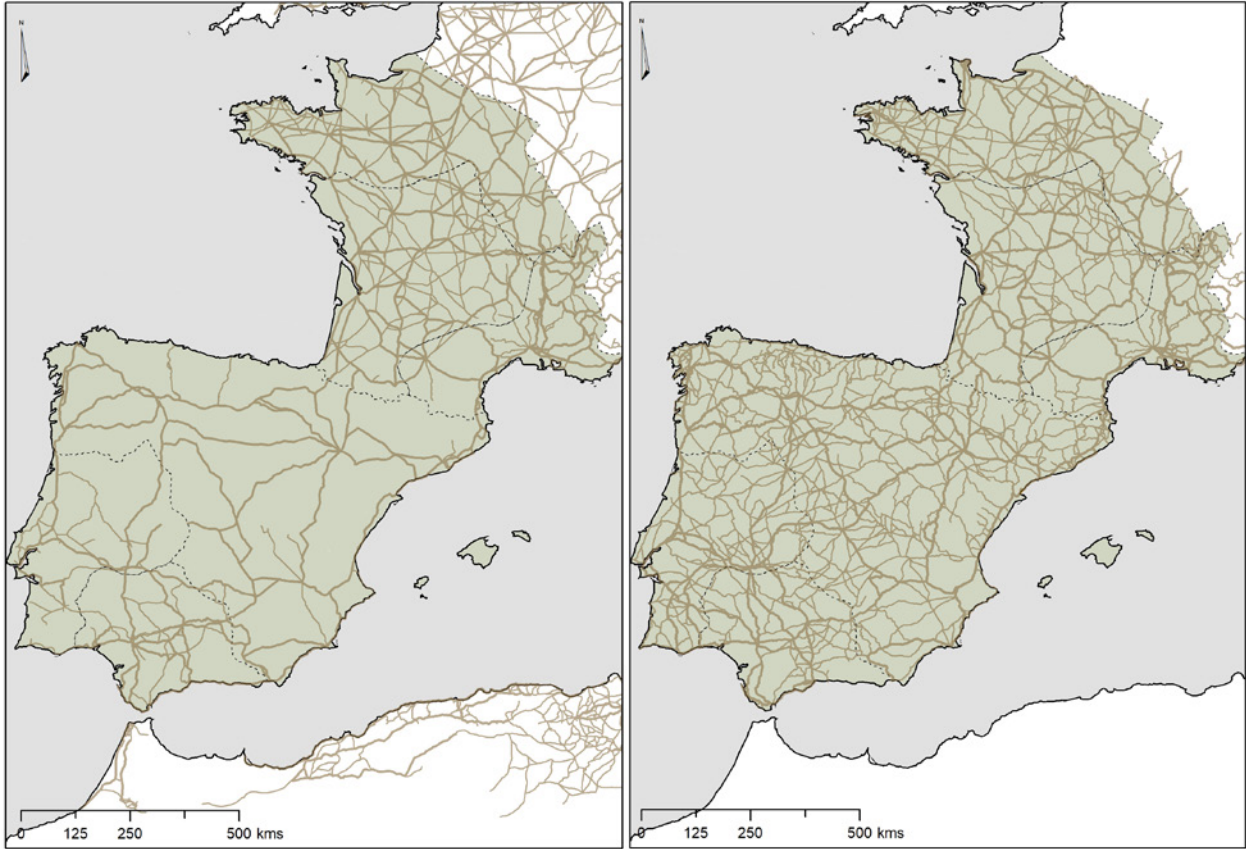


FIGURA 2. Mapa de las vías romanas digitalizadas en AWMC (izq.) y en Viator-e (dcha.).

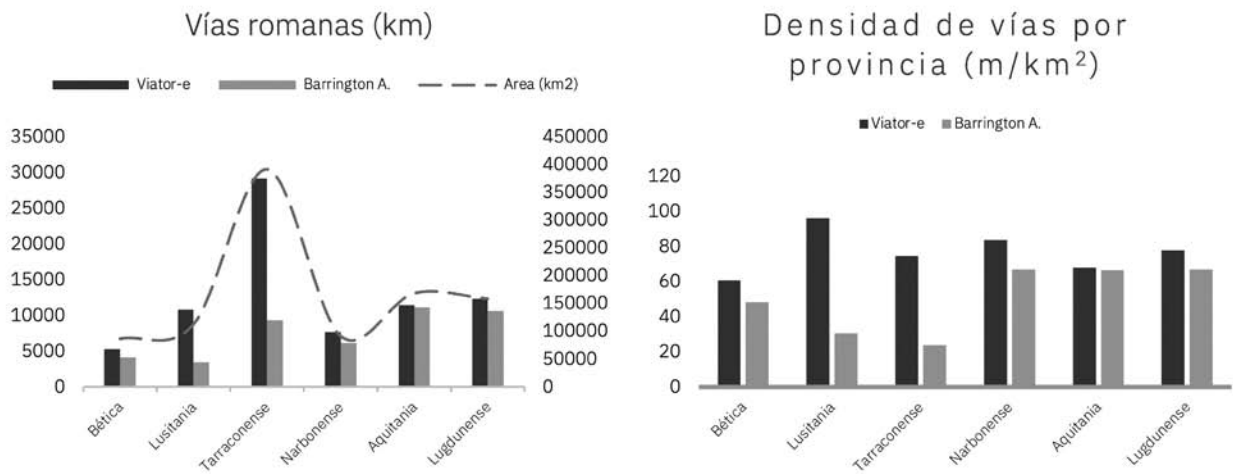


GRÁFICO 1. Distancias de vías romanas en el proyecto Viator-e y Barrington Atlas y densidad por provincia.

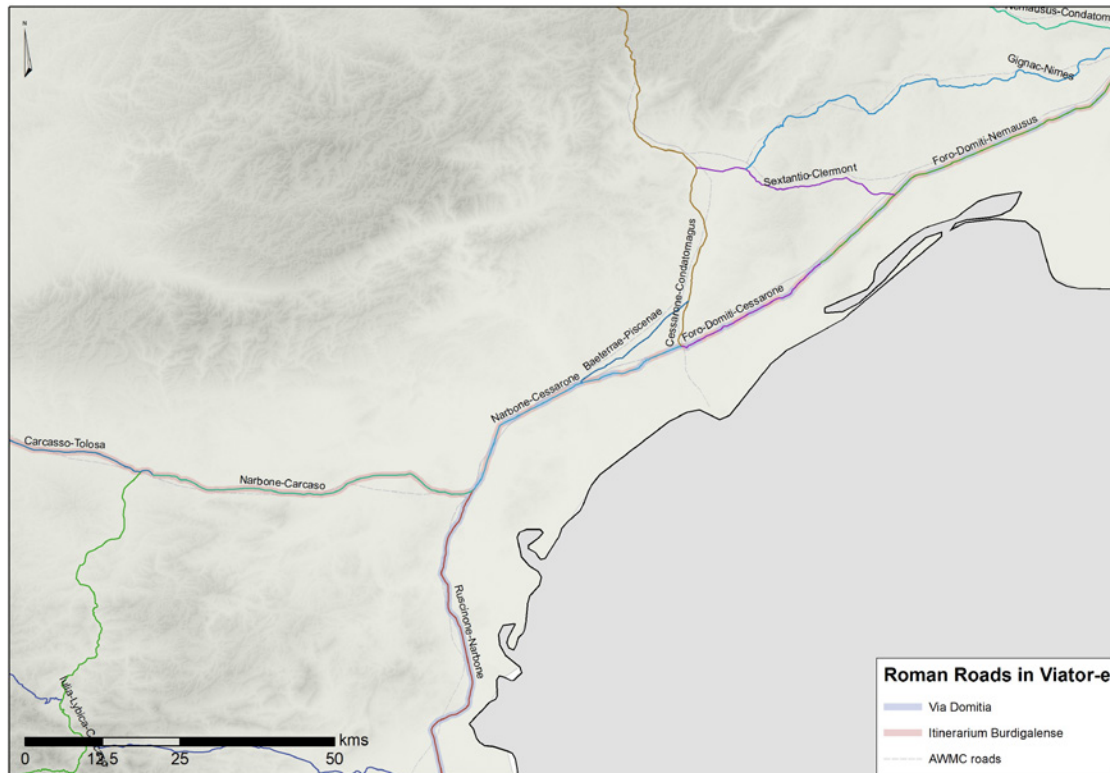


FIGURA 3. Fragmento del trazado de la Via Domitia (azul), el *Itinerario Burdigalense* (marrón) y su trazado coincidente.

incluirán en el proyecto. Los grandes ejes de comunicación se conformarán a partir de la suma de varios tramos viarios. De este modo se logra evitar la repetición de los mismos trazados cuando dos o más grandes rutas romanas coinciden en su itinerario. Un ejemplo de esta situación puede observarse en el caso de la Via Domitia (Castellví *et al* 1997). En Viator-e, se han digitalizado los diversos tramos que conforman este gran eje viario en diversas secciones individualizadas que posteriormente se unirán en un único eje. Sin embargo, parte de estos tramos también coinciden, por ejemplo, con el *Itinerario Burdigalense* (Elsner 2000). Esta metodología evita la duplicidad de tramos digitalizados y permite que varios tramos viarios puedan formar parte de más de una gran ruta (figura 2).

En colaboración con el proyecto Itiner-e,¹² codirigido por Tom Brughmans y Pau de Soto, se está desarrollando una interfaz digital que permita la introducción, el almacenamiento, la

12. <http://itinererecerca.iec.cat/>

publicación online, la consulta y la descarga de todas las vías del Imperio romano.¹³ Este sistema permitirá almacenar toda la información de cada tramo viario, visualizarlo y descargarlo. Además, las grandes rutas, así como los tramos que las conforman, tendrán su propio identificador que permitirá que las vías romanas de Viator-e actúen como elementos de un *gazetteer* online. Este posibilitará la conexión abierta con los datos de otros proyectos a partir de la aplicación de los protocolos establecidos por la comunidad de los Linked Open Data (Bizer *et al.* 2009).

3.1. Linked Open Data

En efecto, uno de los objetivos principales de Viator-e es la creación de un *gazetteer* que permi-

13. Itiner-e englobará en un futuro muy cercano los datos de las vías romanas de la parte occidental del Imperio romano generados por el proyecto Viator-e (IP: Pau de Soto) y los datos del viario de la parte oriental generados por el proyecto Minerva (IP: Tom Brughmans)

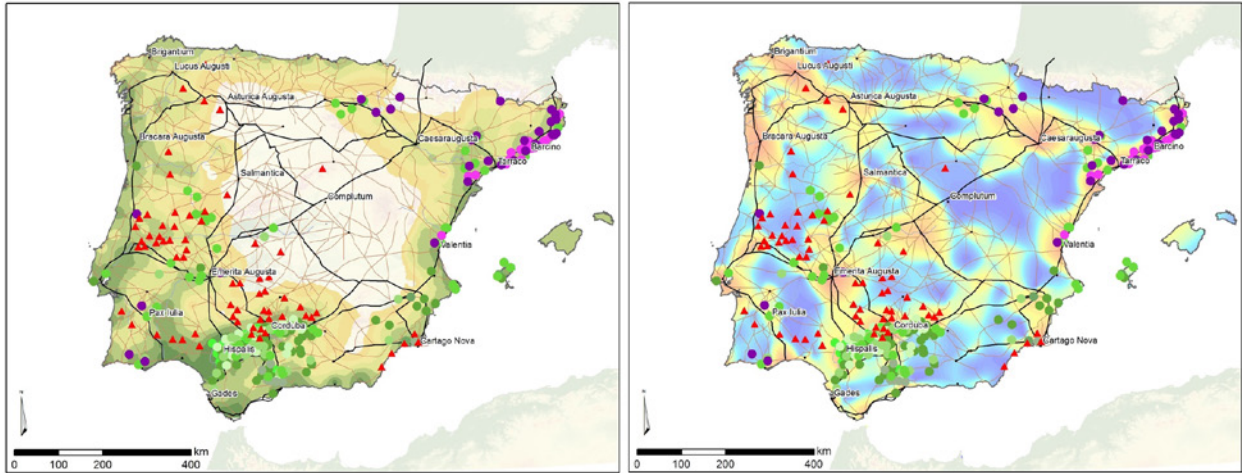


FIGURA 4. Cálculos de la accesibilidad (izq.) y los costes de transporte (dcha.) en la Península ibérica.

ta la utilización de las vías romanas como punto de unión entre proyectos. Siguiendo la propuesta que inició el proyecto Pleiades Gazetteer of the Ancient World,¹⁴ desarrollado bajo el auspicio del Institute for the Study of the Ancient World de la New York University, Viator-e creará un identificador estable para cada tramo viario, del mismo modo que Pleiades identifica cada yacimiento del mundo antiguo. Estos identificadores (URI) de Pleiades pronto se destacaron dentro del Semantic Web, a partir de estándares (RDF, SPARQL), como un elemento indispensable y accesible para conectar, para intersectar proyectos que no se habían podido conectar antes. Las vías romanas en Viator-e no pretenden sustituir de ningún modo la estructura que se ha creado alrededor de los topónimos de Pleiades, pues la estructura y la función son distintas y siempre será más sencillo conectar dos grupos de datos mediante su conexión con un punto geográfico que con una estructura viaria. Sin embargo, también creemos que la combinación y la conexión que pueden establecerse entre topónimos, vías y otros datos pueden resultar muy atractivas e interesantes. Si mediante la conexión más amplia se pueden conectar los datos que coinciden en un yacimiento, parece también interesante poder analizar y vincular todos aquellos datos que apa-

recen vinculados en una estructura viaria como podría ser la Vía Augusta.

3.2. Análisis de las redes de transporte

Finalmente, otro de los objetivos de Viator-e es aprovechar la enorme red de comunicaciones digitalizada durante el proyecto para aplicar estudios basados en Network Science. Un objetivo que permite entender mejor la morfología de las redes que construyó Roma y su funcionalidad. Estos análisis, que ya han sido aplicados al estudio de las vías romanas de la Península ibérica (Carreras y de Soto, 2013, de Soto y Carreras 2013, de Soto 2019), se basan por un lado en el cálculo de la centralidad de las ciudades y asentamientos para visualizar los territorios mejor comunicados y aquellos que en época romana se encontraban más aislados (figura 3). Por otro lado, también se pretende aplicar los conocimientos de que se dispone actualmente sobre los costes temporales y económicos del transporte antiguo (Carreras y de Soto 2010, Scheidel 2013) sobre la red de transporte digitalizada, incluyendo las comunicaciones marítimas, el transporte fluvial y las vías terrestres.

A partir de la aplicación de estos cálculos a un territorio tan amplio como la parte occidental del Imperio romano, que incluye más de 15 provincias, se podrán obtener unos resultados absolutamente interesantes.

14. <https://pleiades.stoa.org/>

BIBLIOGRAFÍA

- ALMEIDA, María José (2017). *De Augusta Emerita a Olisipo por Eborac: uma leitura do território a partir da rede viária*. Tesis doctoral, Universidade Nova de Lisboa.
- ARGÜELLES, Patricia (2016). *Comunicaciones históricas en la región de Asturias desde tiempos antiguos hasta siglos medievales: el caso del viario romano en el sector transmontano*. Tesis doctoral, Universidad de Cantabria.
- BENOIT, Fernand (1964). «Le développement de la colonie d'Arles et la centuriation de la Crau». *Comptes rendus des séances de l'Académie des Inscriptions et Belles-Lettres*. 108-1, 156-169.
- BIZER, Christian; HEATH, Tom; BERNERS-LEE, Tim (2009). «Linked Data: The Story so Far». In: HEATH, T.; HEPP, M.; BIZER, C. (eds.). *Special Issue on Linked Data, International Journal on Semantic Web and Information Systems*. 5(3): 1-22.
- CARRERAS, Cèsar; DE SOTO, Pau (2013). «The Roman transport network: a precedent for the integration of the European mobility». *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 46/3, 117-33.
- CARRERAS, Cèsar; DE SOTO, Pau (2010). *Historia de la Movilidad en la Península Ibérica: Redes de Transporte en SIG*. Editorial UOC.
- CASTELLVI, Georges; PEZIN, Annie; KOTARBA, Jérôme; COMPS, Jean (1997). *Voies romaines du Rhone à l'Ebre: via Domitia et via Augusta*. Documents Archéologie Française, 61. París: Éditions de la Maison des Sciences de l'Homme.
- CORZO, José Ramón; TOSCANO, Margarita (1992). *Las vías romanas de Andalucía*. Dirección General de Ordenación del Territorio, Sevilla.
- CRAMER, Florian (2015). «What Is 'Post-digital'?». *Postdigital Aesthetics*, 12-26.
- DE SOTO, Pau (2010). *Anàlisi de la xarxa de comunicacions i del transport a la Catalunya romana. Estudis de distribució i mobilitat*. Tesis doctoral, Universitat Autònoma de Barcelona.
- DE SOTO, Pau (2019). «Network analysis to model and analyse Roman transport and mobility». In: VERHAGEN, Philip; JOYCE, Jamie; GROENHUIJZEN, Mark (eds.). *Finding the Limits of the Limes: Modelling Demography, Economy and Transport on the Edge of the Roman Empire*. Springer Nature: 271-90.
- DE SOTO, Pau; CARRERAS, Cèsar (2015). «GIS and network analysis applied to the study of the transport in the Roman Hispania». *Proceedings of the XVIII International Congress of Classical Archaeology. Centre and Periphery in the Ancient World. XVIIIth International Congress of Classical Archaeology*. Mérida: 733-38.
- ELSNER, Jas (2000). «The Itinerarium Burdigalense: Politics and Salvation in the Geography of Constantine's Empire». *The Journal of Roman Studies*, vol. 90, 181-195.
- FULLER, Steve; JANDRIĆ, Petar (2019). «The Postdigital Human: Making the History of the Future». *Postdigital Science and Education, Educational Philosophy and Theory* 1: 190-217.
- HOUTEN, Peter (2021). *Urbanisation in Roman Spain and Portugal Civitates Hispaniae in the Early Empire*. Routledge.
- JANDRIĆ, Petar; KNOX, Jeremy; BESLEY, Tina; RYBERG, Thomas; SUORANTA, Juha; HAYES, Sarah (2018). «Postdigital science and education». *Educational Philosophy and Theory*, 50,10, 893-899.
- MAGALLÓN, María Ángeles (1987). *La red viaria romana en Aragón*. Diputación General de Aragón.
- MORENO, Isaac (2011). *Vías romanas en Castilla y León*. Junta de Castilla y León.
- NEGRE, Joan (2013). *De Dertosa a Turtūša. L'extrem oriental d'al-Tagr al-A'la en el context del procés d'islamització d'al-Andalus*. Tesis doctoral, UAB. <http://hdl.handle.net/10803/116319>.
- NEGROPONTE (1998). «Beyond digital». *Wired*, enero, 12. <https://www.wired.com/1998/12/negroponte-55/>
- NOUVEL, Pierre; GAËTAN, Loïc; JOLY, Martine; VENAULT, Stéphane; VINOT-BATTISTONI, Benoit. (2016). *Le centre-est de la Gaule: stations routières et groupements de bord de voie*. Gallia, 73-1, 275-295.
- PARCERO-OUBIÑA, César; FONTE, Joao; COSTA-GARCÍA, José María (2017). «A

- GIS-based analysis of the rationale behind Roman roads. The case of the so-called via XVII (NW Iberian Peninsula)». *Mediterranean Archaeology and Archaeometry*, 17-3, 163-189.
- SCHEIDEL, Walter (2014). «The shape of the Roman world: Modelling imperial connectivity». *Journal of Roman Archaeology* (27), 7-32.
- SILLIÈRES, Pierre (1990). *Les voies de communication de l'Hispanie méridionale*. Diffusion de Boccard.
- TALBERT, Richard (2000). *The Barrington Atlas of the Greek and Roman Empire*. Princeton University Press.

**STUDIES OF LANDSCAPE, SETTLEMENT AND ARCHAEOLOGICAL
TOPOGRAPHY IN THE DEVELOPMENT OF DIGITAL CARTOGRAPHY**

TIR-FOR (*Tabula Imperii Romani – Forma Orbis Romani*) and the landscape archaeology in northern Dacia. The case of Potaissa

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ABSTRACT

This study represents an overview of the settlement of Potaissa (today Turda, Cluj County, Romania). The first part of the study is a short introduction to the topic, while the following sections include a description of some essential aspects regarding the legionary fortress, the city, necropolises, ceramic workshop, aqueducts and the rural settlements around Potaissa.

KEYWORDS: Potaissa, TIR-FOR, Roman Dacia, mapping archaeological sites, gazetteer.

1. INTRODUCTION

Defining the topography of a Roman city is conditioned by numerous circumstances. Important Roman cities such as *Aquincum*, *Vindobona*, *Mogontiacum*, *Argentoratum* and *Napoca* are now entirely or partially covered by modern cities, making research more difficult. Urban archaeology is about rescuing pieces from the puzzle. One must bear in mind that, during the 1970s in Western Europe and after the 1990s in Eastern Europe, increased investments in road constructions, the development of residential areas and the rise in the number of inhabitants, together with other causes, put tremendous pressure on heritage, resulting in a significant increase in preventive archaeological excavations in these affected areas.

The mission of an archaeologist is, in our opinion, not only to discover but also to protect. We must therefore act fast, and we must act now, to identify, map, digitise and promote our heritage. This is our mission, dictated by our conscience and legally sustained by the recommendations of the

La Valletta convention and by each country's legislation in the area of archaeology.

Potaissa is no exception. The history of the city begins with the Romans; before them, a Dacian presence is barely documented. The boom started in 168 AD, when *legio V Macedonica* was transferred here from Troesmis (Moesia Inferior) due to events related to the Marcomannic wars. Before 168 AD, Potaissa was a small *vicus* but the presence of the army led to the rapid development of the city. During Septimius Severus, it became a *municipium* and then *colonia*, possibly at the end of the reign of the famous African emperor.

The topography of Potaissa is a topic constantly focused on by historians (Fig. 1). Since the 1970s, or even earlier, elements of the former city were revealed due to different factors, such as rescue archaeological studies and terrain observations. Even so, we need more data to clarify some issues.

Current preventive archaeological research represents an important source of information for all these issues. This paper attempts to shed some light on the topography of the city, combining data obtained using digital technology, non-invasive methods to locate discoveries, old data

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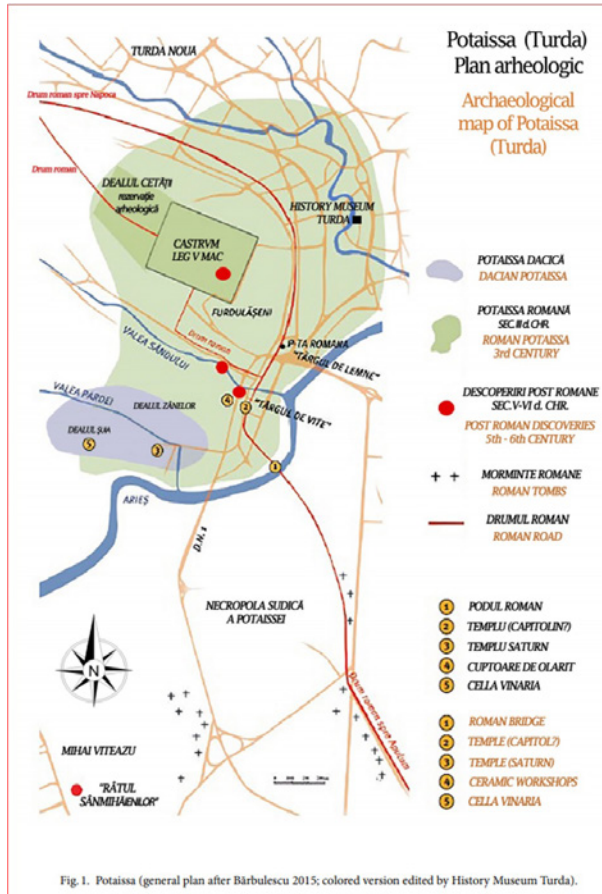


FIGURE 1. General plan of Potaissa. Source: Andone-Rotaru, Nedelea, 2018, 70, Fig. 1.

from the 19th century and information based on archaeological excavations.

2. POTAISSA. THE LEGIONARY FORTRESS AND THE CITY. A SHORT HISTORY OF THE ARCHAEOLOGICAL RESEARCH

The fortress of *legio V Macedonica* was built on the hill known as “Cetate”, located in the western part of the current city (Fig. 2, Fig. 3). The legion was brought here during the Marcomannic Wars (ca. 170 AD) and it stayed here for almost 100 years. The legionary fortress from Potaissa (today Turda, Cluj County, Romania), known since the 19th century, was first archaeologically investigated in 1958.² After

2. Crișan, 1961, 431-439.

an interruption of more than two decades, the archaeological excavations restarted in 1971 under the supervision of Mihai Bărbulescu and they continued, with no other interruptions, until 2019. During this period of half a century, several important internal buildings of the fortress were identified and entirely or partially excavated. These are: *porta decumana*, *porta principalis dextra*, the north-west bastion and a wastewater canal in its proximity, the curtain wall bastion on the western side, *via praetoria*, *via principalis*, the headquarters building (*principia*), the baths (*thermae*), the granaries (*horrea*), the *palaestra*, and the garrison's barracks (*centuriae* partially unearthed in *praetentura sinistra*, *praetentura dextra*, *latera praetorii* and *retentura*). Other buildings located in *praetentura dextra* were also partially investigated. Research in the civil area (*canabae*) was also carried out. Until now ten monographs have been published, of which eight focus on the legionary fortress³ and three on the city.⁴

Preventive and systematic archaeological work was also carried out on different occasions, also within the territory of the former Roman city, nowadays covered by the modern one. The results of these investigations have been published in various articles and studies.⁵

Of the most important buildings unearthed inside the fortress, the headquarters building (*principia*) is very important (Fig. 4). *Principia* were built facing the *via principalis* and centred on the long axis of the fortress. The headquarters cover a surface area of 0.899 ha, accounting for 3.8% of the entire area of the fortress (23.66 ha).⁶ The shape of the *principia* is rectangular (124.6 m, 125 m, the length of the northern and southern

3. Bărbulescu, 1987; Bărbulescu, 1997; Bărbulescu 2004; Bărbulescu, 2008; Bărbulescu, 2012; Nemeti *et alii*, 2017; Bărbulescu *et alii*, 2019; Bărbulescu *et alii*, 2020.

4. Bărbulescu 1994; Pîslaru 2009; Bărbulescu 2015 = Bărbulescu 2016.

5. Selectively: Balázs, 1889; Bajusz, 1980, 367-394; Bajusz, 2005; Bărbulescu, Cătiņaș, 1992, 111-124; Cătiņaș, 1978, 195-200; Fodorean, 2013, 67-70; Fodorean 2015, 112-118; Fodorean, 2017, 187-203; Hopârtean, Luca, 1982, 111-113; Jude, Pop, 1973; Jude, 1972, 497-501; Luca, Hopârtean, 1980, 115-122; Milea, Jude, 1972, 667-670; Milea, Feneșan, 1966, 267-268; Milea, Hopârtean, Luca, 1978, 201-206; Mitrofan, 1969, 517-523; Nemeti, Nemeti, 2014, 85-98; Russu, 1941, 319-340; Téglás, 1913, 22-28; Téglás, 1910, 123-130; Téglás, 1910a, 353-356; Tîgăra, 1960, 195-212.

6. Bărbulescu *et alii*, 2020, 17.

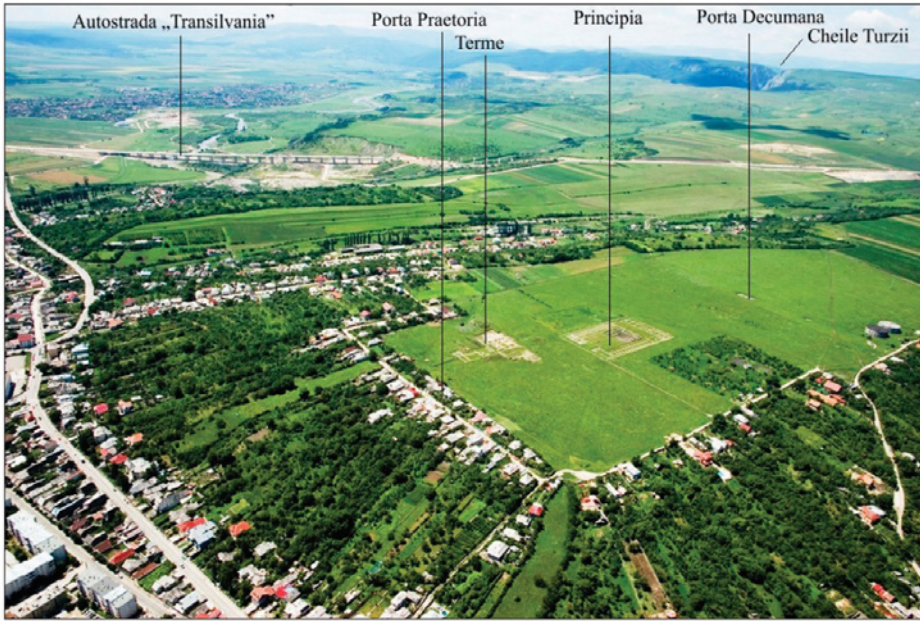


FIGURE 2. The fortress of *legio V Macedonica* at Potaissa. General view. Source: Bărbulescu *et alii*, 2020, 13, Fig. 1.

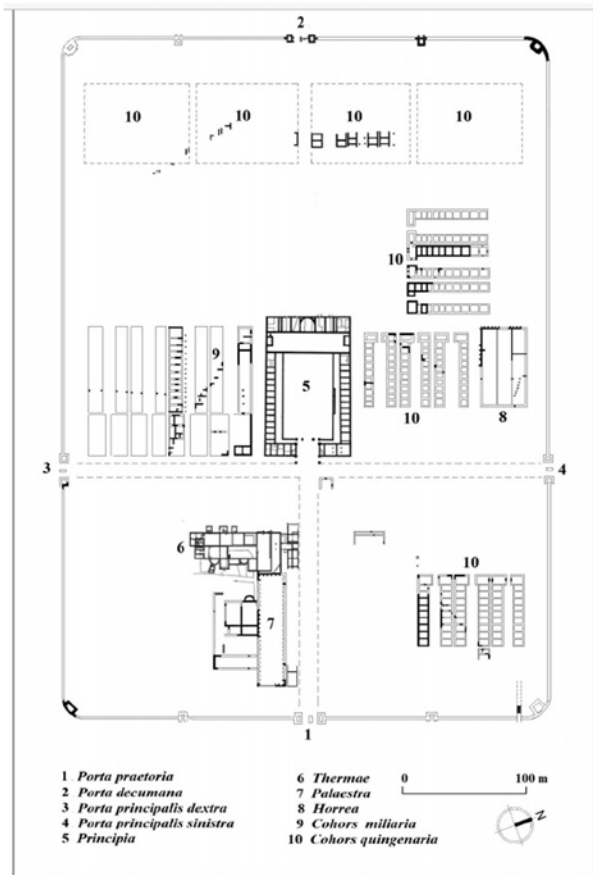


FIGURE 3. The fortress of *legio V Macedonica* at Potaissa. Plan. Source: Bărbulescu *et alii*, 2020, Fig. 3.



FIGURE 4. The reconstruction of the the headquarters building at Potaissa. Perspective superimposed over the archaeological remains. Source: Bărbulescu *et alii*, 2020, 64, Fig. 79.

sides; 72.6 m and 71.8 m, the length of the eastern and western sides). A large opening of 18.90 m was left in the centre of the eastern side. The inner courtyard, without the porches, measured 41.50×73 m, occupying a total surface area of $3,029 \text{ m}^2$. With such an area, this seems to be the largest *principia* court among the legionary fortresses from the Roman Empire, surpassing even the court of the legionary fortress from Vetera, which measures $2,805 \text{ m}^2$.⁷

The fortress baths (*thermae*) were totally unearthed from 1993 to 2007.⁸ The baths are located in the *praetentura dextra*. The edifice has a maximum length of 73 m and a maximum width of 37 m. It has a total surface area of $1,850 \text{ m}^2$, accounting for 0.8 % of the entire area of the fortress (Fig. 5, Fig. 6). The baths at Potaissa are relatively small compared to the large dimensions of the *principia*. The plan of the *thermae* at Potaissa is very similar to the plan of the baths from the auxiliary fort at Weißenburg (phase III), contemporaneous with the baths from Potaissa. The elements identified inside the baths are: 1. The *frigidarium/vestibulum* E (rectangular, 23×9 m), which occupies a central position, paved with bricks; 2. The semi-circular basin, which covered an area of approximately 38 m^2 ; 3. The rectangular basin (7.60×4.10 m), open towards the *frigidarium / vestibulum* E; 4. A small, rectangular basin (255×130 cm) located in the south-eastern corner of the *frigidarium* E; 5. Room G (7.5×5.95 m) located south of basin F; 6. *Latrina* I, located near the entrance from the *basilica*, measuring, on the inside, 9×5.70 m; 7. Wastewater channel I; 8. The *apodyterium* (room N), measuring 9×9 m. This room could be entered from the *basilica* or from the *frigidarium* E; 9. The *tepidarium-districtarium* (room M), a rectangular room of 8.90×9 m with a *praefurnium* located to the west; 10. Room L (*tepidarium*; *laconicum*?), located to the south, also rectangular in shape (8.95×9.10 m) and with a *praefurnium* to the west; 11. Room K (*caldarium*), measuring $12.20\text{-}12.30 \times 9\text{-}9.10$ m, located in the south-western corner of the baths; 12. Room I (*frigidarium*, then *caldarium*), situated in the south-eastern corner of the baths, measuring

7. Bărbulescu et alii, 2020, 39.

8. Bărbulescu et alii, 2019.

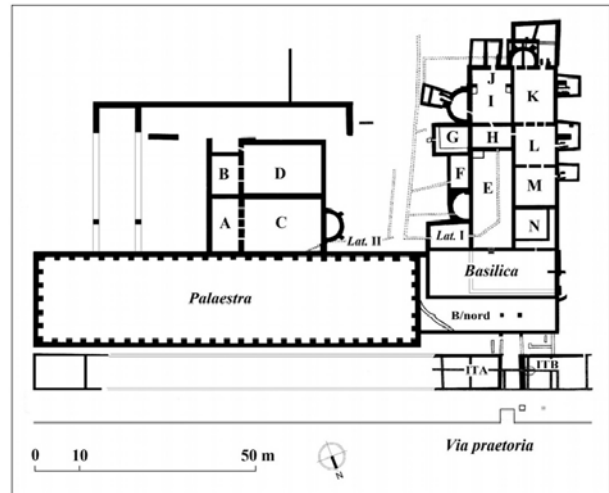


FIGURE 5. The fortress baths at Potaissa. Plan.
Source: Bărbulescu et alii, 2019, 16, Fig. 6.



FIGURE 6. The reconstruction of the fortress baths. Architectural perspective superimposed over the archaeological remains. Source: Bărbulescu et alii, 2019, 109, Fig. 273.

9×12.50 m; 13. Room H, south of the *frigidarium* E, measuring $9.05 \text{ m} \times 4.90$ m; 14. The *basilica thermarum*, initially measuring 19.30×9.20 m, located in front of the *frigidarium* E, enlarged during stage II to 29.60×10.34 m; 15. A *palaestra* without porticoes, situated parallel to the *via praetoria*, measuring 91.15×23.40 m.

The baths were built in three phases: phase I (170-195 AD); phase II (195-211 AD); phase III (211-235 AD).

3. THE INTERNAL ROADS OF THE CITY AND THE FORMER BRIDGE

The traces of the main imperial road are lost at the entrance to the city, in the north-west part of the current city. What we know is that the road avoided the hill “Cetate”. According to M. Bărbulescu, the road followed the route of the current roads Barițiu – Dr. I. Rațiu or General Dragalina, or a route between these two current roads.⁹ Another proposal regarding the route of the former Roman road is to locate it towards the east, following the current roads of Clujului, Avram Iancu, then the central area with Republicii street, then reaching the current area of the 1 Decembrie 1918 street, and then Libertății street.¹⁰ Funerary monuments and graves have been discovered in several areas, including the streets Barițiu, Libertății and Rațiu. In any of these two versions, the road passed through the area called today “Piața Romană”, located in the northern area of the Arieș River and in the southern part of the current city. From this point, the Roman road crossed over the rivulet Sând, then crossed the area of the Septimian *municipium*. M. Bărbulescu recorded that the road represented a *cardo maximus* for the Roman city, which is correct.¹¹ After crossing the Arieș River, the road continued towards the south-east, crossing the so-called “industrial area” of Turda. The southern necropolis of Potaissa is located close to the route of the Roman road. Further on, the same road continued towards the current villages of Bogata and Călărași. It is mapped and indicated with the toponym “Drumul lui Traian” (“Trajan’s road”). After approximately 12 Roman miles from Potaissa, it reaches the Roman fort of Războieni-Cetate.

Like the former Roman city, the internal road network of Potaissa is obviously covered by the current city. However, some small sectors

of these roads have been observed at times in different areas, such as the so-called “Dealul Zânelor”, or along the valley of the river Sând, or at the exit from *porta principalis dextra*.¹²

Regarding the Roman bridge across the Arieș River, nowadays its traces are lost but data about it have been known since the 19th century, when the Hungarian writer Orbán Balázs noted that he saw the ruins of the bridge at a distance of about 100 paces away from the former Bethlen mill.¹³ The building of this mill is still standing today and is located close the crossroads between the streets Panait Cerna and Alecu Russo. The ruins of the bridge were also observed in the terrain before the time of Orbán Balázs. In 1833, J. Ercsey observed, in the field, the remains of the sides of the bridge, together with other artifacts, fragments of columns and some capitals. We also know that, in 1882, these remains totally collapsed, and we know that 42 stone blocks were removed and used for different constructions within the city.¹⁴

4. THE CEMETERIES OF POTAISSA

Potaissa is the only former Roman city where important discoveries, places with ruins and various artifacts have been systematically recorded since the 19th century. The biggest role was played by a school inspector of Hungarian origin, Téglás István (1853-1915). For 21 years, from 1894 until his death in 1915, he drew, noted, made sketches, bought and recorded ruins, wall foundations and artifacts, as a true pioneer of archaeology. He even started an archaeological collection. His hard work and passion resulted in 56 absolutely incredible diaries, full of notes and coloured drawings on maths paper. Based on these data, articles regarding the location of some sites were published.¹⁵ These diaries still exist today and, moreover, in 2005 Téglás’ great-grandson, Bajusz I., published them in a two volume monograph.¹⁶

9. Bărbulescu, 1994, 66.

10. Bărbulescu, 1994, 66.

11. Bărbulescu, 1994, 66.

12. Bărbulescu, 1994, 66.

13. Bărbulescu, 1994, 67; Fodorean, 2011a, 146.

14. Bărbulescu, 1994, 67.

15. Fodorean, 2017, 187-203.

16. Bajusz, 2005.

Another important work published in the 19th century is the book by Orbán Balázs.¹⁷ Some information, mostly about artifacts, can also be recovered by analysing what was left from the collections and photographs made by Botár Imre.¹⁸ Other antiquities from Potaissa were collected during the 19th century by Count Kemény József (1795–1855) at Lunca (Cluj County), a village close to Turda where the Hungarian count owned a castle. Inscriptions from Potaissa are still visible today on the walls of the Reformed church in Lunca.

Roman graves in Potaissa have been uncovered since the 19th century. We owe this to Téglás István, who discovered and registered in his notes a series of Roman graves in 1895, 1902-1907 and 1911-1912.¹⁹ Then, during the last century, graves were discovered in some special circumstances, mostly due to rescue excavations.²⁰

In Potaissa, the archaeological evidence shed light on the location of two main necropolises. The biggest one is the southern cemetery, located on the right (southern) bank of the Arieş River, along the imperial Roman road Potaissa-Apulum (see Fig. 1). It is difficult to appreciate which are the limits of this cemetery. Still, it seems that the northern limit corresponds with the current area where the former cement factory was built. To the south and south-east, the limit might be the line of the imperial road. In the western part, the cemetery was extended towards the current village Mihai Viteazu. Discoveries of graves in this area were registered in several points, such as “Bodoc”, “Râtul Sânmihăienilor”, and “Uzina de apă”. Some graves were also discovered during the preventive archaeological work carried out in 2007 due to the construction of the Transylvanian highway. Comparing the number of the graves discovered within this cemetery (around 2/3 of the total number of graves from Potaissa), it seems that this necropolis was the main one in the city. The other cemetery, located in the western part of the former Roman city, is made up of several points,

such as the hills “Șuia” and “Zânelor”, the valley of Pardei, the valley of the rivulet Sând and other small areas.

5. THE AQUEDUCTS OF POTAISSA

An aqueduct (*aquaeductus*) made of ceramic tubes brought water for the legionary fortress from the spot called “Izvorul Copăcenilor” today, south-west of Copăceni, in the border area of the Trascău Mountains, on the right of the current Turda-Petrești road (Fig. 7). Another aqueduct supplied water to the city of Potaissa. Data regarding this aqueduct have been recorded since 1810, when a traveller, Moise Nicoară, recorded, in the village of Copăceni, the remains of the aqueduct.²¹ Few years later, M. J. Ackner and J. F. Neigebaur mentioned traces of the same aqueduct.²²

At the end of the 19th century, Orbán Balázs presented the antiquities from Turda in a book. In a subchapter about aqueducts, he noted the position of the spring, the qualities of the water, the approximate route of the aqueduct and the possible existence of an aqueduct for the Roman legionary fortress on Zânelor hill. “From here, at a distance of one mile and on the hill above Copăceni, close by the road which goes to the mountain (“Drumul Mocanilor”), there is a corridor of stone where a rich spring called Șipotul (Cișmeaua) de Piatră (Köcsorgó) is located, with a rivulet of water as thick as an arm, as cold as ice, which flows into a sort of stone basin. The Romans collected this from the beginning. They have stolen it from its riverbed, forced it to enter the pipes of the aqueduct and guided it to the Roman camp and the city of Potaissa”.²³

The aqueduct which supplied the fortress with water was identified at several points.²⁴ About 70 m south-west of the road Turda-Petrești and 40 m south of the road to Sândulești, in the autumn of 2007 during the excavation of a trench for a gas pipe, fragments from the aqueduct were discovered at a depth of 0.80 m.

17. Balázs, 1889.

18. Ardevan, Rusu, 1979, 387-409.

19. Bajusz, 2005, 855-894.

20. Mitrofan, 1969, 517-523; Milea, Hopârtean, Luca, 1978, 201-206; Nemeti, Nemeti, 2014, 85-98; Pâslaru, 2007, 339-364; Cociș, 2015, 58-66.

21. Bărbulescu, 1980, 285, note 17.

22. Bărbulescu, 1994, 68.

23. Balázs, 1889, Ch. 9, 51-53.

24. Fodorean, 2011, 99-101.

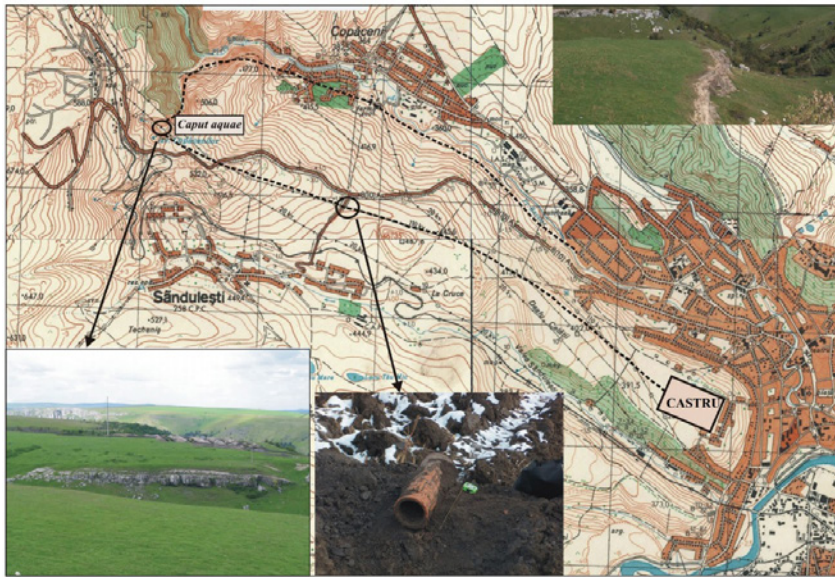


FIGURE 7. The route of the aqueduct which supplied the legionary fortress from Potaissa. Source: Bărbulescu *et alii*, 2019, 157, Fig. 316.

Two years earlier, in the winter of 2005-2006, when the works for the construction of the Transylvanian highway started, another water pipe was discovered, at the same depth and almost in the same place as the other one, around 130 m north-east of the highway. The pipe was found in one piece: 60 cm in length, external diameter 16.5 cm, internal diameter 12.5 cm. Three decades earlier, in 1978, to the west of the military fortress and close to the *porta decumana*, other pipes from the same aqueduct were discovered.²⁵ These are identical in diameter; only the lengths are different (43 cm, 55 cm).

The same aqueduct was identified in gardens on the western side of the village of Copăceni. This point is situated south of the current road between Petrești and Turda.

The distance between the spring (“Izvorul Copăceniilor”) and the fortress is approximately 4,950 m. The altitude of the starting point of the aqueduct (*caput aquae*) is 525 m. The fortress is at an altitude of 375 m, so there is a difference in level of 150 m at 5 km; i.e. 30 m every kilometre. Assuming a ceramic pipe measured on average 50 cm, one can calculate that at least 10,000 tubes were needed to bring spring water to the fortress. Assuming maximum flow, the aqueduct would have brought around 2,600,000 litres daily into the fortress, this being very little for such a large

number of soldiers and so many needs. It has been estimated that human consumption in the fortress needed a maximum of 12,500 litres/day while animal consumption needed around 18,000 litres of water/day. To this, we should add technical consumption, consumption by the *valetudinarium*, the individual baths of the officers, the latrines and the consumption by the baths. Therefore, the water requirements that can be estimated (drinking and cooking water, water to fill the basins in the *thermae*) do not surpass 150,000 litres/day. This is not so much but it merely represents the consumption of “static” water. The largest quantities of water were needed for the baths and this is the so-called “running water”. An estimate regarding solely the flow through the wastewater channel of the latrines indicates 0.0575 m³/sec.; i.e. more than 50 litres/sec., almost double the flow of the aqueduct.²⁶ Therefore, the aqueduct was unable to provide all the water required by the fortress.

6. THE POTTERY WORKSHOP

Starting in the 19th century, Téglás István recorded the existence of pottery fragments in two distinctive areas, called “Zâna Mică” and “Zâna Mare”. Moreover, he was convinced that,

25. Bărbulescu, 1978, 68.

26. Bărbulescu, Fodorean, 2019, 155-156.

at the foot of the “Zâna Mică” hill, and due to consistent discoveries, a pottery workshop had existed in Roman times. These assumptions and terrain observations made by Téglás have been confirmed by both older and more recent archaeological investigations. In 1964 six pottery kilns were identified on the south-eastern slopes of the hills “Zâna Mică” and “Zâna Mare”.²⁷ More recently, other parts of the pottery workshop have been discovered: six kilns in 2005; a further six in 2006 together with waste pits and traces of constructions; and other discoveries in 2008. After the archaeological excavations carried out in the area of the hill called “Zânelor”, and the mapping of these discoveries, a firm conclusion could be drawn: two workshops were in operation in Roman times in Potaissa, in this area.²⁸

7. SOME FINAL REMARKS

It is important to locate and map the precinct wall of the city. Old sources mention that, in 1857 and due to some work, a 200 m long wall was discovered close to the old mill. Locating and mapping the precinct wall would also provide new data regarding the area covered by the former Roman city. The internal road network of Potaissa can be reconstructed based on both older and current data. Moreover, data concerning the former bridge have been known since the 19th century. In the future, it would be interesting to locate the Capitoline temple of the city. In 1856 several altars were discovered in an area which might indicate the existence of such a temple. Another difficult task is the location of the forum, since the current city covers the Roman city. There are also data regarding the existence of other temples in the city; for instance, an interesting altar dedicated to Saturnus, dated around 200 AD, might indicate the existence of a temple dedicated to the African divinity within the territory of Potaissa. There are also archaeological data regarding the location of at least one *mithraeum*. A colossal head of Mithras, together with his right hand, was discovered at a

point called “Forduló” (“Furdulăşeni”). Another task in the future is to establish, more precisely, the residential areas of the former city. If mapped and precisely located, these many disparate discoveries could provide important information about the city’s topography. For example, we estimate that, in the area of the current streets Aroneanu, Cheii, M. Costin, P. Cerna, Zamfirescu, Bălcescu and A. Russo, there is a remarkably high density of discoveries, indicating the presence of some former domestic houses. A fragment of a Roman road, different artifacts (brooches, rings, bracelets, combs), fragments of altars, statues etc. are all discoveries which, after their mapping, will offer new insights regarding domestic life in Potaissa. But we need to put together all these discoveries, to map them and interpret the data obtained. Only by using this methodology will we be able to indicate the density of the inhabitation inside the city and in areas very close to it, like the so-called “Dealul Zânelor” (“The Fairy Hill”), “Piața Romană” (“the Roman square”), the valley of the river Sând, Sândulești street, etc.

Another important research topic for the future is to locate and excavate the amphitheatre. As yet, no indications have been uncovered regarding the existence of an amphitheatre but a city with circa 20,000 inhabitants would presumably have had such a place of entertainment.

Extensive archaeological investigations in the field will also enable us, in the future, to gather more data concerning the topic of *territorium Potaissae*.

Therefore, due to the contribution of amateurs like Téglás István but mostly due to constant archaeological work carried out since the last century, Potaissa has become one of the best known settlements in Roman Dacia in terms of artifacts, topography and other elements. Based on all these data, we could easily include Potaissa in the FOR part of the TIR-FOR project in the future.

BIBLIOGRAPHY

ANDONE-ROTARU, Mariana; NEDELEA, Luciana (2018). “The pottery workshops in Potaissa”. In: RUSU-BOLINDEȚ, V;

27. Mitrofan, 1969, 517-523.

28. Andone-Rotaru, Neledea, 2018, 72.

- ROMAN, C.-A.; GUI, M.; ILIESCU, I.-A.; BOTIȘ, F.-O.; MUSTAȚĂ, S.; PETRUȚ, D. (eds.). *Atlas of Roman Pottery Workshops from the Provinces Dacia and Lower Moesia / Scythia Minor (1st-7th centuries AD) (I)*. Cluj-Napoca, 69-90.
- ARDEVAN, Radu; RUSU, Adrian (1979). "Botár Imre și colecția sa de antichități". *ActaMP* 3, 1979, 387-409.
- BAJUSZ, István (1980). "Colecția de antichități a lui Téglás István din Turda". *ActaMP* 4, 367-394.
- BAJUSZ, István (2005). *Téglás István jegyzetei. Régészeti feljegyzések I/1, I/2, Cluj-Napoca*.
- BALÁZS, Orbán (1889). *Torda város és környéke*. Budapest.
- BĂRBULESCU, Cornelia; BĂRBULESCU, Mihai; BĂRBULESCU, Toma; CĂTINAȘ, Ana; FÁBIÁN, István; FODOREAN, Florin-Gheorghe; MUNTEANU, Mihai; NEDELEA, Luciana; NEMETI, Irina; NEMETI, Sorin; VARGA Timea (2010). *Principia din castrul legionar de la Potaissa*. Cluj-Napoca.
- BĂRBULESCU, Mihai (1980). "Evoluția cercetărilor privind Potaissa romană". *Potaissa. Studii și comunicări*, 2, 283-296.
- BĂRBULESCU, Mihai (1987). *Din istoria militară a Daciei romane. Legiunea V Macedonica și castrul de la Potaissa*. Cluj-Napoca.
- BĂRBULESCU, Mihai (1994). *Potaissa. Studiu monografic*. Turda.
- BĂRBULESCU, Mihai (1997). *Das Legionslager von Potaissa (Turda). Castrul legionar de la Potaissa (Turda)* (Führer zu archäologischen Denkmälern in Dacia Porolissensis. 7). Zalău.
- BĂRBULESCU, Mihai (2004). *Arhitectura militară și tehnică de construcție la romani. Castrul de la Potaissa*. Cluj-Napoca.
- BĂRBULESCU, Mihai (2008). *Mormântul princiar germanic de la Turda. Das germanische Fürstengrab von Turda*. Cluj-Napoca.
- BĂRBULESCU, Mihai (2012). *Inscripțiile din castrul legionar de la Potaissa. The Inscriptions of the Legionary Fortress at Potaissa*. Bucharest.
- BĂRBULESCU, Mihai (2015). *Arta romană la Potaissa*. Bucharest - Cluj-Napoca.
- BĂRBULESCU, Mihai (2016). *Potaissa. L'arte romana in una città della Dacia*. Rome.
- BĂRBULESCU, Mihai; ANDONE-ROTARU, Mariana; BĂRBULESCU, Cornelia; BĂRBULESCU, Toma; CĂTINAȘ, Ana; FÁBIÁN, István; FODOREAN, Florin-Gheorghe; HUSZARIK, Pavel; MUNTEANU, Mihai; NEDELEA, Luciana; NEMETI, Irina; NEMETI, Sorin (2019). *Termele din castrul legionar de la Potaissa* (coord. M. Bărbulescu). Cluj-Napoca.
- BĂRBULESCU, Mihai; CĂTINAȘ, Ana (1992). "Inscripții dintr-un templu de la Potaissa". *Ephemeris Napocensis* 2, 111-124.
- BĂRBULESCU, Mihai; FODOREAN, Florin-Gheorghe (2019). "Apa în castrul legionar de la Potaissa. Consum și alimentare". In: BĂRBULESCU, Mihai (coord.). *Termele din castrul legionar de la Potaissa* (coord. M. Bărbulescu). Cluj-Napoca.
- CĂTINAȘ, Ana (1978). "Noi descoperiri pe Dealul Zânelor". *ActaMP* 15, 195-200.
- COCIȘ, Horațiu (2015). "Some remarks on the Roman necropolises of Potaissa". *Journal of Ancient History and Archaeology* 2/2, 58-66.
- CRÎȘAN, Ion Horațiu (1961). "Șantierul arheologic Turda". *Materiale și cercetări arheologice* 7, 431-439.
- FODOREAN, Florin-Gheorghe (2011). "The aqueducts of Potaissa". In: *Frontinus - Schriftenreihe. Internationale Gesellschaft für Wasser und Energie zur Förderung der Wissenschaft, Forschung und Bildung auf dem Gebiet der Geschichte der Rohrleitungs-, Energie- und Wassertechnik sowie der rohrleitungstechnischen Fachausbildung*, 28, 95-108.
- FODOREAN, Florin-Gheorghe (2011a). "The Bridges of Roman Dacia". In: *Archäologie der Brücken. Vorgeschichte. Antike. Mittelalter. Neuzeit (Archaeology of Bridges. Prehistory. Antiquity. Middle Ages. Modern Era)*. Bayerische Gesellschaft für Unterwasserarchäologie (Herausgeber), in Verbindung mit dem Bayerischen Landesamt für Denkmalpflege, Eds. Prell, M., Verlag Friedrich Pustet, Regensburg, 143-147.
- FODOREAN, Florin-Gheorghe (2013). "Roman Potaissa and its surroundings". In: *Aerial Archaeology and Remote Sensing*

- from the Baltic to the Adriatic". Selected Papers of the Annual Conference of the Aerial Archaeology Research Group, 13th-15th September 2012, Budapest, Hungary, Institute of Archaeological Sciences, Faculty of Humanities, Eötvös Loránd University (Czajlik, Z., Bődőc, A. eds.), 67-70.
- FODOREAN, Florin-Gheorghe (2015). "Archaeological field surveys in *territorium Potaissae*. New discoveries in Ceanu Mic and Aiton (Cluj County)". *Ephemeris Dacoromana* 17, 112-118.
- FODOREAN, Florin-Gheorghe (2015). "Archaeological sites recorded by Téglás István in the territory of Potaissa". In: SZABÓ, C. *et alii* (eds.). *Adalbert Cserni and his contemporaries*. Cluj-Napoca, 187-203.
- FODOREAN, Florin-Gheorghe (2017). "Archaeological sites recorded by Téglás István in the territory of Potaissa". In: SZABÓ, C. *et alii* (eds.). *Adalbert Cserni and his contemporaries*. Cluj-Napoca, 187-203.
- HOPÂRTEAN, Ana; LUCA, Claudia (1982). "Un monument funerar roman descoperit la Turda". *Potaissa* 3, 111-113.
- JUDE, Magda. "Monumente funerare de la Potaissa". *ActaMN* 9, 497-501.
- JUDE, Magda; POP, Constantin (1973). "Monumente sculpturale romane în Muzeul de Istorie Turda". Turda.
- LUCA, Claudia; HOPÂRTEAN, Ana (1980). "Noi descoperiri în necropola sudică a Potaissae (Uzina de apă)". *Potaissa* 2, 115-122.
- MILEA, Zaharia; FENEȘAN, V. (1966). "Monument sculptural de la Potaissa, reprezentând un banchet funebru". *Revista Muzeelor* 3, 267-268.
- MILEA, Zaharia; HOPÂRTEAN, Ana; LUCA, Claudia (1978). "Noi contribuții privind necropola Romană de la Potaissa". *ActaMN* 15, 201-206.
- MILEA, Zaharia; JUDE, Magda (1972). "O nouă inscripție descoperită la Potaissa". *SCIV* 23/4, 667-670.
- MITROFAN, Ioan (1969). "Descoperiri arheologice la Potaissa (Turda)". *ActaMN* 6, 517-523.
- NEMETI, Sorin; ANDONE-ROTARU, Mariana; BINDEA, Diana; BLAGA, Dragoș; FÁBIÁN, István; FODOREAN, Florin-Gheorghe; MUNTEANU, Mihai; NEDELEA, Luciana; NEMETI, Irina (2017). *Studii asupra granițelor romane din Dacia. Castrul legionar de la Potaissa. I. Centuriae din praetentura sinistra*. Cluj-Napoca.
- NEMETI, Sorin; NEMETI, Irina (2014). "Civic space and municipal statutes in Potaissa". In: COCIȘ, S. (ed.). *Archäologische Beiträge. Gedenkschrift zum hundertsten Geburtstag von Kurt Horedt*. Cluj-Napoca, 2014, 85-98.
- PÎSLARU, Mariana (2007). "Un grup de morminte romane și gepidice de la Potaissa". In: *Dacia Felix. Studia Michaeli Bărbulescu Oblata*. Cluj-Napoca, 339-364.
- RUSSU, Ioan Iosif (1941). "Descoperiri arheologice la Potaissa". *Anuarul Institutului de Studii Clasice* 3, 319-340.
- TÉGLÁS, Gábor (1913). "Potaissa (Torda) bányapolgárságának háztartási emlékeiből". *Bányászati és kohászati lapok* 46, 22-28.
- TÉGLÁS, István (1896). "Torda-aranyosmegyei régiségekről". *Archaeologiai Értesítő* 1, 427-428.
- TÉGLÁS, István (1910a). "Romok és leletek a tordai Tünderhegyen". *Archaeologiai Értesítő* 30, 353-356.
- TÉGLÁS, István (1910b). "A mezőtóháti vicusról és a potaissai Apollóról". *Archeologiai Értesítő* 30, 1910, 123-130.
- ȚIGĂRA, Ion (1960). "Necropolele de la Potaissa". *Probleme de muzeografie* 3, 195-212.

La realización de mapas de densidad para la investigación del poblamiento antiguo. El entorno del Bajo Guadalquivir (SO de España) entre los siglos II y IV d.C. como caso de análisis

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RESUMEN

En este trabajo detallamos el procedimiento metodológico para la realización de mapas que nos permitan analizar la evolución de la densidad del poblamiento antiguo en un territorio. Nos centraremos concretamente en el cálculo basado en la estimación de la densidad de núcleo (KDE). En este tipo de análisis es muy importante seleccionar un ancho de banda (h) óptimo, para cuyo cálculo existen dos estrategias: una que baraja criterios cualitativos y otra centrada en procedimientos cuantitativos. Tras valorar los pros y los contras de cada una de estas estrategias, proponemos una tercera opción que consiste en combinar ambos criterios. Para ejemplificar esta propuesta metodológica hemos tomado como caso de estudio varias zonas del Bajo Guadalquivir (SO de España) en las que se han documentado yacimientos arqueológicos datados entre los siglos II y IV d.C.

PALABRAS CLAVE: Estimación de densidad de núcleo, mapa de densidades, poblamiento antiguo, arqueología espacial, Sistema de Información Geográfica (SIG), *Hispania*.

Creating density maps for research into ancient settlements. The surrounding area of the Lower Guadalquivir Basin (SW Spain) between the 2nd and 4th centuries AD as a case study

ABSTRACT

In this paper we reflect on the different concepts and issues required to make density maps that allow the ancient settlements in a territory to be studied. We will focus on the kernel density estimation (KDE). In this type of analysis, it is important to select an optimum bandwidth (h) and there are two strategies for this purpose: one that considers qualitative criteria and another that focuses on quantitative criteria. After evaluating each of these strategies, we propose a third option that consists of combining both criteria. Following a series of statistical calculations, a minimum and maximum value can be determined for the bandwidth, using this interval as a qualitative testing range. To exemplify this methodological proposal with a practical case, a series of density maps have been drawn up based on the known Roman sites in the Lower Guadalquivir Basin (SW Spain) between the 2nd and 4th centuries AD.

KEYWORDS: Kernel density estimation, density map, ancient settlements, spatial archaeology, geographical information system (GIS), Roman Spain.

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1. INTRODUCCIÓN

En este trabajo vamos a detallar el procedimiento metodológico para la realización de mapas que nos permitan analizar la evolución de la densidad del poblamiento antiguo en un territorio. Nos centraremos concretamente en el cálculo basado en la estimación de la densidad de núcleo (KDE), para la cual haremos una propuesta procedimental para la determinación del ancho de banda, es decir, el valor numérico del radio del núcleo, y que en el modelo espacial de densidad actúa como parámetro de suavizado.

Para ilustrar esta propuesta metodológica con un caso práctico se ha elaborado una serie de mapas de densidades a partir de los yacimientos romanos conocidos en el Bajo Guadalquivir (en el SO de España) entre los siglos II y VI d.C. (Pérez-Aguilar, 2018), si bien aquí presentaremos solo los correspondientes al tránsito del periodo altoimperial al tardorromano (siglos II-IV d.C.) por razones de espacio.

Valga decir que el cuadrante SO de la Península ibérica fue durante el periodo altoimperial de gran relevancia económica para el Imperio romano, explotándose sectores tan importantes como el de la minería argentífera (Vidal y Campos, 2008; Garrido, 2011; Pérez Macías, 2014), la producción de aceite de oliva y vino (Reynolds, 2007), e incluso la producción de salazones y de salsas de pescado (García Vargas y Bernal, 2009). Todo ello potenciado por la existencia de un gran río, el Guadalquivir o *Baetis*, que en su tramo bajo era navegable para barcos de mediano y gran calado (Strab. III, 2.3), hecho que abarataba costes y beneficiaba las relaciones comerciales con otras zonas del Imperio (Chic, 2009).

Dicho auge económico coincide en el tiempo no solo con la monumentalización de los espacios urbanos (Padilla, 1999) sino también con un aumento general de los asentamientos rurales volcados a las distintas actividades productivas (Pérez-Aguilar, 2017 y 2018).

Los mencionados sectores económicos parecen entrar en crisis por distintas razones en el tránsito del periodo altoimperial al tardorromano (Chic, 2005; García Vargas, 2012 y 2014), hecho que influyó en el poblamiento humano de la zona (Pérez-Aguilar, 2017 y 2018). Son precisamente tales cambios poblacionales los que pre-

tendemos cartografiar en términos de densidad mediante un SIG.

Para ello hemos seleccionado 4 zonas de muestreo, distribuidas en torno a distintos tramos del Bajo Guadalquivir (Fig. 1). La superficie de estas 4 zonas equivale aproximadamente a 3699 km², lo que representa el 36% de la superficie del entorno del Bajo Guadalquivir. A partir de estas zonas de muestreo hemos elaborado una base de datos geoespacial con todos los yacimientos romanos claramente fechados entre los siglos II y VI d.C., y que equivalen a un total de 285 asentamientos², cuya inmensa mayoría son entidades rurales (Pérez-Aguilar, 2018). En la zona 4 hemos realizado incluso prospecciones arqueológicas en los términos municipales de Trebujena y El Cuervo para disponer de datos más actualizados (Pérez-Aguilar, 2018).

2. DEFINICIÓN Y CARACTERÍSTICAS

Estudiar el poblamiento humano implica necesariamente definir primeramente la unidad de análisis, que estará determinada en todo momento por la escala espacial definida previamente por el investigador. Una aproximación arqueológica al poblamiento de un territorio a escala macro difícilmente puede trabajar con el número de habitantes o pobladores como unidad de análisis ya que, actualmente, seguimos careciendo de un método efectivo que nos permita calcular con más o menos exactitud la cantidad de individuos que ocupaban los asentamientos y su evolución a lo largo del tiempo. Dicho lo cual, en nuestro estudio poblacional la unidad operativa no será el número de individuos que ocupa un territorio, sino el de asentamientos. Aunque no sea este el tema que aquí nos concierne, es evidente que cada uno de estos núcleos habitacionales debió tener un peso demográfico concreto y dinámico en el tiempo, y que esto debería contemplarse para que el análisis fuese más realista. Peso demográfico al que nos podríamos aproximar indirectamente mediante el cálculo de la entropía

2. La información referente a cada uno de estos sitios arqueológicos puede consultarse en el catálogo de yacimientos de nuestra tesis doctoral (Pérez-Aguilar, 2018), y en cada una de las entradas se detalla la bibliografía específica consultada.

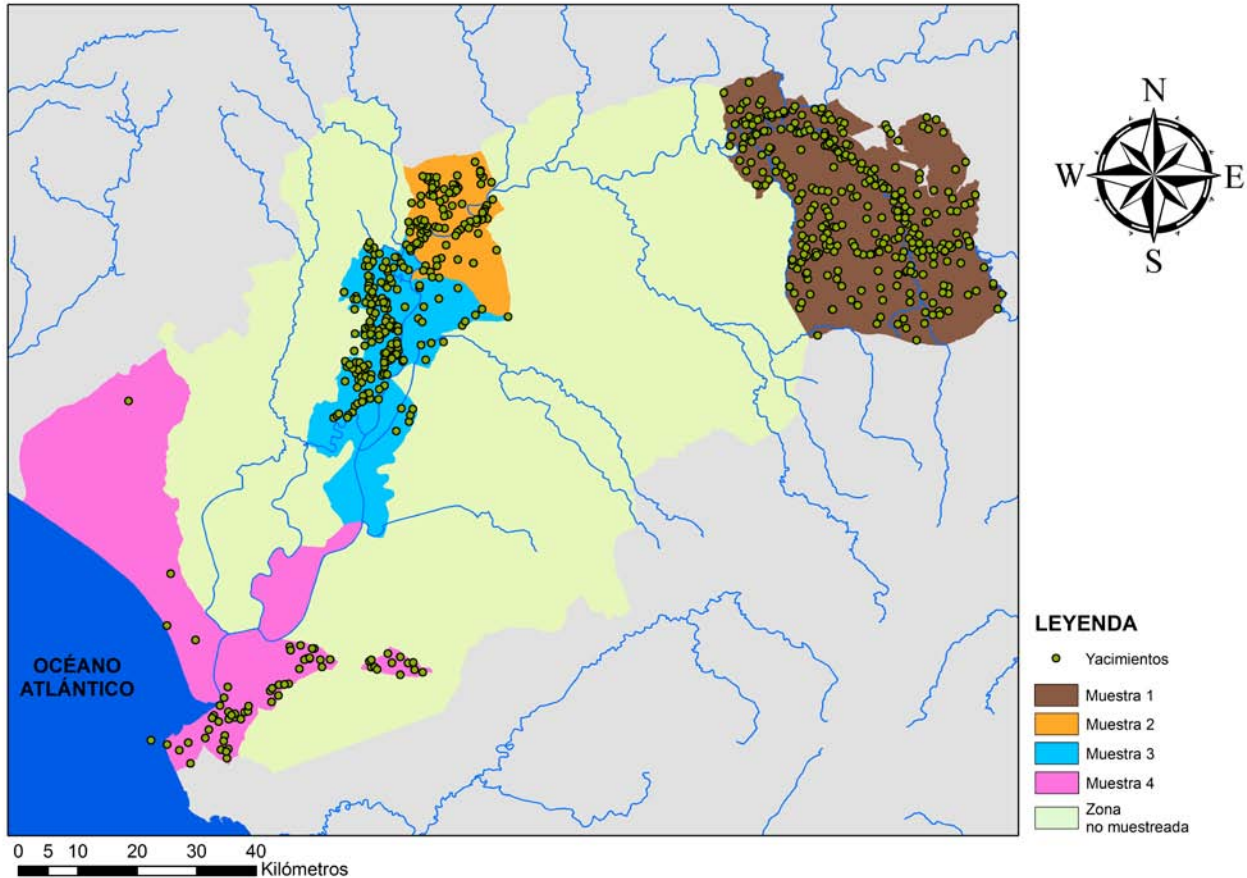


FIGURA 1. Localización de las distintas áreas de muestreo y de los yacimientos arqueológicos muestreados en el entorno del Bajo Guadalquivir (SO de España).

interna de cada sitio (Pérez-Aguilar, 2018, 1145-1163) y sobre la conceptualización teórica de que cada asentamiento ocupa un nicho ecológico (Pérez-Aguilar, 2021, 114-118), siendo una unidad disipativa de gradientes energéticos –compuesta a su vez por subunidades–, y que tiene un metabolismo exosomático cuantificable (Shawcross, 1972; Pérez-Aguilar, 2021, 35-36 y 46-47). Pero de momento este tipo de aproximaciones resultan inviables para el estudio de muchos yacimientos debido a la calidad de los datos disponibles, de ahí que en este trabajo otorguemos irrealmente a cada sitio el mismo valor disipativo.

Un cálculo en bruto de la densidad (d = unidad de poblamiento/unidad de superficie), sin tener en cuenta factores de distribución temporal ni geográfica, de poco o nada sirve para comprender las dinámicas geohistóricas del poblamiento humano. Para ello se hace necesario

inferir, en términos de probabilidad espacial, tanto patrones de asentamientos como su variabilidad distribucional a nivel espacio-temporal (cf. Barceló *et al.*, 2006, 37-38). De ahí la necesidad de cartografiar tales procesos.

Tratar de contemplar la totalidad de sitios estudiados permitiría sin duda percibir agrupaciones sobre el territorio, sin embargo la cantidad de sitios y la escala a la que se trabaja introducen borrosidad debido a la proximidad de los asentamientos, de forma que se producen solapamientos que impiden ver con claridad las fronteras entre distintas áreas de densidades (Fig. 1). Para evitar esto se requiere de un modelado espacial de análisis de densidad (Conolly y Lake, 2009, 232-234). El modelo que emplearemos es el de análisis de densidad de núcleo o *kernel density estimation* (KDE), y usaremos para ello ArcGIS 10.0.

La KDE es una técnica no paramétrica porque no parte de presunciones de patrones distribucionales, sino que hace análisis a partir de los datos mismos (Brunsdon, 1995, 878). Emplea una función de probabilidad de densidad que contempla dos dimensiones, el núcleo, a partir del conjunto de datos puntuales, con coordenadas X e Y , para generar una aproximación suavizada de su distribución centrífuga a partir del centro de los núcleos (Conolly y Lake, 2009, 234). De esta forma obtenemos un modelado basado en isolíneas de color que se generan a partir de la localización de los datos, y que permiten de un vistazo percibir las distribuciones probabilísticas de las densidades en la zona estudiada (Moreno, 1991, 156; Maximiano, 2013, 137).

Se puede llegar a pensar que hacer mapas de densidades basados en esta técnica no tiene mayor interés que el de presentar una cartografía visualmente más atractiva y moderna. Sin embargo, su uso no responde a una mera cuestión de estética. A diferencia de los mapas de densidad basados en cuadrantes, los mapas realizados por estimación de núcleos ofrecen resultados más atenuados que permiten interpretar de una forma más realista datos cuya naturaleza en términos de densidad no es discontinua sino continua, y que requieren de una mayor precisión en la estimación de las modas o tendencias de densidad (Wheatley y Gillings, 2002, 186-187; Prada, 2015, 79; Yin, 2020). Dicho de otro modo, en los mapas de densidad basados en cuadrantes la densidad permanece constante dentro de cada cuadrante, y no se perciben variaciones locales dentro de ellos ni en la transición entre cuadrantes (Baxter, 2017: 2; De Smith et al., 2020; Yin, 2020).

A la hora de hacer la estimación, el programa informático aplica la siguiente función matemática de forma automatizada para datos de naturaleza bivariada (tomada de Beardah y Baxter, 1996, 180); donde X e Y representan el punto bidimensional desde el que se estima la densidad, X_i e Y_i son los valores de las variables, K es el símbolo del tipo de *kernel* (véase apartado 2.1), y h_1 y h_2 son los anchos de banda para las direcciones de las coordenadas X e Y :

$$\hat{f}(x, y) = \frac{1}{nh_1h_2} \sum_{i=1}^n K\left(\frac{x - X_i}{h_1}, \frac{y - Y_i}{h_2}\right)$$

Beardah y Baxter (1996, 180) recomiendan usar valores diferentes para h_1 y h_2 en el caso de las KDE bivariadas, ya que de utilizarse el mismo valor de suavizado ($h_1 = h_2$) se generarían baches (*bumps*) simétricamente esféricos en torno a los núcleos. De usarse valores distintos ($h_1 \neq h_2$), las protuberancias o baches generados en el modelo de densidad tendrían forma elíptica, e incluso se podría añadir un tercer valor (h_3) fuera de la diagonal de simetría para introducir una orientación arbitraria (Beardah, 1999, 5-6). Sin embargo, como recientemente se ha percatado Baxter (2017, 11-12), los SIG actuales trabajan con funciones de KDE bivariadas que proyectan el mismo ancho de banda en ambas direcciones ($h_1 = h_2$), lo que resulta excesivamente simplificador e incorrecto. No obstante, se trata de un problema que de momento no podemos evitar en el modelado espacial mediante el SIG utilizado, y que tendrán que corregir sus programadores en el futuro.

2.1. Tipos de *kernels*

Lejos de lo que pudiera pensarse, existen distintos tipos de *kernels* que en la función ocuparían el valor del símbolo K . En la Fig. 2 señalamos los más frecuentes, si bien la mayoría ofrecen resultados finales muy similares. La elección del tipo de *kernel*, por tanto, resulta casi irrelevante, y muchas veces depende del paquete informático utilizado (cf. Moreno, 1991, 158; Baxter *et al.*, 1997, 348; De Smith et al., 2020). En nuestro caso hemos usado la función K2 de Silverman.

2.2. Ancho de banda (h)

Más importante es la determinación óptima de la varianza del radio del núcleo, también llamada ancho de banda (*bandwidth*) (Moreno, 1991, 161; Brunsdon, 1995, 878-879; Conolly y Lake, 2009, 234; Yin, 2020). Este se define como la semiamplitud del núcleo para cada intervalo de interés, y controla el grado de suavidad del modelado espacial (Prada, 2015, 82). Existen dos clases de anchos de banda: el fijo, es decir, el que permanece constante para todo el conjunto de datos, y el adaptativo. En nuestro caso, tanto las unidades de análisis, que son yacimientos, como

TIPOS DE KERNELS	
KERNEL	K (u)
Uniforme	$\frac{1}{2}$, para $ u < 1$
Triangular	$(1 - u)$, para $ u \leq 1$
Epanechnikov	$\frac{3}{4} (1 - u^2)$, para $ u < 1$
Cuártico o Biweight de Tukey	$\frac{15}{16} (1 - u^2)^2$, para $ u \leq 1$
Triweight	$\frac{35}{32} (1 - u^2)^3$, para $ u \leq 1$
Gaussiano	$\frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2} u^2\right)$
Coseno	$\frac{\pi}{4} \cos\left(\frac{\pi}{2} u\right)$, para $ u \leq 1$
K_2 de Silverman	$\frac{3}{\pi} (1 - u^2)^2$, para $ u \leq 1$

Donde $u = (x-h_i)/h$

FIGURA 2. Cuadro-resumen con los tipos de *kernels* más frecuentes (Moreno, 1991, 157).

la escala macroespacial y el carácter bidimensional de los datos nos invitan a trabajar con un ancho de banda fijo (*cf.* Terrell y Scott, 1992; Baxter, 2017; Yin, 2020).

El procedimiento a partir del cual se calcula el ancho de banda como parámetro de suavizado ha estado sujeto a discusión, sobre todo entre matemáticos, y ha generado una importante cantidad de literatura (véanse en los siguientes párrafos algunos ejemplos). Aquí partiremos de la premisa de que $h_1 = h_2$ en la función de KDE bivariada debido a la problemática ya anotada al inicio del apartado 2.

En su aplicación al campo de la geografía y de la arqueología espacial podemos diferenciar dos grandes posturas. De un lado quedan aquellos autores que se inclinan a determinar el ancho de banda a partir de procedimientos estadísticos (p. ej. Moreno, 1991; Brunson, 1995; Baxter *et al.*, 1997), y de otro lado encontramos a autores que invitan a determinarlo de forma cualitativa, probando diferentes anchos de banda hasta encontrar uno que más o menos se perciba como óptimo visualmente hablando (p. ej. Gibin *et al.*, 2007; Conolly y Lake, 2009).

La estimación cualitativa tiene como ventaja el hecho de que es el analista el que determina el parámetro de suavizado en función de los resultados que percibe, ya que si el radio del núcleo es muy pequeño se formarán picos, es decir, se tiende a la rugosidad de los datos iniciales (Fig. 3A), mientras que si es muy grande la distribución de la densidad será excesivamente suavizada, lo que le resta realismo o utilidad al modelado espacial (Fig. 3B). Por tanto, el investigador puede ajustar el ancho de banda a la densidad verdadera de los datos con los que trabaja (Fig. 3C) (Conolly y Lake, 2009, 234).

Sin embargo, esto último puede ser un inconveniente importante, porque los investigadores rara vez tienen una idea realmente sólida o consistente sobre la densidad verdadera y su distribución, por lo que este tipo de estimaciones parte siempre de ideas preconcebidas que no tienen por qué coincidir con la realidad (Yin, 2020). Aun así, este procedimiento puede permitir generar modelos interesantes siempre y cuando se pruebe con múltiples valores de h y se vayan comparando los resultados unos con otros (Yin, 2020). Pero esto puede implicar invertir un exceso de tiempo y de

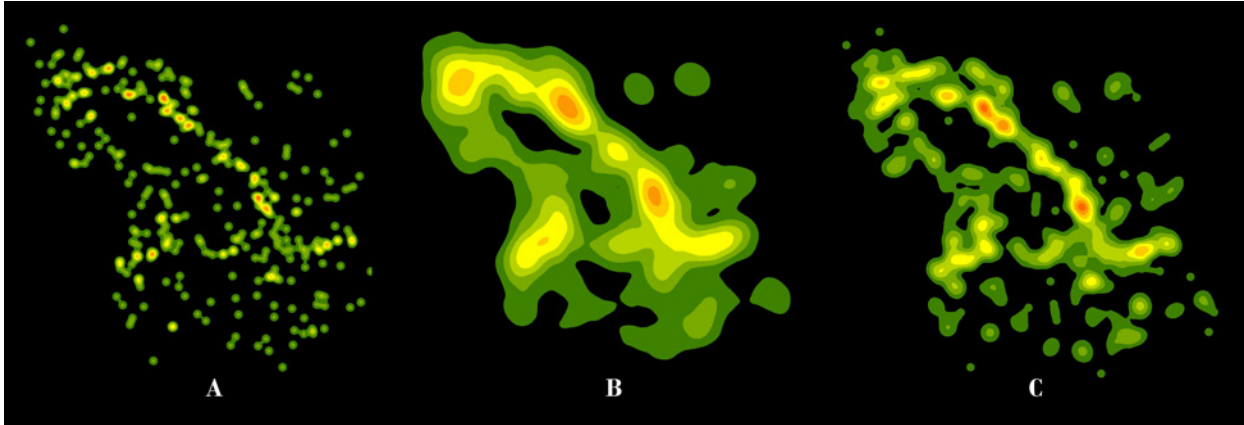


FIGURA 3. KDE de yacimientos romanos y tardoantiguos en la confluencia de los ríos Genil y Guadalquivir (Muestra 1) con diferentes valores para el ancho de banda: $h_a = 970.528003$ m; $h_b = 3951.2890799577$ m; y $h_c = 2084$ m.

esfuerzo dependiendo de la casuística, de los tipos de datos e incluso de la experiencia del analista.

Por ello otros investigadores optan directamente por emplear distintos criterios cuantitativos en la estimación del ancho de banda (para más detalles véanse entre otros a Moreno, 1991; Brunson, 1995; Baxter *et al.*, 1997; Beardah, 1999; Nakoinz y Knitter, 2016; Gonçalves *et al.*, 2018). El problema de usar estos criterios de forma automática es que podemos pecar de excesiva rigidez o de poca flexibilidad procedimental, derivando esta en unos resultados poco adecuados, con una salida gráfica excesivamente atomizada o, por el contrario, suavizada. Por esto mismo, M. Gibin *et al.* (2007, 275) han sostenido que «mathematical algorithms [...] can improve the selection process but are no complete substitute for personal experience and knowledge of the study area and of the attribute upon which density analysis is performed».

La propuesta que hacemos, y con la que hemos trabajado a escala macroespacial, consiste precisamente en combinar ambos criterios procedimentales. Para ello nos hemos inspirado en los trabajos de Beardah (1999), De Cos (2004) y Baxter (2017). De un lado acotamos mediante operaciones estadísticas los valores mínimo y máximo que puede adquirir el ancho de banda, y dentro de ese rango de tanteo probamos varios valores, seleccionando el resultado visualmente mejor. De esta forma damos solidez estadística al análisis a la par que discriminamos todos los valores que que-

dan fuera del rango de tanteo, agilizándose así el proceso, pero también descartamos la posibilidad de seleccionar un valor excesivamente rígido basado únicamente en un criterio estadístico. A esta forma de operar la hemos denominado *estimación del ancho de banda por rango de tanteo*.³

El valor mínimo se ha determinado a partir del algoritmo de análisis del vecino más próximo (*k-nearest neighbour*). Como valor máximo se ha respetado el que por defecto calcula el SIG empleado. Según ESRI, el algoritmo usado por ArcGIS ejecuta de forma automática los siguientes pasos⁴: 1) Cálculo del centro medio de los puntos de entrada; 2) cálculo de la distancia desde el centro medio ponderado para todos los puntos; 3) cálculo de la distancia media ponderada de esas distancias (D_m); 4) cálculo del valor de la distancia media estándar ponderada (SD); y 5) aplicación de la siguiente fórmula, donde n es el número de puntos:

$$h = 0.9 * \min \left(SD, \sqrt{\frac{1}{\ln(2)} * D_m} \right) * n^{-0.2}$$

3. Esta propuesta metodológica de momento parece no ofrecer tan buenos resultados a escala microespacial, aunque tenemos que seguir sometiéndola a prueba, modificando incluso los análisis espaciales que abajo proponemos para determinar el rango de tanteo.

4. La información sobre el algoritmo ha sido obtenida de <https://pro.arcgis.com/es/pro-app/latest/tool-reference/spatial-analyst/how-kernel-density-works.htm> [consultada a 28/10/2021].

Normalmente al arqueólogo le suele interesar el análisis diacrónico de un fenómeno o caso de estudio, como es el caso que aquí presentaremos. Por tanto, el resultado cartográfico no se corresponderá con un mapa sino con varios. Durante el proceso de elaboración de cada uno de ellos puede surgir la siguiente pregunta: ¿debemos mantener constante el valor de h , calculado a partir del total de datos, o debemos recalcularlo a partir de los datos correspondientes a cada periodo? Proceder de esta última forma no sería incorrecto. Sería incluso más realista, ya que el valor de h dependerá en todo momento del grado de ocupación del territorio. Sin embargo, cuando lo que se desea hacer es un ejercicio comparativo recalcularlo el valor de h es menos operativo, ya que al alterar el valor del ancho de banda estamos en última instancia cambiando el patrón comparativo en términos de densidad. Por esta razón nosotros, al igual que otros colegas (p. ej. Bonnier *et al.*, 2019, 73), optamos por calcular el ancho de banda a partir de la totalidad de los datos y por mantener constante su valor para hacer mapas que permitan evaluar la diacronía del fenómeno analizado.

2.3. Tamaño del píxel

Otro elemento relevante a la hora de proyectar visualmente el análisis efectuado gira en torno al tamaño del píxel o de celda (*output cell size*). De Cos (2004, 143) emplea para su zona de

estudio –España– uno equivalente a 500 m de lado. En nuestro caso esta cantidad resulta insatisfactoria, ya que abordamos un área de estudio más reducida que la de esta autora. Tampoco recomendamos fiarnos demasiado del parámetro que el programa de SIG define por defecto, ya que dependiendo del proyecto en el que estemos trabajando este podría ser igualmente elevado.

Jugar con un tamaño de píxel excesivamente grande podría motivar que la salida gráfica obtenida esté muy pixelada, con lo que se corre el riesgo de que existan valores que queden indefinidos (Fig. 4A). De suceder esto, tendríamos que ir reduciendo el tamaño del píxel hasta lograr una nitidez y una definición gráfica óptimas (Fig. 4B) (Yin, 2020).

3. RESULTADOS

Teniendo en cuenta todo lo anterior, se ha procedido a determinar el rango de tanteo para el cálculo del ancho de banda en el conjunto de las cuatro zonas de muestreo. El análisis del vecino más próximo nos ha devuelto un valor mínimo de 1248.348267 m; mientras que el valor que calcula ArcGIS por defecto para el ancho de banda es de 3951.2890799577 m. Por tanto, tales valores determinan el rango de tanteo. Dentro de dicho intervalo hemos tanteado con un ancho de banda de 1923, 2598 y de 3273 m, siendo el segundo de los valores el que ha ofrecido mejo-

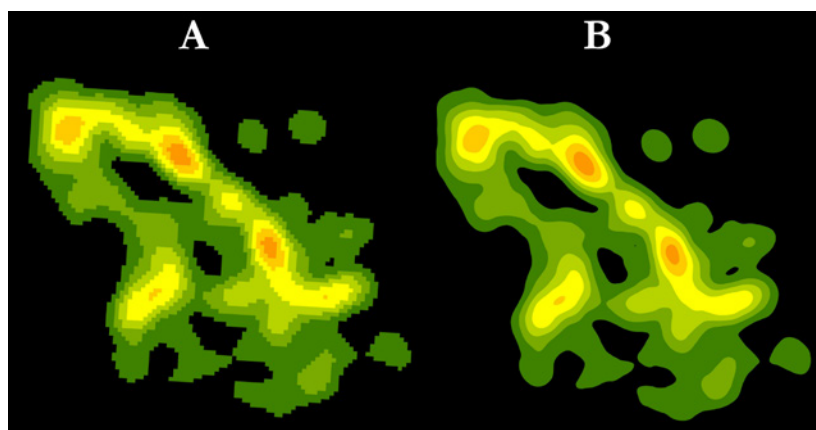


FIGURA 4. KDE de yacimientos romanos y tardoantiguos en la confluencia de los ríos Genil y Guadalquivir (Muestra 1) con diferentes valores para el tamaño de píxel: $h_a = 514.262972389728$ m; y $h_b = 10$ m.

res resultados, y el que finalmente se ha seleccionado. Por su parte, los análisis se han ejecutado con un tamaño de píxel de 10 m para tener una alta resolución gráfica. A partir de estos parámetros hemos realizado un total de 10 mapas por periodos de medio siglo que cubren la evolución de la densidad para estas zonas entre los siglos II y VI d.C. (Pérez-Aguilar, 2018, 1173-1182), si bien aquí solo presentamos los 6 mapas que cubren los siglos II y IV d.C. (Figs. 5-10).

Los mapas resultantes permiten inferir cómo la primera mitad del siglo II d.C. fue el periodo con una mayor tasa de ocupación del territorio, siendo la densidad de yacimientos la más alta de los mapas realizados, con picos de densidad máximos de hasta 0.92 yac./km² (Fig. 5A). En las tres primeras zonas de muestreo el poblamiento rural tiende a concentrarse en torno a ríos y arroyos, vías de comunicación, y en las inmediaciones de varias ciudades romanas (Fig. 5B). En la zona de muestreo 4 el poblamiento se distri-

buye especialmente en el reborde meridional de lo que quedaba del antiguo *lacus Ligustinus*, y llama especialmente la atención el vacío poblacional existente en las actuales marismas del Guadalquivir, probablemente debido a razones edáficas y topográficas (Fig. 5B).

Ya en la segunda mitad del siglo II d.C. se asiste a una contracción del sistema poblacional, tal y como se percibe en el mapa de densidad (Fig. 6); contracción que se acentuó durante la primera mitad del siglo III d.C., bajando la densidad máxima a 0.66 yac./km² (Fig. 7). Pocos cambios se aprecian en la segunda mitad del siglo III (Fig. 8), lo cual parece indicar el cese de la fase de decrecimiento poblacional y la estabilización de la red de asentamientos.

En el siglo IV d.C. se asiste a una nueva fase de crecimiento poblacional relevante, aun sin alcanzarse las tasas de ocupación del periodo altoimperial. La densidad poblacional vuelve a incrementarse, experimentándose máximos de

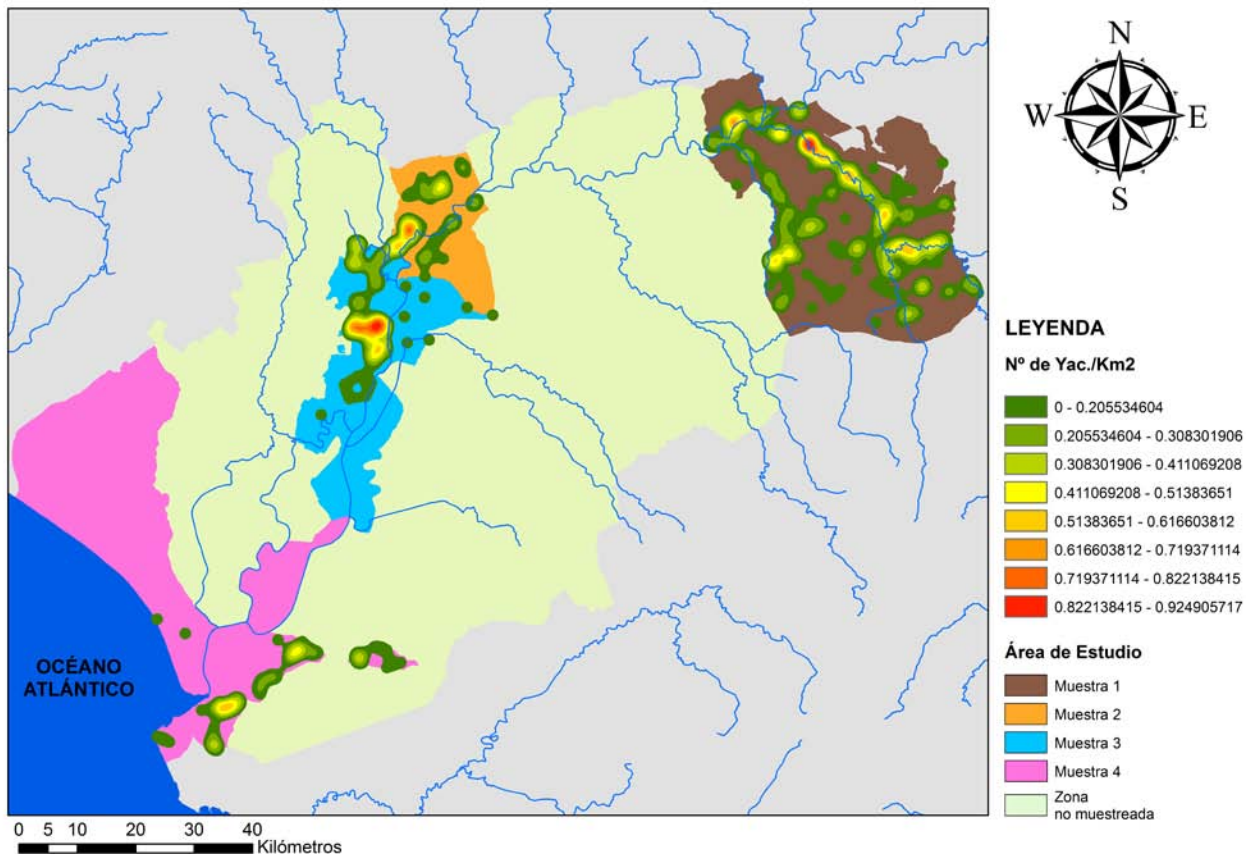


FIGURA 5A. Mapa de densidad de asentamientos para la primera mitad del siglo II d.C.

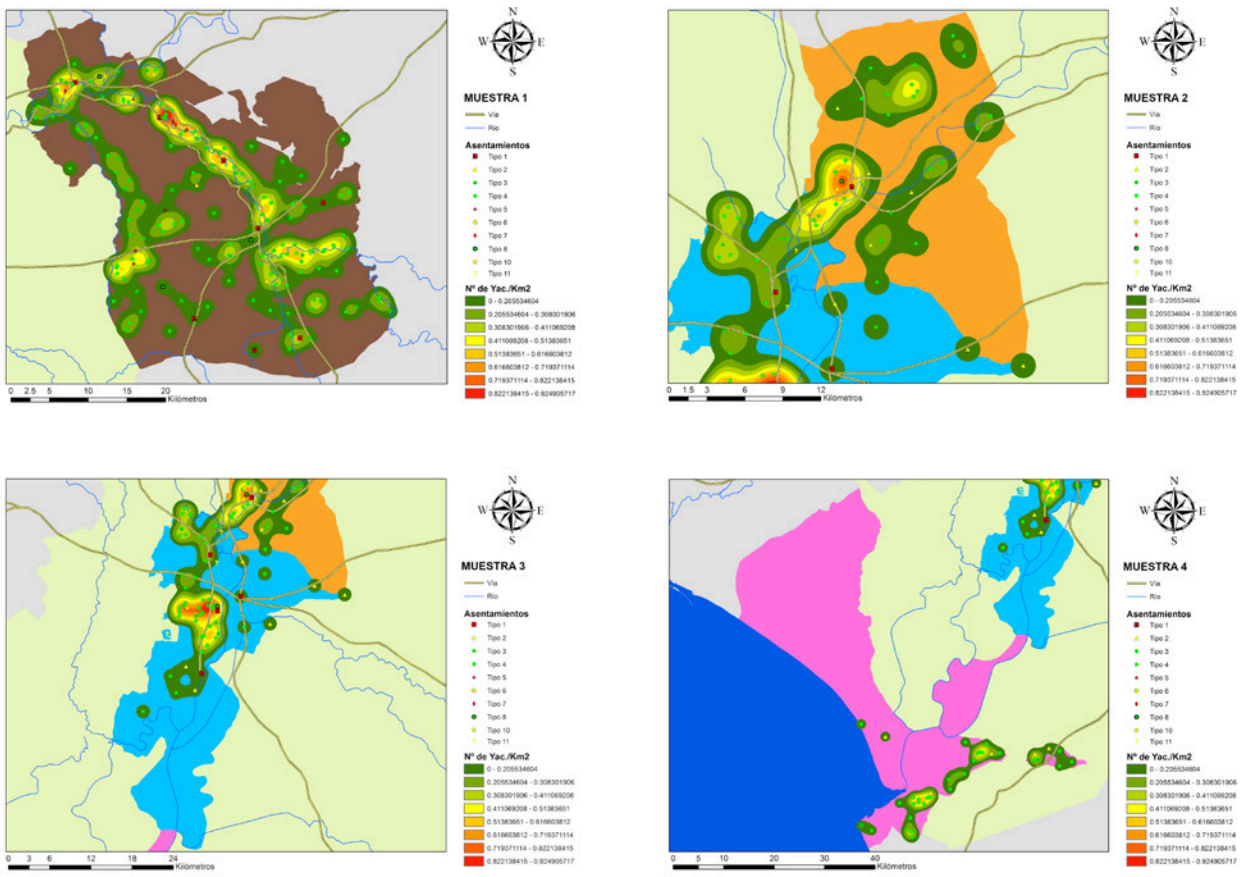


FIGURA 5B. Patrones de asentamiento en las distintas zonas de muestreo para la primera mitad del siglo II d.C. Los tipos de yacimientos se corresponden con: ciudades (tipo 1), poblados rurales o *vici* (tipo 2), villae suntuosas (tipo 3), *villae* no suntuosas (tipo 4), chozas (tipo 5), complejos religiosos (tipo 6), complejos productivos varios (tipo 7), necrópolis (tipo 8), infraestructuras varias (tipo 10) y sitios inciertos o indefinidos (tipo 11).

hasta 0.84 yac./km² en ciertas zonas del territorio (Fig. 9). Esta fase expansiva de la red de asentamientos se mantiene también en la segunda mitad de la centuria (Fig. 10).

4. DISCUSIÓN HISTÓRICA DE LOS RESULTADOS

El más alto índice de ocupación del territorio estudiado se corresponde con la primera mitad del siglo II d.C. El aumento del número de *villae* se relaciona con la consolidación de la *Baetica* occidental como una región fundamental en la economía imperial, tanto por la captación de metales amonedables (Chic, 2005; Pérez Macías, 2014) como de recursos agropecuarios destina-

dos al comercio a distintas escalas (Chic, 2009). Comercio, minería y vida urbana requerían constantemente de suministros alimentarios. Fueron muchas las granjas (*villae*) y factorías pesqueras (*cetariae*) que emergieron para satisfacer tales demandas (Pérez-Aguilar, 2017), situación a su vez reforzada por la estabilidad en las condiciones de navegabilidad del bajo tramo del río *Baetis* (Borja, 2014) y por unos condicionantes climáticos bastante benignos para la producción agropecuaria (McCormick *et al.*, 2018).

Muchos de estos asentamientos rurales comenzaron a abandonarse a partir de la segunda mitad del siglo II d.C., tendencia que se mantuvo a lo largo de la centuria siguiente. Ni la navegabilidad del río *Baetis* —que parece no mermar, al

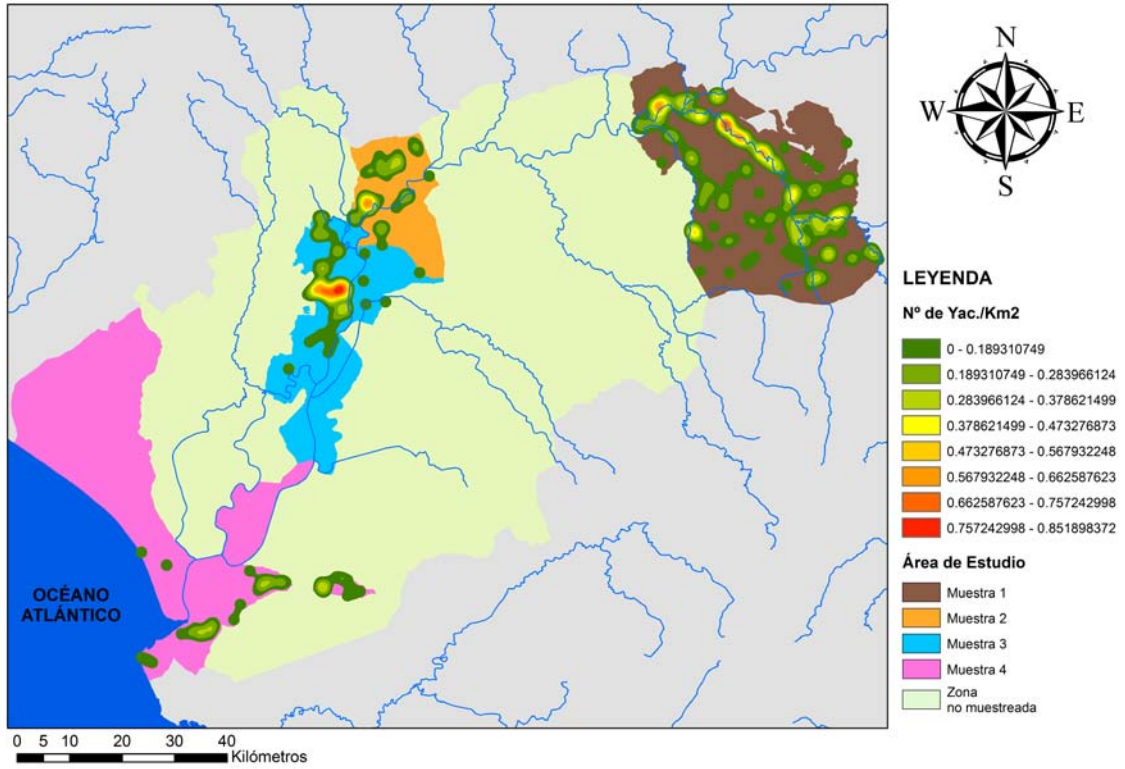


FIGURA 6. Mapa de densidad de asentamientos para la segunda mitad del siglo II d.C.

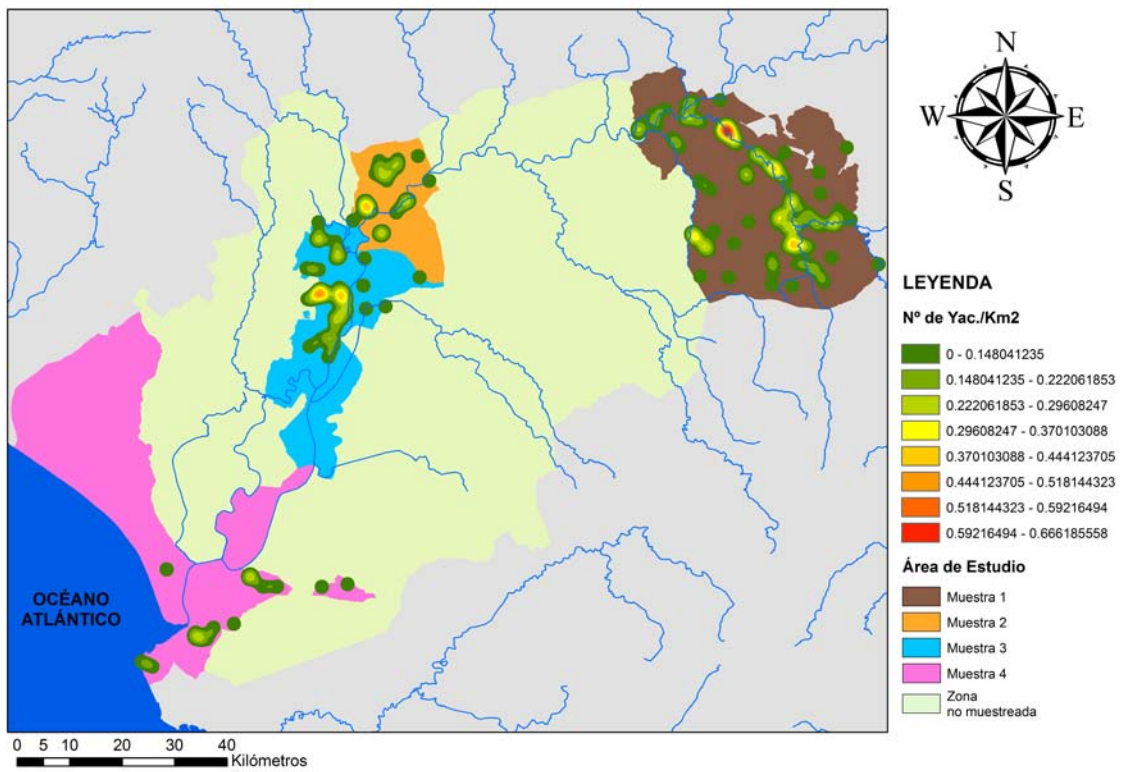


FIGURA 7. Mapa de densidad de asentamientos para la primera mitad del siglo III d.C.

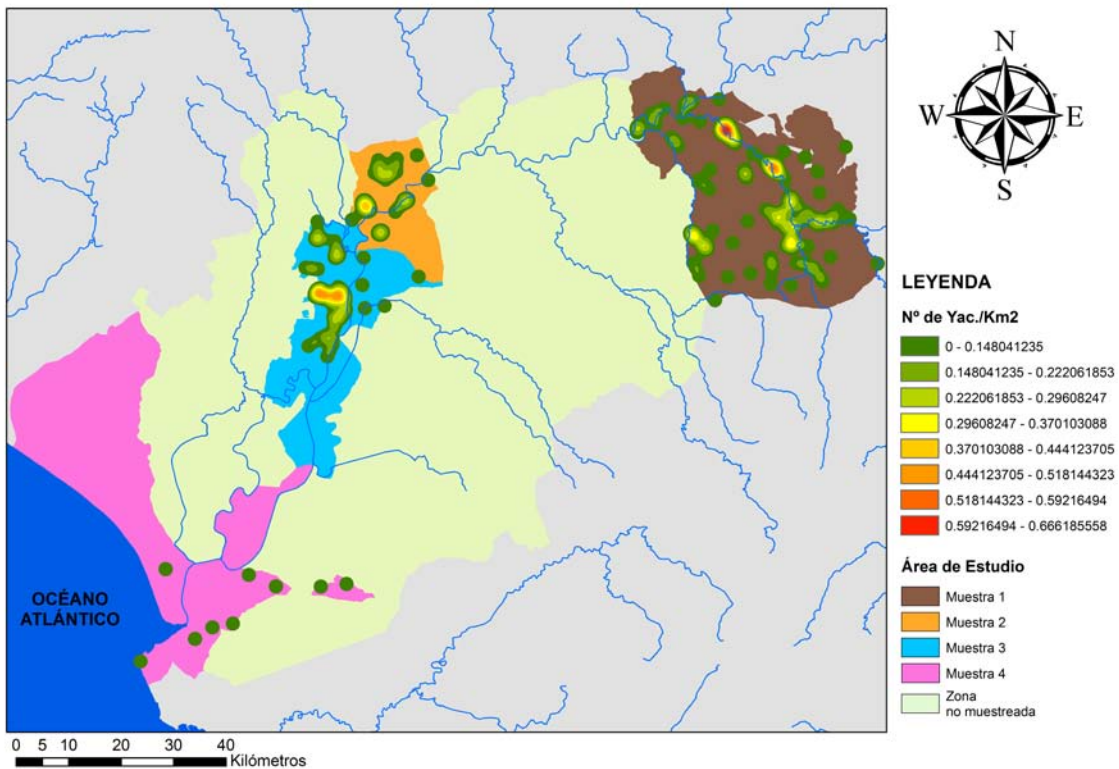


FIGURA 8. Mapa de densidad de asentamientos para la segunda mitad del siglo III d.C.

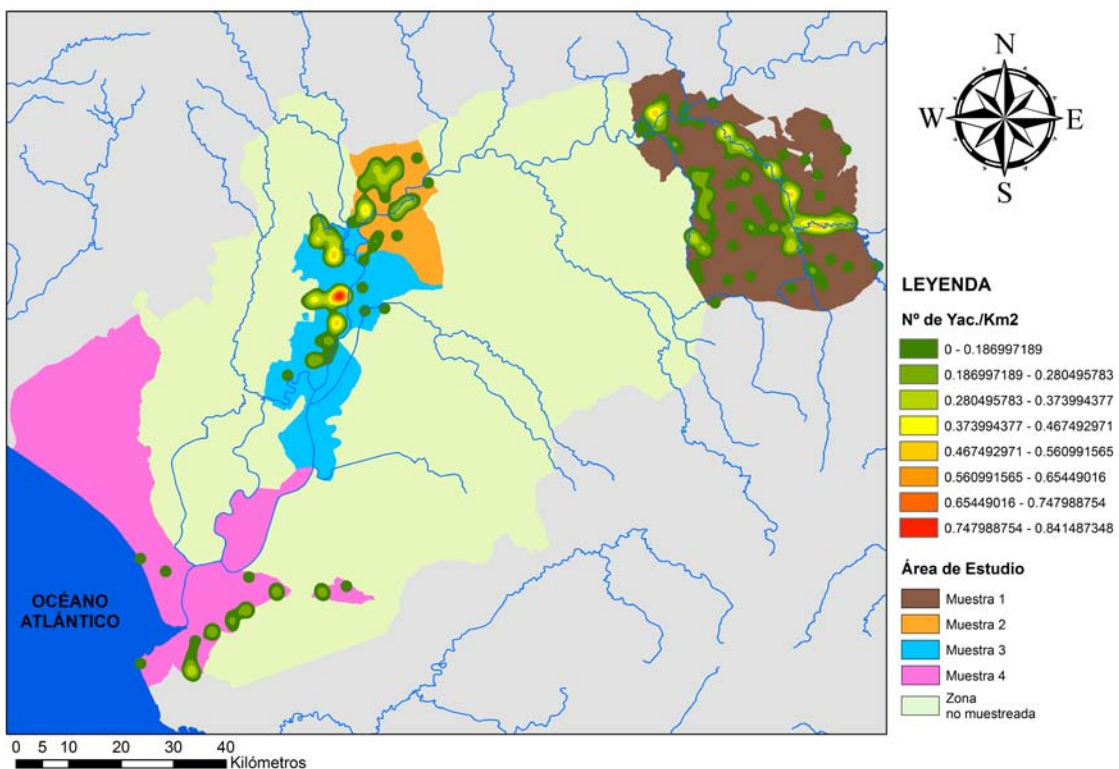


FIGURA 9. Mapa de densidad de asentamientos para la primera mitad del siglo IV d.C.

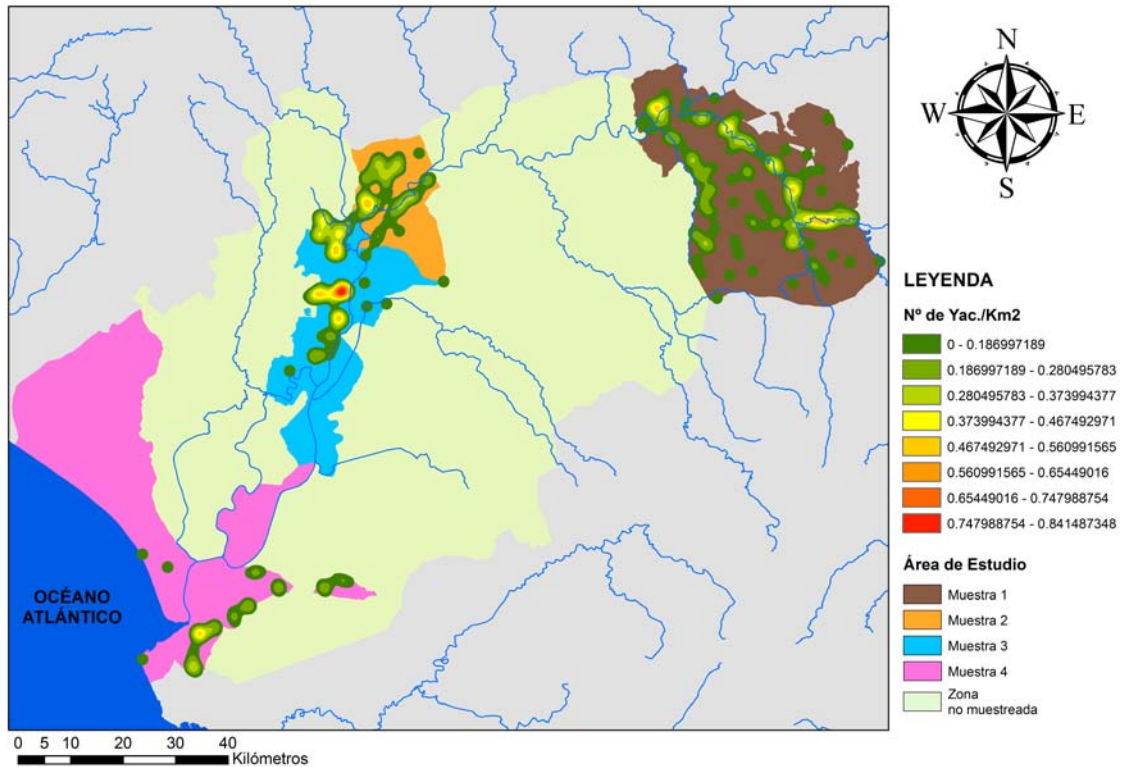


FIGURA 10. Mapa de densidad de asentamientos para la segunda mitad del siglo IV d.C.

coincidir con una fase de dinámica fluvial estable (Borja, 2014)– ni los condicionantes climáticos –en términos generales óptimos (McCormick *et al.*, 2018)– parecen haber sido factores decisivos en esta pérdida poblacional de los últimos 50 años del siglo II. Más relevantes debieron ser otros aspectos de índole sociocultural, como las dificultades de financiación de la actividad minera por parte del Estado romano tras la desastrosa y costosa campaña militar de Trajano en Mesopotamia junto a las guerras defensivas en la frontera del Imperio a partir del reinado de Marco Aurelio (García Vargas, 2012 y 2014).

Muchas minas del SO peninsular se cerraron debido a la infrafinanciación o disminuyeron de forma sustancial su explotación (Garrido, 2011; Pérez Macías, 2014). La consecuente devaluación de la moneda de plata y el proceso inflacionista frenó en las ciudades béticas el evergetismo de tendencia monumentalista, reorientándose ahora hacia la manutención de los espacios urbanos existentes y hacia la beneficencia y la caridad (García Vargas, 2014). Así, un buen número de

canteras de mármol del sur hispano entraron también en crisis (Padilla, 1999).

El aceite y el vino béticos fueron progresivamente desplazados en el mercado interprovincial por productos africanos y orientales, tendencia que se agudizó a partir de las políticas de Septimio Severo (Reynolds, 2007). También muchas *cetariae* de la bahía de Cádiz y de la desembocadura del Guadalquivir fueron abandonadas ante la imposibilidad de hacer negocio, debido a las injerencias y al control del Estado sobre actividades que anteriormente habían estado en manos de particulares (García Vargas y Bernal, 2009).

Todas estas dificultades económicas que atravesaba el Imperio, al menos en lo que al SO hispano se refiere, hicieron que un buen número de asentamientos rurales volcados a la captación de recursos perdieran su razón de ser y se abandonaran en el entorno del Bajo Guadalquivir, siempre bajo una concepción pragmática de la economía que tiempo después quedaría reflejada en el Panegírico Latino: «*Siquidem ager qui numquam respondet impendiis ex necessitate deseritur*» (Paneg.

Lat. VIII, 6), que puede traducirse como «Un campo en el que se invierte más de lo que se obtiene es necesariamente abandonado». Muchas de las *villae* y *cetariae* altoimperiales se habían construido al calor de un contexto de bonanza económica y de óptimos condicionantes geográficos y climáticos. Al verse ahora truncados los factores económicos que habían potenciado la eclosión de estos sitios, muchos fueron abandonados, pues mantenerlos activos resultaba más costoso que el rédito obtenido (Pérez-Aguilar, 2017).

La crisis económica y poblacional iniciada en el SO hispano en la segunda mitad del siglo II pudo agudizarse durante el siglo III por razones climáticas. En esta centuria se produjeron bruscos descensos en las temperaturas y un gran aumento de la aridez, situación denominada por los paleoclimatólogos como *Rapid Climate Change* (McCormick *et al.*, 2012). Este contexto climático debió impactar negativamente sobre el ciclo agrícola del que dependían buena parte de los asentamientos rurales, lo que desencadenó sequías y malas cosechas (Pérez-Aguilar, 2018; Pérez-Aguilar *et al.*, en prensa).

Los asentamientos supervivientes a todas estas vicisitudes y presiones económicas y climáticas se encontraban en la segunda mitad del siglo III perfectamente adaptados a tales circunstancias. Tanto es así que la red de asentamientos dejó de contraerse en este periodo en el entorno del Bajo Guadalquivir (Pérez-Aguilar, 2018). A partir del siglo IV d.C. hubo de nuevo un contexto de estabilidad política y de bonanza económica (Reynolds, 2007; Vidal y Campos, 2008; García Vargas, 2012 y 2014; Pérez Macías, 2014), acompañado de unas circunstancias climáticas que volvieron a resultar prolíferas para el ciclo agropecuario de la zona, con un aumento general de las temperaturas y de la humedad (McCormick *et al.*, 2018). Tales circunstancias, y pese a la merma de la navegabilidad del río *Baetis* (Borja, 2014), hicieron que la red de asentamientos experimentase una nueva fase de crecimiento que se prolongaría hasta comienzos del siglo V d.C. (Pérez-Aguilar, 2018).

5. CONCLUSIONES

Sintetizando todo lo dicho hasta el momento, podríamos decir que la realización de mapas

de densidad permite cartografiar, tomando como unidad operativa los asentamientos documentados arqueológicamente, la evolución de la ocupación de un territorio para luego tratar de explicar en clave histórica la misma. De optarse por llevar a cabo tales mapas mediante estimaciones de densidad de núcleo, debemos prestar gran atención tanto al uso de un tamaño de píxel como de un ancho de banda óptimos. Para determinar esto último hemos propuesto un método basado en el empleo de un rango de tanteo en el que se combinan tanto criterios cuantitativos como cualitativos.

A futuro, queremos seguir sometiendo a prueba esta forma de operar en el cálculo del ancho de banda en el proyecto de investigación posdoctoral que estamos desarrollando en la comarca de Tierra de Barros (Extremadura). Vemos necesario ensayar otros tipos de análisis que permitan acotar de una forma más exacta el rango de tanteo a distintas escalas espaciales, siempre con el afán de mejorar el realismo de los resultados y de su proyección cartográfica.

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BIBLIOGRAFÍA

- BARCELÓ, J. A.; MAXIMIANO, A.; VICENTE, O. (2006). «La multidimensionalidad del espacio arqueológico: teoría, matemáticas y visualización». En: GRAU, I. (ed.). *La aplicación de los SIG en la arqueología del paisaje*. Alicante: Universidad de Alicante, 29-40.
- BAXTER, M. J. (2017). «Kernel density estimation in Archaeology». *Online*: https://www.academia.edu/34849361/Kernel_density_es

- timation_in_archaeology [consultada a 11/01/2021].
- BAXTER, M. J.; BEARDAH, C. C.; WRIGHT, R. V. S. (1997). «Some archaeological applications of Kernel Density Estimates». *Journal of Archaeological Science*, 24(4), 347-354.
- BEARDAH, C. C. (1999). «Uses of multivariate kernel density estimates». En: DINGWALL, L.; EXON, S.; GAFFNEY, V.; LAFLIN, S.; LEUSEN, M. (eds.). *Archaeology in the Age of Internet: Computer, Applications and Quantitative Methods in Archaeology*. Oxford: Archaeopress, 107, 5-12.
- BEARDAH, C. C.; BAXTER, M. J. (1996). «MATLAB Routines for kernel density estimation and the graphical representation of archaeological data». En: KAMERMANS, H.; FENNEMA, K. (eds.). *Interfacing the Past. CAA95: Computer Applications and Quantitative Methods in Archaeology*. Vol. 1. Leiden: University of Leiden, 179-184.
- BONNIER, A.; FINNÉ, M.; WEIBERG, E. (2019). «Examining land-use through GIS-Based Kernel Density Estimation: A re-evaluation of legacy data from Berbatil-Limes Survey». *Journal of Field Archaeology*, 44(2), 70-83.
- BORJA, F. (2014). «Geoarqueología urbana en Sevilla». En: BELTRÁN, J.; RODRÍGUEZ, O. (coords.). *Sevilla arqueológica. La ciudad en época protohistórica, antigua y andalusí*. Sevilla: Universidad de Sevilla, 276-303.
- BRUNSDON, C. (1995). «Estimating probability surfaces for geographical point data: an adaptive kernel algorithm». *Computer & Geosciences*, 21(7), 877-894.
- CHIC, G. (2005). «Marco Aurelio y Cómodo. El hundimiento de un sistema económico». En: HERNÁNDEZ, L. (coord.). *La Hispania de los Antoninos (98-180)*. Actas del II Congreso Internacional de Historia Antigua (Valladolid, 10-12 de noviembre de 2004). Valladolid: Universidad de Valladolid, 567-586.
- CHIC, G. (2009). *El comercio y el Mediterráneo en la Antigüedad*. Madrid: Akal.
- CONOLLY, J.; LAKE, M. (2009). *Sistemas de Información Geográfica aplicados a la arqueología*. Barcelona: Bellaterra.
- DE COS, O. (2004). «Valoración del método de densidades focales (Kernel) para la identificación de los patrones espaciales de crecimiento de la población de España». *GeoFocus*, 4, 136-165.
- DE SMITH, M. J.; GOODCHILD, M. F.; LONGLEY, P. A. (2020). *Geospatial analysis. A comprehensive guide to principles techniques and software tools*. En: <https://spatialanalysisonline.com> [Consultada a 01/12/2020].
- GARCÍA VARGAS, E. (2012). «Aspectos socioeconómicos de la Antigüedad Tardía en la Bética (siglos III-VII d.C.)». En: BELTRÁN, J.; RODRÍGUEZ, S. (coords.). *La arqueología romana de la provincia de Sevilla. Actualidad y perspectivas*. Sevilla: Universidad de Sevilla, 235-253.
- GARCÍA VARGAS, E. (2014). «La Europa de época tardorromana (siglos III-V d.C.)». En: CHIC, G. (dir.). *Historia de Europa (ss. X a.C.-V d.C.)*. Sevilla: Universidad de Sevilla, 613-756.
- GARCÍA VARGAS, E.; BERNAL, D. (2009). «Roma y la producción de *garvm* y *salsamenta* en la costa meridional de Hispania. Estado actual de la investigación». En: BERNAL, D. (ed.). *Arqueología de la pesca en el Estrecho de Gibraltar. De la Prehistoria al fin del Mundo Antiguo*. Cádiz: Universidad de Cádiz, 133-181.
- GARRIDO, P. (2011). *La ocupación romana del valle del Guadiamar y la conexión minera*. Tesis doctoral. Sevilla: Universidad de Sevilla. URI: <http://hdl.handle.net/11441/15988>
- GIBIN, M.; LONGLEY, P.; ATKINSON, P. (2007). «Kernel density estimation and percent volume contours in general practice catchment area analysis in urban areas». En: WINSTANLEY, A. C. (ed.). *GISRUK 2007. Proceedings of the Geographical Information Science Research UK Conference*. Country Kildare: National University of Ireland Maynooth, 270-276.
- GONÇALVES, C.; CASCALHEIRA, J.; COSTA, C.; BÁRBARA, S.; MATIAS, R.; BICHO, N. (2018). «Detecting single events in large Shell mounds: A GIS approach to Cabeço da Amoreira, Muge, Central Portugal».

- Journal of Archaeological Science Reports*, 18, 1000-1010.
- MAXIMIANO, A. (2013). «Datos óptimos para la caracterización espacial y temporal de la variabilidad arqueológica a escala *intra-site*». *GeoFocus*, 13(1), 131-153.
- MCCORMICK, M.; BÜNTGEN, U.; CANE, M. A.; COOK, E. R.; HARPER, K.; HUYBERS, P.; LITT, T.; MANNING, S. W.; MAYEWSKY, P. A.; MORE, A. F. M.; NICOLUSSI, K.; TEGEL, W. (2012). «Climate change during and after the Roman Empire: reconstructing the past from scientific and historical evidence». *Journal of Interdisciplinary History*, 43(2), 169-220.
- MORENO, A. (1991). «Modelización cartográfica de densidades mediante estimadores Kernel». *Treballs de la Societat Catalana de Geografia*, 30, 155-170.
- NAKOINZ, O.; KNITTER, D. (2016). *Modelling human behaviour in landscapes. Basic concepts and modelling elements*. Suiza: Springer.
- PADILLA, A. (1999). «Consideraciones en torno a la explotación del mármol en la Bética durante los siglos I-II». *Habis*, 30, 271-281.
- PÉREZ-AGUILAR, L. G. (2017). «Termodinámica del No Equilibrio y evolución del poblamiento rural tardoantiguo. Reflexiones y casos de estudio de la Bética occidental». En: DIARTE, P. (ed.). *Cities, Lands and Ports in Late Antiquity and the Early Middle Ages: Archaeologies of Change*. Roma: BraDypUS: 133-146.
- PÉREZ-AGUILAR, L. G. (2018). *Termodinámica y poblamiento humano en el Bajo Guadalquivir durante la Antigüedad Tardía (siglos III-VI d.C.)*. Un enfoque darwiniano. Tesis doctoral. Sevilla: Universidad de Sevilla. URI: <https://hdl.handle.net/11441/79400>
- PÉREZ-AGUILAR, L. G. (2021). *La arqueología como biología. Una introducción teórica a la arqueología darwiniana*. Sevilla: Editorial Universidad de Sevilla.
- PÉREZ-AGUILAR, L. G.; CABALLERO-MÁRQUEZ, P.; GORDILLO-SALGUERO, D.; NIETO-DOMÍNGUEZ, V. (en prensa). «Cambios climáticos, crisis de subsistencia y poblamiento humano en el SW hispano entre la Prehistoria Reciente y la Edad Media: las comarcas del Bajo Guadalquivir (Andalucía) y Tierra de Barros (Extremadura)». En: *Plagas, hambrunas, masacres y persecuciones desde la Antigüedad hasta los albores del Medievo*. Murcia: Universidad de Murcia.
- PÉREZ MACÍAS, J. A. (2014). «Agricultura y minería romanas en el suroeste ibérico». *Huelva Arqueológica*, 23, 117-146.
- PRADA, L. (2015). *Métodos estadísticos aplicados en Arqueología*. Trabajo Fin de Grado en Matemáticas. Sevilla: Universidad de Sevilla. URI: <http://hdl.handle.net/11441/40814>
- REYNOLDS, P. (2007). «Cerámica, comercio y el Imperio Romano (100-700 d.C.): Perspectivas desde Hispania, África y el Mediterráneo Oriental». En: MALPICA, A. y CARVAJAL, J. C. (eds.). *Estudios de cerámica tardorromana y altomedieval*. Granada: Alhulia, 13-82.
- SHAWCROSS, W. (1972). «Energy and Ecology: thermodynamic models in Archaeology». En: CLARKE, D. (ed.). *Models in Archaeology*. Londres: Methuen, 577-622.
- TERRELL, G.R.; SCOTT, D.W. (1992). «Variable kernel density estimation». *The Annals of Statistics*, 20(3), 1236-1265.
- VIDAL, N.O.; CAMPOS, J.M. (2008). «Relaciones costa-interior en el territorio onubense en época romana». *Mainake*, 30, 271-287.
- WHEATLEY, D.; GILLINGS, M. (2002). *Spatial Technology and Archaeology. The archaeological applications of GIS*. Londres: Taylor & Francis.
- YIN, P. (2020). «Kernels and density estimation». En: WILSON, J. P. (ed.). *The Geographic Information Science & Technology Body of Knowledge*. Ithaca: University Consortium for Geographic Information Science. DOI: <https://doi.org/10.22224/gistbok/2020.1.12>

The Calore River: settlements and roads in Roman times

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ABSTRACT

This paper presents the results of the territorial investigation of the lower valley of the Calore River, a tributary of the Volturno, providing contact to and from the hinterland. In the Roman period, this area was administered by the city of *Telesia*, in the municipality of S. Salvatore Telesino (BN). A large number of archaeological sites have been documented along the banks of the Calore River, related to this ancient town. The archaeological evidence increases especially in the Late Republican Period when the colony was founded. In fact, traces of centuriated systems are recognisable from this period. Along the terraces overlooking the river, we have identified tombs and rural settlements dating from the Late Republic to the 5th century AD. Scatters of materials provide evidence of small and medium-sized farms and large villas have also been identified, of which structures in *opus incertum* still remain. This sector is crossed by the *Via Latina*, from *Allifae* to *Beneventum*, which ran parallel to the course of the Calore River.

In the territory of Solopaca, on the left bank of the river, are a number of examples of rustic villas, often accompanied by *torcularia* for the production of wine and oil.

The mapping of the archaeological sites and finds along the river valley enable a fresh evaluation of the development of settlement and occupation within this area over time.

KEYWORDS: *Ager Telesinus*, villas, *limitatio*, *Via Latina*, Solopaca, Calore River, *Samnium*.

1. INTRODUCTION

The *Ager Telesinus* (district of Benevento-Campania), in the south-east of the *Samnium*, is located along several routes that were important in the ancient age, primarily the *Via Latina*, and close to other Samnite towns (*Allifae*, *Caiatia*, *Cubulteria*, *Trebula*), to the Latin colony of *Beneventum* and not far from the most important centre in the region, *Capua* (Fig. 1). This area was even more important for communication to and from the Campania plain due to the presence of the river valleys of the Volturno, which crosses the mountains, and the Calore.

The research presented in this paper was initiated in 2005 and is related to the Archaeological Map of the Campania project, designed and coordinated by Stefania Quilici Gigli (Quilici, Quilici Gigli, 2004-2021). A systematic and extensive survey and analysis of different sources (ancient and modern literary sources, archive documentation, finds stored in museums, epigraphy, remote sensing, LiDAR and aerial images) (see Quilici, Quilici Gigli, 2004, 63-76; Quilici Gigli, 2017, 97-98; Belvedere, 2017) have increased the archaeological datasets by approximately 71% (Quilici Gigli, 2017, 135). The data collected in the Guardia Sanframondi and San Lorenzello municipalities were unknown prior to this research project and have contributed towards a fresh understanding of the history of this area from the prehistoric periods through to the early medieval period (Renda, 2020, 123-124).

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This article focuses on the lower Calore valley, one of the preferential routes for communications between the coast and the Apennine Mountains. The river has created a wide alluvial plain on its right bank and is bordered by hills on its left bank. The land overlooking the river and its surroundings comprises intensively cultivated vineyards that contain deposits of stones, silt and sand transported by the Calore River and the numerous streams that run longitudinally through the landscape. For this reason, in the territory of Guardia Sanframondi and San Lorenzello we have worked with the geomorphologists Paolo Magliulo (Department of Science and Technology - Unisannio) and Natalia Leone (CNR) to discover the complex dynamics and geomorphological and anthropic changes which have contributed to the formation of the modern landscape (Renda, 2020, 124-127;

Leone, Magliulo, 2020). Overlaying the archaeological data on the geomorphological map shows that, in every age, the settlement occupied the top surfaces of the ancient alluvial terraces and crest of the hills, avoiding alluvial fans, landslides and recent alluvial terraces, which are flood-prone even today.

2. THE ROMAN PERIOD AND THE VILLAS ON THE RIGHT BANK OF THE CALORE RIVER

2.1. The villas

Several settlements characterised the sector overlooking the Calore River between prehistory and the archaic period, contrary to the trend recorded for the Samnite period, when small rural settlements were concentrated inland around the hill forts of the area (Renda, 2010b,

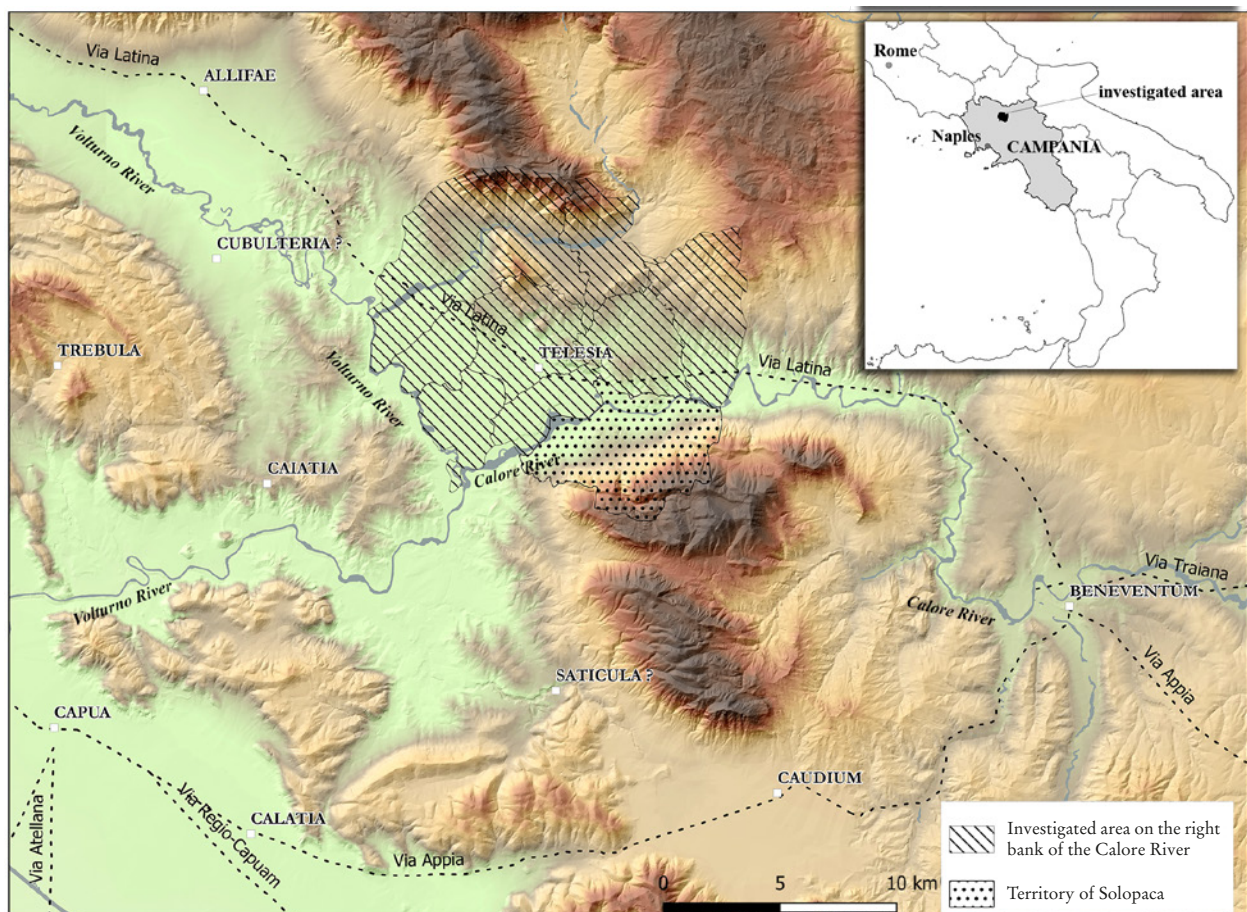


FIGURE 1. The area surveyed in the middle valley of the Volturno River (by G. Renda).

282-289; Renda, 2012, 200-201; Renda, 2020, 131-136).

Renewed archaeological evidence for activity in areas overlooking the river is detected from the second half of the 3rd century BC but this increase is recorded above all between the end of the 2nd and the beginning of the 1st century BC. In this period, a lot of rural units appear in the countryside around the city of *Telesia* (Renda, 2010b, 289-300) (Fig. 2). This mirrors the magnificent fortified walls of *Telesia* in the same broad period (Quilici, 1966), in which inscriptions have been recorded preserved in the wall's towers (Gregori, Nonnis, 2013, no. 25-28; Buonocore, 2018, no. 6430, 6431, 2230, 2233, 2235). Architecturally, this wall system is characterised by circular arc walls alternately connected by rounded and polygonal towers.

On the right bank of the Calore River, settlement in the Late Republic is represented by

small and medium-sized farms, as evidenced by scatters of materials, and villas, of which structures in *opus incertum* still remain.

Usually these buildings occupy elevated positions, with standing heights increased by the use of substructures and cryptoporticos, on which the upper structures were built. We can obtain information about the original appearance of the Late Republican villas in the *Ager Telesinus* from the remains of a large cryptoporticus incorporated within the modern structures of the Masseria delle Grotte (Castelvenere) (Fig. 3, A) (Renda, 2012, 158-171), at the top of an isolated hill and in the canonical location recommended by ancient agronomists (Cato, *De agri cultura*, I, 3; Varro, *Res Rusticae*, 1, 7, 1; Columella, *De Re Rustica*, 1, 2 and 1, 5). On the basis of the reconstruction, this villa was a single block building set on a cryptoporticus which included a reservoir with four branches. In this case the structure is smaller than monumental examples with the same arched

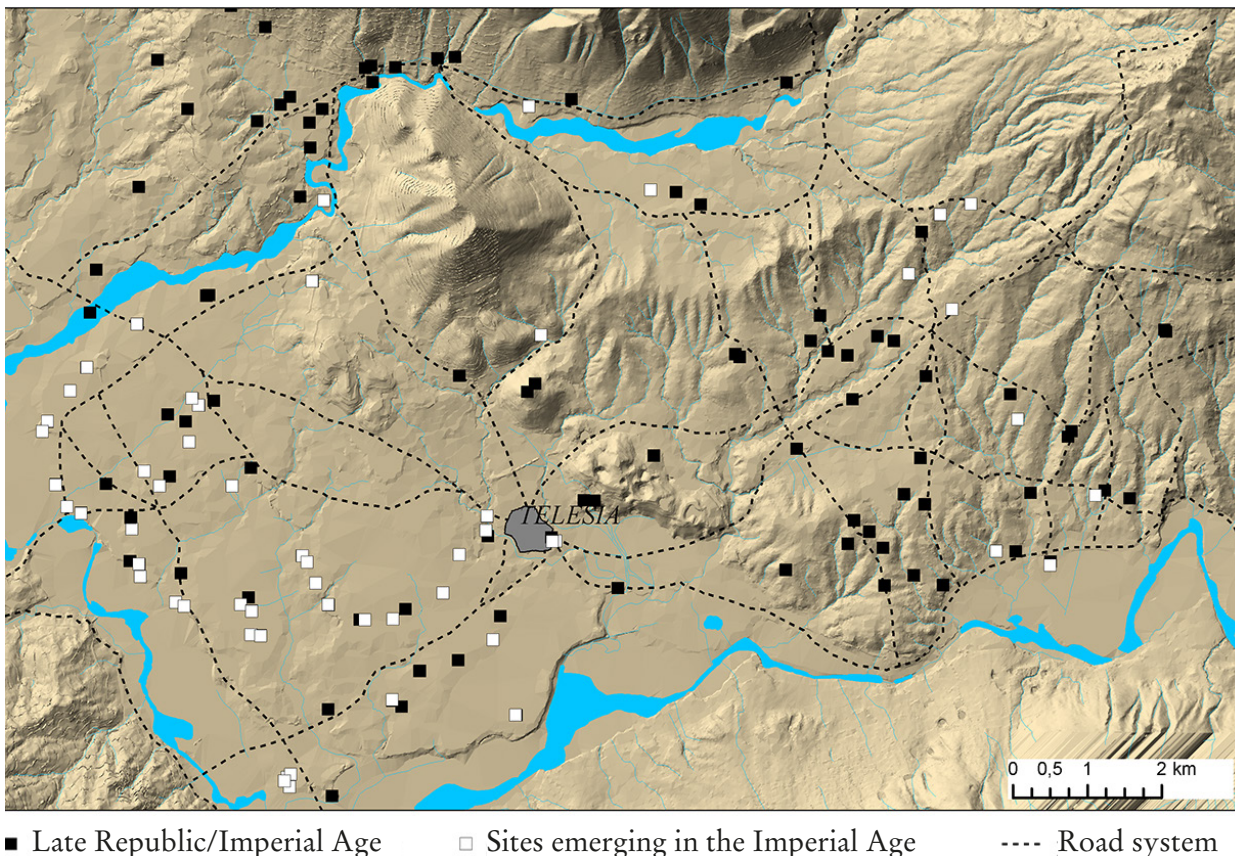


FIGURE 2. The archaeological rural settlements from the Late Republic to the Imperial Age (by G. Renda).

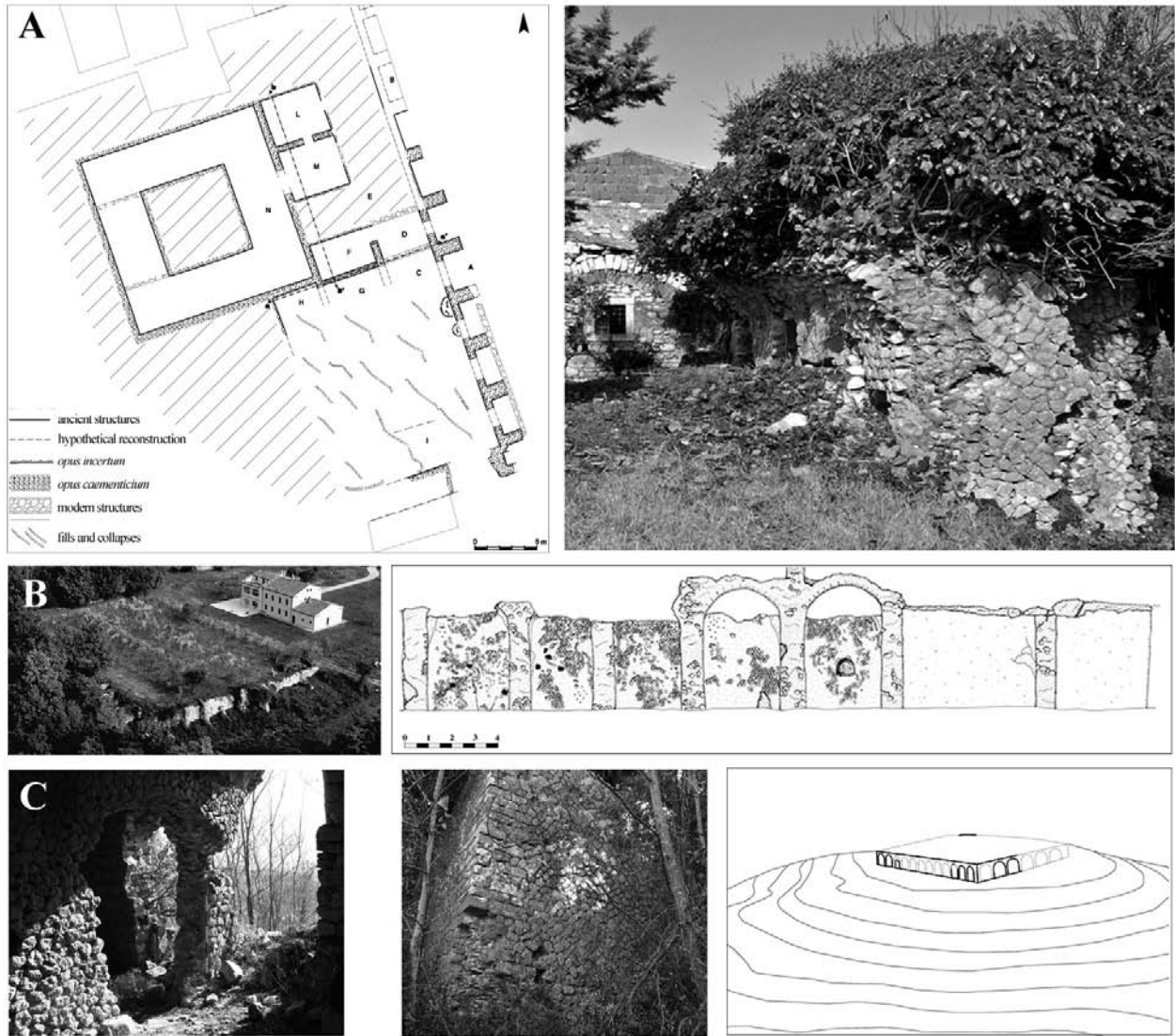


FIGURE 3. The villas and cryptoporticos in the *Ager Telesinus* and in the *Ager Allifanus*: A) the villa of Masseria delle Grotte (Castelvenere); B) the villa of S. Potito Sannitico in the *Ager Allifanus*; C) the remains on the hill of the Rocca of S. Salvatore Telesino (photos and diagrams by G. Renda).

prospect of the villas of the *Ager Allifanus* (Johannowsky, 1973, 150-151; Di Cosmo, 1990, 171-172, 184; Cera, Renda, 2006; Miele, 2006, 208-209) (Fig. 3, B) and of the remains incorporated in the medieval fortress of San Salvatore Telesino (Renda, 2010a, 243-258) (Fig. 3, C). The latter are perhaps what remains of the monumental terracing of a sanctuary, considering the size and topographical relationship with the underlying *Telesia* (Renda, 2010b, 295).

The dynamism of the area continued in the Imperial Age and Late Antiquity (Renda, 2010b,

298-300; Renda, 2012, 204-205; Renda, 2020, 138-139). Some small settlements disappeared but new ones emerged (Fig. 2), both farms and villas, some devoted to the production of wine or oil. Such production is evidenced by parts of *torcularia*, most of them incorporated in modern structures, as in the case of a villa in the territory of Guardia Sanframondi, while others have been found among the remains of rural buildings, in the villa on the western slopes of Monte Pugliano (S. Salvatore Telesino) (Renda, 2010a, 210-219; Renda, 2020, 52-63).

2.2. The centuriated systems of the *Ager Telesinus*

In addition to the archaeological evidence, traces of centuriated systems in the *Ager Telesinus* are also recognisable. The Besançon Group recognised two orthogonal grid systems (20×20 *actus*) based on the different orientation of the traces. The first is called *Telesia I* and the second *Telesia II*; this second centuriated system has been detected along the entire Volturno middle valley (Chouquer et alii, 1987, 152-192).

This analysis excludes the first *limitatio* (*Telesia I*) due to the scarcity of surviving evidence for this section. In addition, our comparison with the ancient cartography and analysis of the archive documentation have shown that many of the paths reported in this

reconstruction were in fact developed in the modern era (Renda, 2010b, 306-308).

For the second grid, dated in the Triumvirate period, French scholars have found a few traces in the *Ager Telesinus* relating only to the *cardines*, oriented N 32° 15' E. After a review of satellite and aerial photos, further traces than those proposed by French scholars have been identified as part of this new research.

Furthermore, traces with the same orientation have been recognised in the territories of *Allifae* (Castagnoli, 1956, 376; Tagliamonte; Miele, 2002; Miele, 2006, 189-190; Soricelli, 2019, 379-380) and *Venafrum* (Cera, 2011, 158-172), enabling the reconstruction of a centuriated system with a format of 20×20 *actus* along the Volturno river (Fig. 4), as already proposed by the Besançon Group.

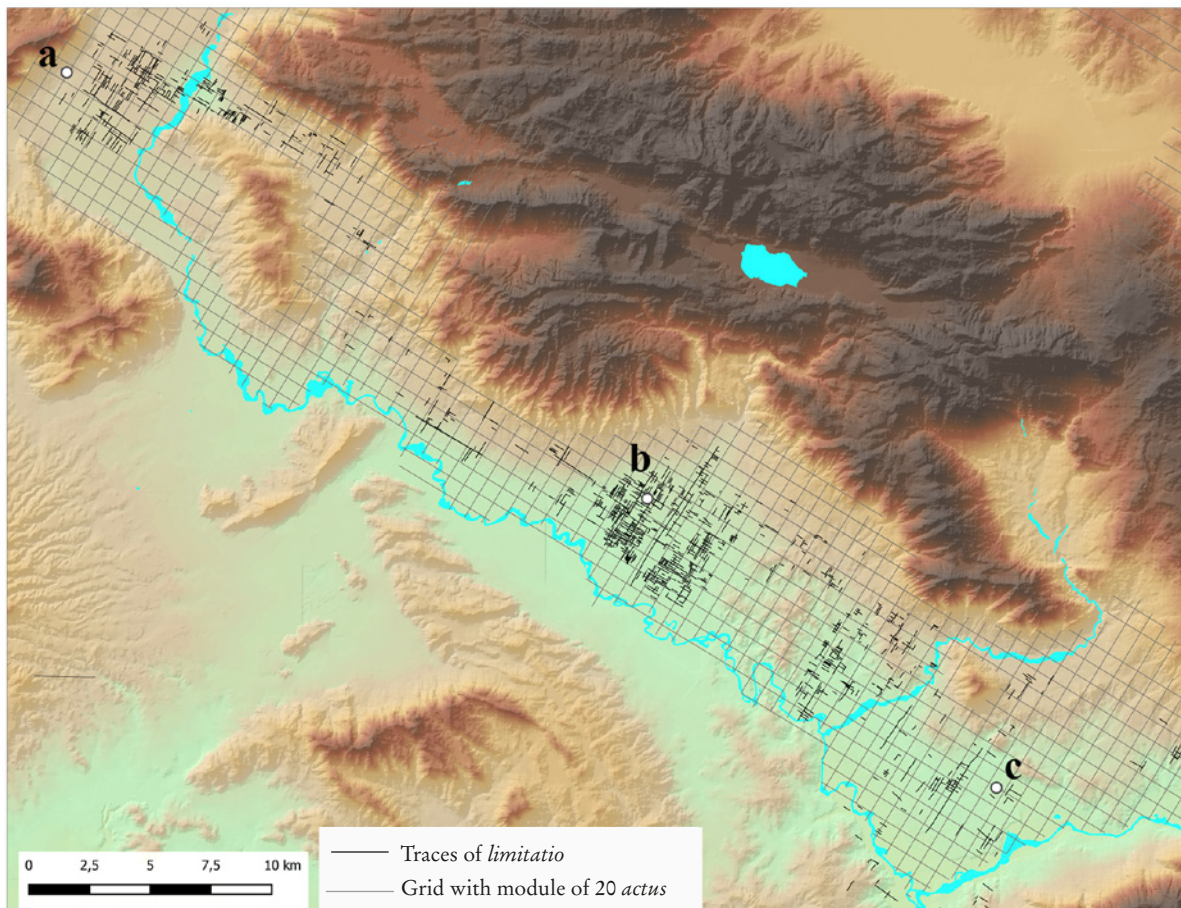


FIGURE 4. The centuriated system (module of 20 *actus*) in the territories of *Venafrum* (a), *Allifae* (b) and *Telesia* (c) (by G. Renda).

However, in the *Ager Telesinus*, satellite and aerial images have revealed traces of another centuriated system based on a format of 15 *actus* (Renda, 2010b, 306-308; Renda, 2012, 207-208; Renda, 2020, 143) (Fig. 5). These, with *cardines* oriented N 37° W, are evident in most of the plain of Marafi (Faicchio), along Titerno Creek. In this area the orientation of the roads, of the boundaries of fields and of some ditches still follow the same direction. The antiquity of this grid has been indicated by archaeological evidence from the Roman period along the axes recognised, as well as by the same orientation of the structures of a Roman villa in the eastern sector of the Marafi plain and of ancient water pipes.

Traces with a similar orientation have also been found in the territories of Puglianello, Amorosi, San Salvatore Telesino, Teleso Terme,

Castelvenere and San Lorenzello (Fig. 5). These are fragmentary and discontinuous but, in some cases, relate to important road systems, perhaps a continuation of ancient Roman roads.

The dating of these systems is much discussed. The *Liber Coloniarum* states “*Telesia, muro ducta colonia, a triumviris deducta*” (Chouquer et alii, 1987, 77) but we would argue that it’s difficult to make a chronological proposal without datable evidence from stratigraphic excavations (Renda, 2010b, 306).

2.3. The *Via Latina*

Some rural settlements overlook an important road, the *Via Latina*, parallel to the right bank of the Calore River, joining *Allifae* with *Beneventum*



FIGURE 5. The centuriated system (module of 15 *actus*) in the *Ager Telesinus* (by G. Renda).

(Fig. 1 and 6). This route, at least for the period of Late Antiquity, is outlined in the *Itinerarium Antonini*, in the segments *A Terracina Benevento* (*It. Anton.*, 121, 8-12; 122, 1-3) and *Praenestina. Ab Vrbe Benevento* (*It. Anton.*, 304, 3).

The arrangement of archaeological evidence has enabled the reconstruction of the route, which is mostly the same as the modern road (Renda, 2010b, 300-303; Renda, 2012, 204; Renda, 2016; Renda, 2020, 139-140). In the investigated area, the route, skirting the amphitheatre, entered *Telesia* from the north-west gate and exited from the south-east gate. After crossing the necropolis to the south of the town, it went through the foothills overlooking the Calore River. The fragmentary altar recovered in the locality of Starze (municipality of Guardia Sanframondi) (Fig. 6, A) must have belonged to one of the many graves along the road. Its appearance was not dissimilar from other great roads of the Roman world, with buildings, funerary monuments and tombs along the way that often mark the boundaries, as attested by the *Lex de sepulchris*, of the Tiberian age (Lachmann, 1848, 271.1). Modern toponymy testifies the passage of the ancient road via the toponyms “Taverna” and “Santa Maria la Strada”, near the Calore River, which must have been one of the cornerstones of the area. This is where the road to *Beneventum* met the Calore River and one of the routes

coming from the mountains (Fig. 6, C). Behind the church and convent of Santa Maria la Strada, next to the ruins of a medieval bridge, there are structures and fictile materials belonging to a villa, perhaps with a quay on the Calore River given its proximity to the watercourse (Autieri, 2017, 37-38). The *lapis pedicinus* re-used in the facade of the church, part of a Roman press, might attest to one of the productive activities of the settlement. The discovery of a funerary altar (Fig. 6, C), in a neighbouring vineyard, dated the 2nd century AD, and the presence of other tombs suggest there was a small necropolis, perhaps connected to the villa. The inscription on the altar mentions a *Q. Tettaeus* and its proximity to the villa suggests it was owned by this *gens*, also referred to in another inscription recovered still further west (Renda, 2019, 231-236) (Fig. 6, B).

In the area around *Telesia*, a minor pathway must have separated from the *Via Latina*, crossing the Calore River and reaching its left bank, to serve the rural buildings in the territory of Solopaca. It’s possible that the crossing point was in the sector marked by the 19th-century river port, as testified in the cartography of this time and by the modern bridges, in a sector geologically more stable than the area immediately to the west, where some water-rich valleys converged.

Giuseppina Renda



FIGURE 6. The lower valley of the Calore River: road directions (dotted line), epigraphic (A-C) and archaeological evidence (by G. Renda).

3. THE LEFT BANK OF THE CALORE RIVER AND THE AREA OF SOLOPACA

3.1. The territory and its geomorphology

The municipality of Solopaca extends to the slopes of Mount Taburno, on the left bank of the Calore River (Fig. 1). Unlike the terraces on the hydrographic right bank of the Calore (Leone, Magliulo, 2020), the area of Solopaca is composed of a wide aggradation belt in the foothills, consisting mainly of coalescing bodies of alluvial fans and slope deposits (Leone, 2015-2016, 106). Four generations of conoids have been identified, formed over the Laiano system between the Middle and Upper Pleistocene, apart from the fourth most recent generation dating back to the Holocene (Amato et alii, 2018, 2470-2471). Complex dynamics and geomorphological and anthropic changes have contributed to the formation of the modern landscape in the area of Solopaca. Preliminary research suggests that the archaeological data and Roman archaeological remains occupy, on the geomorphological map, the top surfaces of ancient, cemented crests of conoids (I and II generation) and ancient alluvial terraces (Campanian Ignimbrite), avoiding alluvial fans, landslides and recent alluvial terraces which are flood-prone even today. In any case, some cores carried out on IV generation fans have highlighted the presence of archaeological elements of uncertain chronology, although this generation can even be considered as still active since some of the recent bodies reactivated during the floods affecting the Calore valley in October 2015 (Leone, 2015-2016, 116).

3.2. Ancient roads and archaeological remains in the territory of Solopaca

Solopaca was an important hub between the areas of *Telesia* and *Caudium-Beneventum*, especially as a crossing point of the river (Renda, 2010b, 303). This is also evident in the toponyms indicated by 19th-century maps held by the Military Geographical Institute as well as the historical bridges across the Calore River. From this passage, parallel to the left bank of the Calore, a secondary path probably branched off

towards the east and reached *Beneventum*, crossing the Jenga valley, as well as intercepting the mountain paths leading to Taburno-Camposauro (Renda, 2010b, 303). Continuing towards the west, it headed towards the settlements in *Santianni-Staglio*, until re-joining the roads from *Telesia* to *Capua* and the modern Sant'Agata dei Goti (Caiazza, 2010, 92).

Several elements testify to the importance of this route. In the locality of *Bolla*, 1.3 km from the modern Maria Cristina bridge, there is a monumental tomb (Fig. 7), heavily damaged and stripped of its vestments but one can still distinguish the quadrangular base and a circular upper plane that tends to taper towards the top. The structure is preserved for approx. 4.5 m of its height, of which 1.50 m approx. is taken up by the rectangular base, the sides of which are about 3 m long; the current diameter of the cusp is about 2.5 m to the base. Access to the inner chamber is on the south side through an arched entrance. The room still has its vaulted roof intact, while on the north side there's a small niche. Of the structure only the *opus caementicium* nucleus remains, composed of several fragments of tile, bricks and abundant flakes of limestone and splinters of yellow tuff. The *opus latericium* that covered the inner wall of the burial chamber has been preserved and is still distinguishable for about 50 cm. Over the quadrangular base is a truncated conical plateau, 30 cm thick, connecting with a cusp, still standing for 2.7 m. In the locality of *Bosco S. Stefano*, near the monumental tomb, a funerary epigraph has been found of *C. Acellius, mercator suarius*, suggesting it might be this person's tomb (Caiazza, 2010, 20). The funerary monument is reminiscent of mausoleums with a parallelepiped podium (the sepulchral base), on which a tapered cylindrical cusp is set, datable between the 1st century BC and 1st century AD. This is a well-known typology, widespread in Campania, used as a status symbol for the emerging classes (Carfora, 2013, 114). The funerary monument, therefore, was located along a secondary path that connected the left bank of the Calore River with *Beneventum*. Not far from the mausoleum, about 600 m to the south-east, a small cistern has been found, probably connected to a villa. It's possible the funerary monument was connected

to the villa in *Bolla*, as confirmed by various other cases of a villa-funerary monument connection, located along roads in a clearly visible position (Carfora, 2013, 116).

As regards agricultural exploitation during the late Republican period, the most evident archaeological traces were found following surface surveys (Mezzazappa, 2007-2008). Several rustic villas have been active in the localities of *Fetente*, *Cese-Bolla* and *Campaminico* since the late Republican era, with long settlement continuity (Fig. 7), some testified by cisterns. Until a few decades ago, another cistern in *opus caementicium*, now destroyed (Mezzazappa, 2007-2008, 131), was present in the *Cersole-Staglio* zone. Remains attributable to a villa are present in *Casa delle Fate* (Fig. 7), close to the mountain slopes, where structures with facing in *opus incertum* have been preserved. This villa, from surveys in the late 1980s, has provided fragments of *dolia*, three *lapides pedicini* and

various ceramic fragments dating from the 2nd century BC up to the 5th century AD, probably when it was abandoned (D'Onofrio *et alii*, 1994, 65-66).

Among the water infrastructures in the area is a large, vaulted cistern covered by a vineyard and shrubs, in *opus caementicium* with a waterproof plaster coating, which occupies the southern limit of a terrace in the western part of the Solopaca area (near the route leading to *Capua*), in *Santianni-Staglio* (Fig. 7). The cistern was supplied by the waters that flowed from the slopes behind (suggested by the presence of two holes along the south wall), especially because the area is rich in natural springs, such as the *Fontana dei Monaci* and *Fontana Santianni*, not so far from the cistern. It's mostly filled with soil, well preserved if we exclude the collapse of the western portion (approx. 5 m): with two naves, although only the southern one remains visible, while the northern nave is covered by

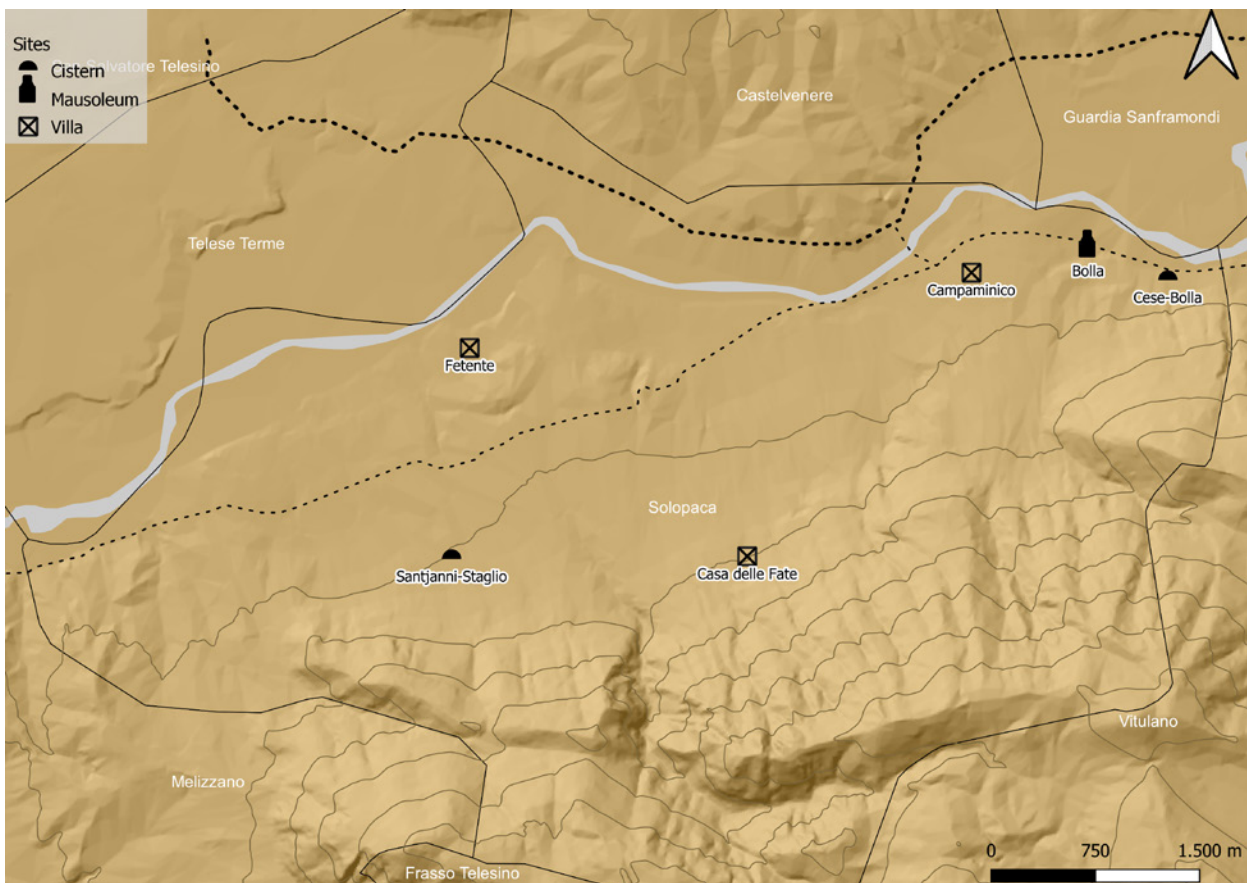


FIGURE 7. Archaeological evidence analysed in the municipality of Solopaca.

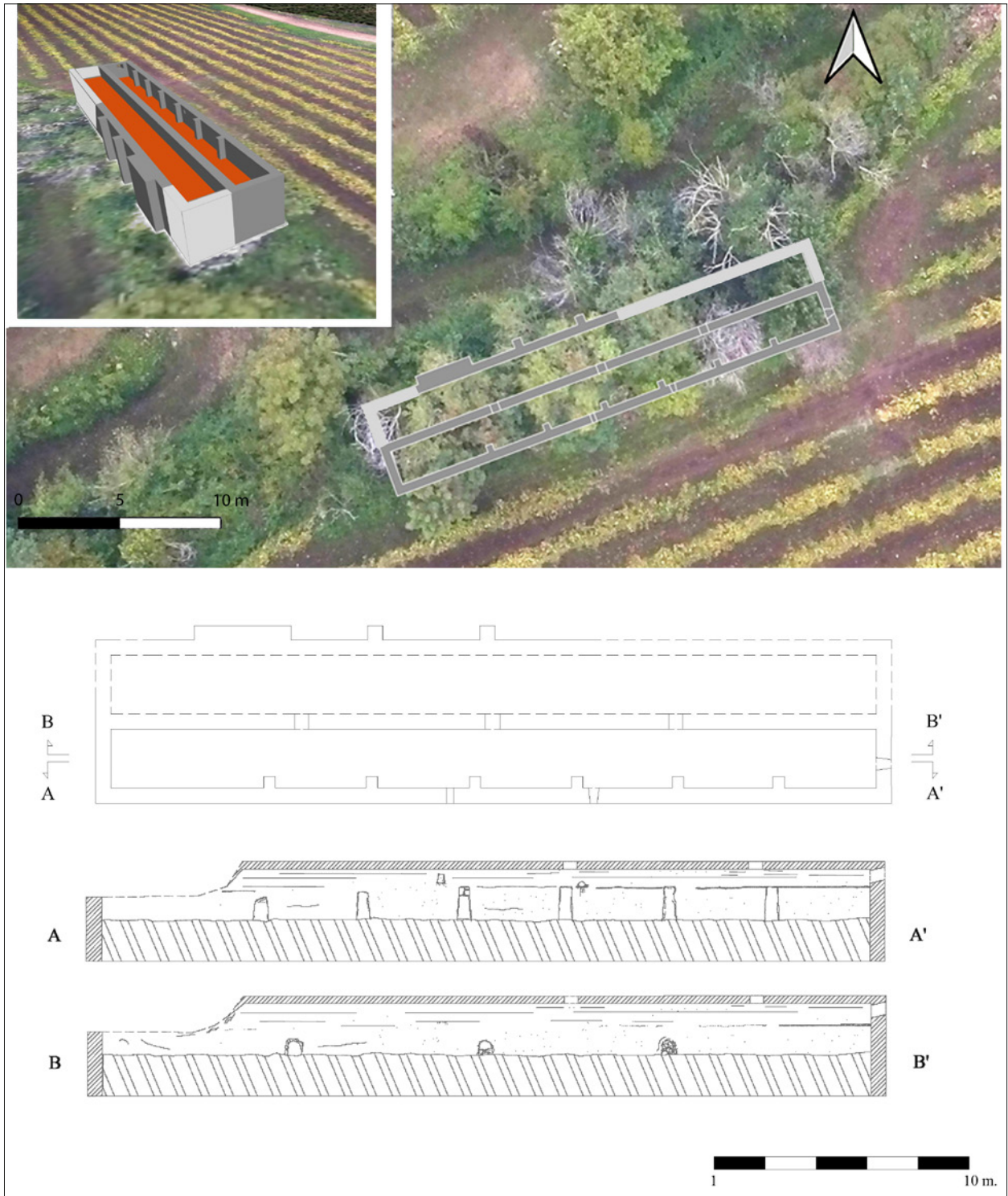


FIGURE 8. The cistern in *Santianni-Staglio*. Plan, relief, and 3D model with reconstructive hypothesis (in light grey) of the remains of the Roman cistern in the *Santianni-Staglio* (Solopaca) (photos and diagrams P. Izzo).

soil and shrubs with a part of the collapsed vault still perceptible to the east. Along its north external side, three preserved buttresses can be identified, used to keep the structure stable. The southern nave is 2.3 m wide and 30 m long, with an east-west orientation. Along the northern side (thickness 60 cm), are three holes (diameter 30 cm) arranged at a regular distance (7 m) and connected to the other nave. Along the southern side are two small openings for water to flow out and six internal semi-pillars (approx. 50×40 cm) arranged at a regular distance of approx. 3.5 m. A 3D model of the cistern was created using the QGis tool “QGis 2threejs”, extruding the polygonal shapefiles derived from a direct survey in the field (Fig. 8). This 3D model can help us understand the dimensions of the Roman cistern, even though it’s almost completely covered by soil and dense vegetation.

Furthermore, field surveys near this structure have identified numerous pottery and tile sherds, unfortunately mostly not diagnostic due to the continuous working of the land for agricultural purposes. The area of pottery sherds extends over about 1.7 h, in a north-south direction, on three terraces in succession, bordered by walls of uncertain age for the first two, and by the substructures of the cistern in the case of the third, most southern terrace. The few diagnostic pottery sherds identified suggest a chronological occupation of the area until the 2nd-3rd century AD.

Cisterns with one or more naves with semi-pillars and buttresses are present from the 1st century BC (De Franceschini, 2005, 308-309). An example is the large cistern of *Madonna degli Angeli* in Bellona (district of Caserta) (Renda, Salerno, 2014, 82-83) (Fig. 9).



Solopaca, Santjanni-Staglio

Ph. P. Izzo



Bellona, Madonna degli Angeli Cistern
Ph. G. Renda

FIGURE 9. Solopaca and Bellona: comparison of the Roman cisterns (by P. Izzo).

3.3. Closing remarks on the preliminary survey in the territory of Solopaca

Although research in the Solopaca territory is still in its early stages, the numerous archaeological finds indicate the importance of the left bank of the Calore River, both for reaching major locations such as *Capua*, *Saticula* and *Beneventum* and also for agricultural production, probably to serve the *Telesia* area (visible from the cistern in *Santianni*, as shown by the analysis carried out with QGIS, about 4 km away as the crow flies). GIS tools can help us to analyse more thoroughly the archaeological presence in the territory. The terraces around the structure have provided a range of pottery sherds although these have unfortunately been fragmented by continuous agricultural work. The aforementioned *lapides pedicini* from the *Campaminico*, *Casa delle Fate* and *Santianni-Staglio* districts belonging to ancient presses (D’Onofrio *et alii*, 1994) attest to the agricultural importance of the territory of Solopaca and its production of wine, an activity that continues to this day.

Pierfrancesco Izzo

BIBLIOGRAPHY

- AMATO, Vincenzo *et alii* (1994). “Geomorphic response to late Quaternary tectonics in the axial portion of the Southern Apennines (Italy): A case study from the Calore River valley”. In: *Earth Surf. Process. Landforms*, 43, 2463-2480.
- AUTIERI, Carmela (2017). “Il complesso monastico di S. Maria della Strada: l’analisi delle sopravvivenze strutturali-insediative e archeologiche”. In: AUTIERI, Carmela (ed.). *Prospezioni archeologiche. Il complesso monastico di Santa Maria della Strada a San Lorenzo Maggiore*. Teano: Tipolito Fiore, 37-38.
- BELVEDERE, Oscar (2017). “Archaeological survey in Italy between Ancient Topography and Landscape Archaeology”. In: BERGEMANN, Johannes; BELVEDERE, Oscar (eds.). *Survey-Archäologie: Naturwissenschaftlich-technische und historische. Methode in Italien und Deutschland – La ricognizione archeologica: Metodi tecnico-scientifici e approccio storico in Germania e in Italia*. Rahden: Leidorf, 21-28.
- BUONOCORE, Marco (2018). *CIL IX, Supplementum, Pars Prima*. Berlin/Boston: W. De Gruiter.
- CAIAZZA, Domenico (2010). “La via Latina e i suoi raccordi”. In: DE BENEDETTIS, Gianfranco (eds). *La Provincia Sannii e la viabilità Romana*. Isernia: Volturina Edizioni, 75-96.
- CARFORA, Paola (2013). “Su un edificio funerario nell’agro di Nola”. *Orizzonti: rassegna di archeologia*, XIV, 111-118.
- CASTAGNOLI, Ferdinando (1956). “Tracce di centuriazioni nei territori di Nocera, Pompei, Nola, Alife, Aquino, Spello”. *Rendiconti. Accademia dei Lincei*, s. 8, 11, 374-378.
- CERA, Giovanna (2011). *Carta archeologica e ricerche in Campania, Fascicolo 5, Atlante Tematico di Topografia Antica*. Suppl. XV/5. Rome: L’Erma di Breitschneider.
- CERA, Giovanna; RENDA, Giuseppina (2006). “La villa romana di località Torelle a San Potito Sannitico”. *Atlante Tematico di Topografia Antica*, 16, 69-88.
- CHOUQUER, Gérard; CLAVEL-LEVEQUE, Monique; FAVORY, François; VALLAT, Jean-Pierre (1987). *Structures agraires en Italie centro-méridionale. Cadastres et paysage ruraux*, Collection de l’École Française de Rome. Vol. 100. Rome: École Française de Rome.
- D’ONOFRIO, Salvatore *et alii* (1994). *La Festa dell’Uva a Solopaca*. Cusano Mutri (BN): Nuova Impronta.
- DE FRANCESCHINI, Marina (2005). *Ville nell’agro romano*, Rome: L’Erma di Breitschneider.
- DI COSMO, Luigi (1990). “Nota preliminare su materiale proveniente dal criptoportico in località Taverna (S. Angelo d’Alife)”. In: DI COSMO, Luigi; VILLUCCI, Antonio Marcello (eds.). *Il territorio alifano. Archeologia arte e storia. Atti del Convegno (S. Angelo d’Alife (CE) 1987)*. S. Angelo d’Alife (CE): Gruppo Archeologico Rufrium, 171-179.

- GREGORI, Gian Luca; NONNIS, David (2013), “Il contributo dell’epigrafia allo studio delle cinte murarie di età repubblicana”. In: BARTOLONI, Gilda; MICHETTI, Laura (eds.). *Mura di legno, mura di terra, mura di pietra: fortificazioni nel Mediterraneo antico, Scienze dell’Antichità*, 19, 2/3, 491-524.
- JOHANNOWSKY, Werner (1973). “Note sui criptoportici pubblici in Campania”. In: *Les cryptoportiques dans l’architecture romaine. Colloque (Rome 1972)*. Collection de l’École Française de Rome. Vol. 14. Paris: Centre national de la recherche scientifique, 143-157.
- LACHMANN, C. (1848) (ed.). *Gromatici veteres*, I. Berlin: G. Reimer.
- LEONE, Natalia (2015-2016). *Studio dell’evoluzione quaternaria di alcune conche intermontane dell’Appennino campano-molisano, a supporto della pianificazione e gestione del territorio e della prevenzione del rischio sismico*, PhD Thesis (unpublished).
- LEONE, Natalia; MAGLIULO, Paolo (2020). “Assetto geologico e geomorfologico dei territori di Guardia Sanframondi e San Lorenzello”. In: RENDA, Giuseppina (2020). *Carta archeologica e ricerche in Campania, Fascicolo 11, Atlante Tematico di Topografia Antica*. Suppl. XV/11. Rome: L’Erma di Breitschneider, 147-164.
- MEZZAZAPPA, Stefania (2007-2008). *Carta archeologica del territorio sulla riva sinistra del Calore nell’alto beneventano*, PhD Thesis (unpublished).
- MIELE, Floriana (2006). “*Allifae* e il suo *ager*. Considerazioni sugli aspetti storici e sulle testimonianze monumentali alla luce delle recenti indagini archeologiche”. In: SIRANO, Francesco (ed.). *In Itinere. Ricerche di archeologia in Campania*, S. Angelo in Formis: Lavieri editore, 185-193.
- QUILICI GIGLI, Stefania (2014), “Il territorio di Bellona. Lettura topografica dei dati archeologici”. In: *Carta Archeologica e Ricerche in Campania, Fascicolo 8, Atlante Tematico di Topografia Antica*. Suppl. XV/8. Rome: L’Erma di Breitschneider, 97-108.
- QUILICI GIGLI, Stefania (2017). “Lettura storica dei dati archeologici: dall’epoca sannitica all’epoca imperiale”. In: QUILICI GIGLI, Stefania; RENDA, Giuseppina (2017). *Carta archeologica e ricerche in Campania, Fascicolo 10, Atlante Tematico di Topografia Antica*. Suppl. XV/10. Rome: L’Erma di Breitschneider, 135-154.
- QUILICI, Lorenzo (1966). “Telesia”. In: *Studi di urbanistica antica, Quaderni dell’Istituto di Topografia antica della Università di Roma*, 2, 85-106.
- QUILICI, Lorenzo; QUILICI GIGLI, Stefania (2004). *Introduzione alla Topografia Antica*, Bologna: Il Mulino.
- QUILICI, Lorenzo; QUILICI GIGLI, Stefania (2004-2021) (eds). *Carta archeologica e ricerche in Campania, Atlante Tematico di Topografia Antica*, suppl. XV, fasc. 1-11. Rome: L’Erma di Breitschneider.
- RENDA, Giuseppina (2010a). “La zona dal torrente Titerno al Fiume Calore”. In: *Carta archeologica e ricerche in Campania, Fascicolo 4, Atlante Tematico di Topografia Antica*. Suppl. XV/4. Rome: L’Erma di Breitschneider, 93-272.
- RENDA, Giuseppina (2010b). “Il territorio tra il Monte Monaco e il fiume Calore. Lettura topografica dei dati archeologici”. In: *Carta archeologica e ricerche in Campania, Fascicolo 4, Atlante Tematico di Topografia Antica*. Suppl. XV/4. Rome: L’Erma di Breitschneider, 275-311.
- RENDA, Giuseppina (2012). “Il territorio di Castelvenere”. In: *Carta archeologica e ricerche in Campania, Fascicolo 7, Atlante Tematico di Topografia Antica*. Suppl. XV/7. Rome: L’Erma di Breitschneider, 131-211.
- RENDA, Giuseppina (2016). “Landscape Archaeology in the Ager Telesinus: Scientific Results and Land-Use Planning”. In: *LAC2014 Proceedings | DIO 10.5463/lac.2014.50* [2016], 1-9.
- RENDA, Giuseppina (2019). “Il contributo dell’epigrafia alla ricostruzione del paesaggio antico: altari funerari dalle ricognizioni per la Carta archeologica della Campania”. In CUTILLO, Antonietta (ed.). *Theodor Mommsen nell’archeologia ed epigrafia dell’Italia meridionale nel Bicentenario della nascita, Atti del Convegno*. Telesina: Associazione Storica Valle Telesina, 225-245.
- RENDA, Giuseppina (2020). *Carta archeologica e ricerche in Campania, Fascicolo 11, Atlante*

- Tematico di Topografia Antica*. Suppl. XV/11. Rome: L'Erma di Breitschneider.
- RENDA, Giuseppina; SALERNO, Antonio (2014). “Madonna degli Angeli”. In: *Carta archeologica e ricerche in Campania, Fascicolo 8, Atlante Tematico di Topografia Antica*. Suppl. XV/8. Rome: L'Erma di Breitschneider, 79-93.
- SORICELLI, Gianluca (2019). “*Tractus ille celeberrimus Venafranus Allifanus*”. In: MAIURO, Marco (ed.). *Uomini, Istituzioni, Mercati, Studi di storia per Elio Lo Cascio*. Bari: Edipuglia, 373-380.
- TAGLIAMONTE, Gianluca; MIELE, Floriana (2002). “L'Ager allifanus”. In: *Ager Campanus, Atti del Convegno Internazionale La storia dell'Ager Campanus, i problemi della limitatio e sua lettura attuale (Real sito di S. Leucio, 2001)*. Naples: Jovene, 191-201.
- LATIN SOURCES
- CATO, Marcus Porcius. *Opere*. CUGUSI, Paolo, SBLENDORIO, Maria Teresa (eds.). Turin: UTET (2001).
- COLUMELLA, Lucius Iunius Moderatus. *On Agriculture, I. Books 1-4*. Translated by Harrison Boyd. *Ash. Loeb Classical Library*. Vol. 361. Cambridge, MA: Harvard University Press (1941).
- Itinerarium Antonini Augusti et Hierosolymitanum, ex libris manu scriptis* (1848). PARTHEY, Gustav; PINDER, Moritz (eds.). Berolini: Friderici Nicolai.
- VARRO, Marcus Terentius. *Opere di Marco Terenzio Varrone*. Translated by Traglia, Antonio. Turin: UTET (1979).

The territory of Roman *Barcino*: methodological advances applied to the study of a centuriated landscape

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ABSTRACT

Landscape archaeology has contributed greatly to the advance of centuriation studies, a research area widely considered marginal in recent decades. This was due in large part to a multiplicity of unreliable studies from the 1970s to the 1990s, some of which were proved wrong by large-scale excavation. Despite this, the last decade has seen a revival of archaeomorphology-based studies that has helped put this discipline back on the map. Moreover, current research has adopted multidisciplinary approaches which include archaeological evidence, spatial analysis and palaeoenvironmental data. Environmental sources offer important insights on the effects a *deductio* had on the landscape. The incorporation of new digital methods and Geographic Information Systems (GIS) represents a major qualitative leap forward in the planimetric accuracy of field system restitution, improving the quality and reliability of archaeomorphological analyses. These new methodological advances have been largely developed in the territory of Roman *Barcino* (Barcelona), an Augustan colony in which the *centuriatio* embodied the ideal territory of a Roman town. The results allow a move from purely economic or materialistic approaches to more socially and culturally focused explanations. Linking centuriation with Roman settlements and landscape dynamics, our text proposes a rethink of *Barcino* centuriation which brings out both its economic impact through its influence on land use and the significance of its conceptual and representative dimension.

KEYWORDS: Centuriation, settlement, *ager*, road network, archaeomorphology, land use, *villae*, *Barcino*.

1. INTRODUCTION

Centuriation, the grid-based parcelling of landscapes for land distribution and field allotment, is a key evidential paradigm for tracing how the Romans transformed the environments they colonised in order to fit their economic and productive needs. In its division of land into rectilinear units (*centuriae*) through a grid of parallel planning lines based on right-angled axes (*limitatio*), centuriation reflected the

rational thinking of the Classical world. This also linked it to urban development so that, as described in ancient land-surveying treatises, it represented for the Romans the ideal extension of a city into its adjacent territory (López, 1994).

Advances in research have demonstrated that centuriation's apparent uniformity is in fact relative. Transported from the Italic world to the provinces from c. 100 BC, particular features within individual territories depended on chronology, cultural/social background and geographical features. Written sources mention the existence of undivided areas within the *centuriae*, the integration of woods and grasslands and the adaptation of these systems to

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mountain areas, the natural relief and streams. A number of examples and studies reveal wide spaces without limits as well as variations in the equidistance of the main axes and adaptations to topography and drainage (Ariño, Gurt, Palet, 2004, 157-164). The complexity of these reconstructions is increased by the selective conservation of features, their re-use and deformation over time. Furthermore, in the Mediterranean, research has demonstrated that large areas within centuriated landscapes were never exploited for agriculture or pastoral purposes, which may suggest that centuriation had a symbolic background beyond its economic uses (Palet, Orengo, 2011).

Despite these nuances, the phenomenon of centuriation remains crucial for understanding the Roman idea of territory. Various approaches have been applied in the study of centuriated areas but a particularly influential approach reached its peak during the 1980s with the work by the Besançon group (Clavel-Lévêque, 1983; Chouquer, *et al.* 1987). This school developed a methodology based on two criteria: constant orientation and modulation based on the *actus* (120 Roman feet, about 35.5 metres) and identification of the canonical model of grid squares with sides of 20 *actus*. This method, applied through aerial photography both in France and later in the rest of Europe, increased the number of centuriations identified without any critical interpretation of agrarian morphology. In some cases archaeological evidence, itself difficult to obtain, has proven these hypotheses wrong, further discrediting this approach.

During the 1990s researchers developed a suite of complementary methods and techniques that resulted in a wiser use of metrology, long-term and multidisciplinary approaches (Chouquer, Favory, 1991; Palet, 1997) and the development of archaeological (especially fieldwork and surveys) and geomorphological techniques (Berger, Jung, 1996) that allowed the archaeomorphological sequence to be analysed from a diachronic perspective. Centuriation studies have now evolved further with the application of techniques based on Geographical Information Systems and the increased availability of digital materials, together improving the quality and reliability of results.

However, archaeomorphological studies provide a sequence of relative chronology but not absolute dates, while surveys and test pits cannot always be carried out because of local conditions, with landscape changes especially remarkable in urban and peri-urban areas (Palet, 1997, 28-29). Regressive study (from the most recent to the oldest) of historical documents, including maps, is an essential source of information. It provides *ante quem / post quem* dating for structures and proves that archaeomorphological analysis is based on relevant historical landscape elements. The relationship between paths and routes and the distribution of rural settlement and sites is another relevant dating technique. Moreover, the incorporation of historical and palaeoenvironmental data enables an interdisciplinary approach based on landscape archaeology, offering insight into the complex relationship between territorial structuring, settlement and landscape change (Franceschelli, Marabini, 2007; Palet, Orengo, Riera 2011; Matteazi, 2019). These methodological advances have contributed to the reintegration of centuriations into landscape archaeology (Orengo, Palet, 2016).

2. METHODOLOGICAL ADVANCES AND THE STUDY OF *BARCINO* CENTURIATION

These studies have been carried out largely in the territory of *Barcino*. The research on landscape dynamics on the Plain of Barcelona, today an immense urban agglomeration, and specifically the territorial impact of the foundation of *Barcino*, had a reference study in J.M. Palet (1997) (Fig. 1). The analysis was updated by the same author and H.A. Orengo in 2009 and 2010, incorporating information from archaeomorphological, archaeological and paleoenvironmental data into a GIS project (Palet, Fiz, Orengo, 2009; Palet, Orengo, Riera, 2011). This update made it possible to rethink the impact of centuriation within the context of the foundation of *Barcino*.

Most recently there has been a significant advance in urban archaeology research in the city of Barcelona thanks to the development of rescue excavations by local authorities. Also

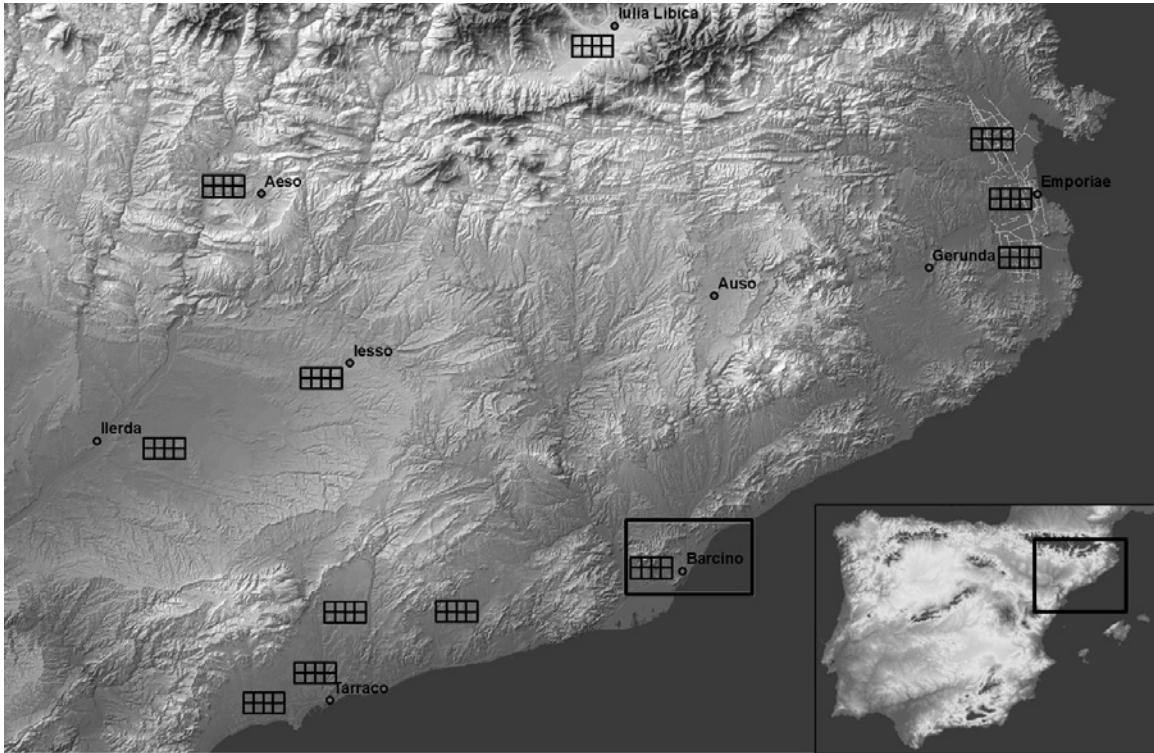


FIGURE 1. Location of the study area, indicating the impact of centuriation in north-east *Tarraconensis*.

noteworthy is the quality of the Archaeological Map produced by the Archaeological Service of the municipality and available via open access on the *Pla Barcino* website (<http://cartaarqueologica.bcn.cat/>). The Archaeological Service and GIAP-ICAC began a research collaboration in 2018 based on the revision of these new archaeological data. The aim was to correlate this database with the archaeomorphological geodatabase updated from 2010 and paleoenvironmental evidence. As an urban landscape, much of the Plain of Barcelona has not been able to be prospected. This gap in the research may explain certain blanks visible, especially in the Eixample area of the 19th century. However, the changing urban landscape of Barcelona also involves archaeological research, rescue excavations that have often confirmed previous hypotheses.

Developed in a GIS environment, cartographical documents were incorporated, specifically the digital 1:5,000 topographical base and 1:5,000 orthophotographic series, using ICGC WMS servers. This enabled the

georeferencing of the 28 sheets of the city plan of Barcelona from 1933-1936, covering an important extent of the Plain of Barcelona⁴ and the topographical map of Ildefons Cerdà from 1855⁵. In turn, their combination made it possible to geo-reference and rectify historical maps of major interest, such as the 1851 land division map from the municipality of Barcelona⁶. Also incorporated were the aerial photographs taken by CETFA in 1947 using scales of 1:10,000 and 1:2,000, as well as the American aerial survey from 1956-1957. These show large parts of the surrounding area of Barcelona before the urbanisation of the second half of the 20th century. A digital terrain model (DTM) was

4. *Plano de la Ciudad de Barcelona (1933-1936)*, Servicio Topográfico del Ayuntamiento, S. 1: 5,000. PC. Ajuntament de Barcelona (digital source ICGC).

5. *Plano de los alrededores de la ciudad de Barcelona*, I. Cerdà, 1855, 1/10,000 (digital source ICGC).

6. *Plano geométrico del término jurisdiccional de la Ciutat de Barcelona separado del termino de la Villa de Gracia que antes estaban reunidos*. J. Soler 1851. (Arxiu Històric de la Ciutat de Barcelona 2943).

created (cell/2 × 2 m), downloaded from the ICGC website.

The oldest edited cartography for the city of Barcelona, from the 18th and 19th centuries, is of great interest and especially useful for the study of an area now entirely urbanised (Galera, Roca, Tarragó, 1982; Alberch, Caballé, 2001). The earliest maps of Barcelona and its surrounding area are military surveys from the end of the 17th and the beginning of the 18th century which plot physical elements of the landscape (streams, lagoons and relief), as well as roads and paths, the largest rural settlements and military defences, but with no reliable indications as to how the land was divided.

This geodatabase enabled previous works to be revised regarding the historical morphology of the landscape (Palet, 1997; Palet, Fiz, Orengo, 2009). A vector layer was created associated with a table in which the previous archaeomorphology was digitised. In this way, the table helped to detect differences between the types of plotted lines and allowed them to be attributed to periods of time. This methodology not only enabled the rectification and correct geographical referencing of the lines in the landscape but also led to the discovery of new lines from comparing the information in the constituent layers. The Roman coastline was also corrected, based on the latest published paleoenvironmental and geomorphological data (Julià, Riera, 2012).

An updated archaeological map was produced with all the available information relating to the Iberian and Roman periods, with contributions from the Archaeological Service of Barcelona, the Inventory of Catalan Archaeological Heritage and the Geoportal of Cultural Heritage of the Catalan government. The aim was to analyse settlement chronology and distribution in Roman times and especially the relationship between sites and remains associated with Roman roads and centuriation axes.

Finally, archaeological reports and topographical plans from different rescue excavations in Barcelona kept in the Archaeological Service were consulted. As a result, we were able to incorporate into the GIS project 14 plans of archaeological sites that were of interest due to their chronology and preserved structures. The most recent plans, in dwg format,

were incorporated by merely correcting the coordinates. The older ones, available in jpg format, were georeferenced by identifying geographical points via current and historical orthophotography (ICGC) and cadastral mapping. Analysis of these plans in the GIS project has allowed us to contrast and compare the relationships between the layouts of particular settlements and the orientation of the grid and axes of the centuriation.

3. THE CENTURIATION OF THE TERRITORY OF ROMAN *BARCINO*

The foundation of the colony of *Barcino* on a small promontory next to the shoreline in the Augustan period (c. 15-13 BC) and the structuring of the adjacent territory on the *centuriatio* model gave the immediate landscape an appearance characteristic of the ideal territory of a Roman town. The centuriation based on a module of 15 × 20 *actus* (Palet, 1997; Palet, Fiz, Orengo, 2009) extended over the littoral plain between the Besòs and Llobregat rivers, and from the shore to the Collserola mountain range, whenever necessary adapted to natural slopes, promontories and streams. It seems likely that, in inland areas, this would be the reason why some *decumani* were displaced from the theoretical grid axes, in certain cases creating smaller *centuriae* of 15 *actus*. By basing their south-west/north-east orientation on the general direction taken by the coastline and littoral range of hills, it seems the surveyors were intent on ensuring efficient land use and good drainage. The project's effective implementation can particularly be seen in the south-west and south-central sectors, where the plain is wider and allows greater implementation and conservation of the grid axes (Fig. 2).

The articulation between the urban layout of *Barcino* and the centuriated grid undoubtedly reflects coordinated planning. The grid is delimited by the *Via Augusta* to the south-west and north-east, the main Roman road dated by milestones in 9-7 BC (IRC I, 183, 184). In different sections this road constitutes the diagonal for several *centuriae* of the theoretical grid, following the system of the *varatio* (Chouquer, Favory,

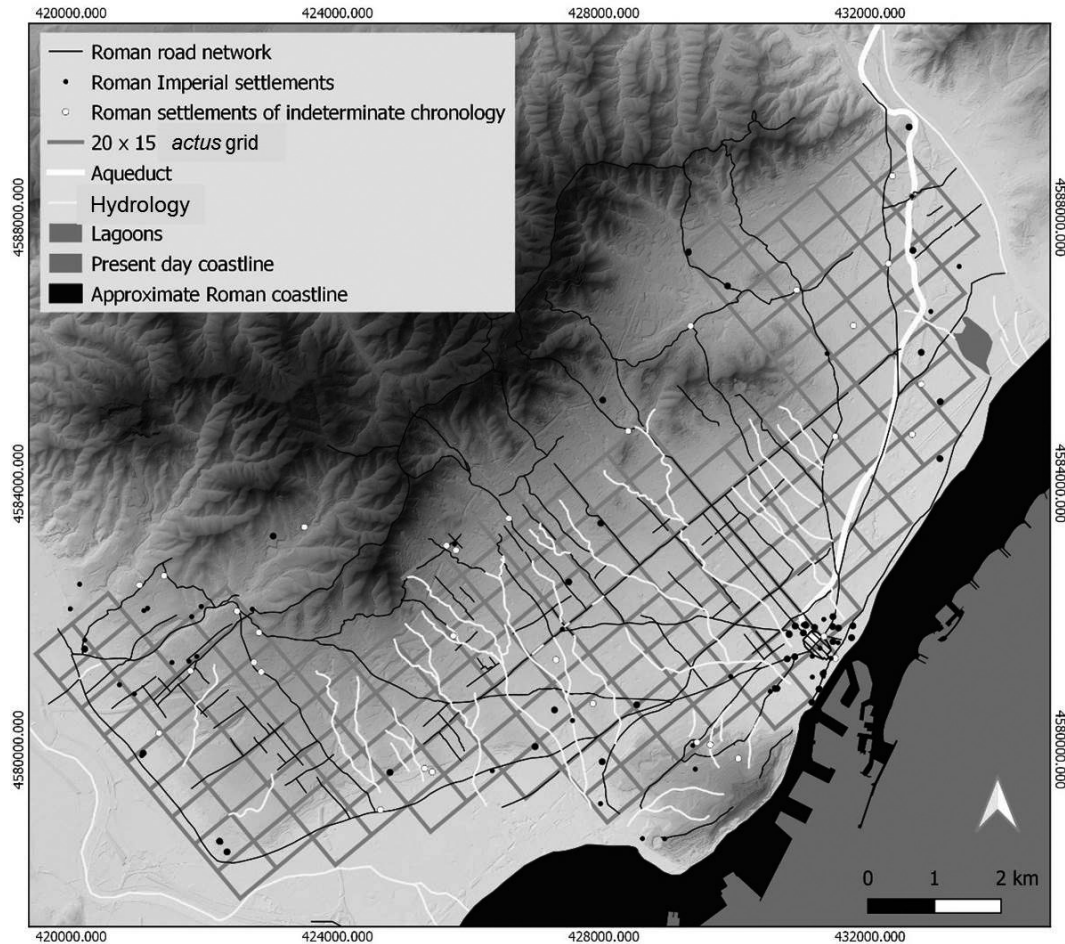


FIGURE 2. Archaeomorphological analysis of the study area, showing the centuriated grid surrounding *Barcino* and the distribution of Roman settlement in Imperial times.

2001, 89-94; Roth-Conges, 1996). This is especially visible along the Llobregat valley in the south-west. In the north-east extreme of the grid, the place called *Finestrelles* (today in La Trinitat Vella, Sant Andreu district) was probably used as a *gromma* point for surveyors laying out the grid. From this hypothesised *gromma* point at *Finestrelles*, the *Via Augusta* provides the hypotenuse for the successive triangles of 40x45, 20x30, 60x45 and 40x30 *actus* (Fig. 3)

The Augustan *colonia* was a focal point for the centuriated network. Especially remarkable is the relation between the *centuriatio* axes and the temple of Augustus in the forum of *Barcino*. The place of Santa Madrona at Montjuïc was probably also another *gromma* point. This relationship between the town, the new Roman road and the *limitatio* reinforces the Augustan

dating of the whole system (Palet, Fiz, Orengo, 2009) (Fig. 2 and 3).

The promontory of Montjuïc is a good example of the selective conservation and adaptation to the relief revealed by the surviving traces of the centuriation, which in general avoided mountainous areas and promontories. This can also be observed in inland areas and in the first spurs of the littoral range. In fact, selective conservation of the axes can be seen as they disappear in certain sectors. The axes parallel to the coast form *saltus* of three *centuriae*. In addition, in certain sectors it seems that streams were incorporated into the grid and adapted with the addition of paths laid in a sea-to-mountain direction, thus avoiding the construction of new *limites* and favouring drainage and use of the natural landscape.

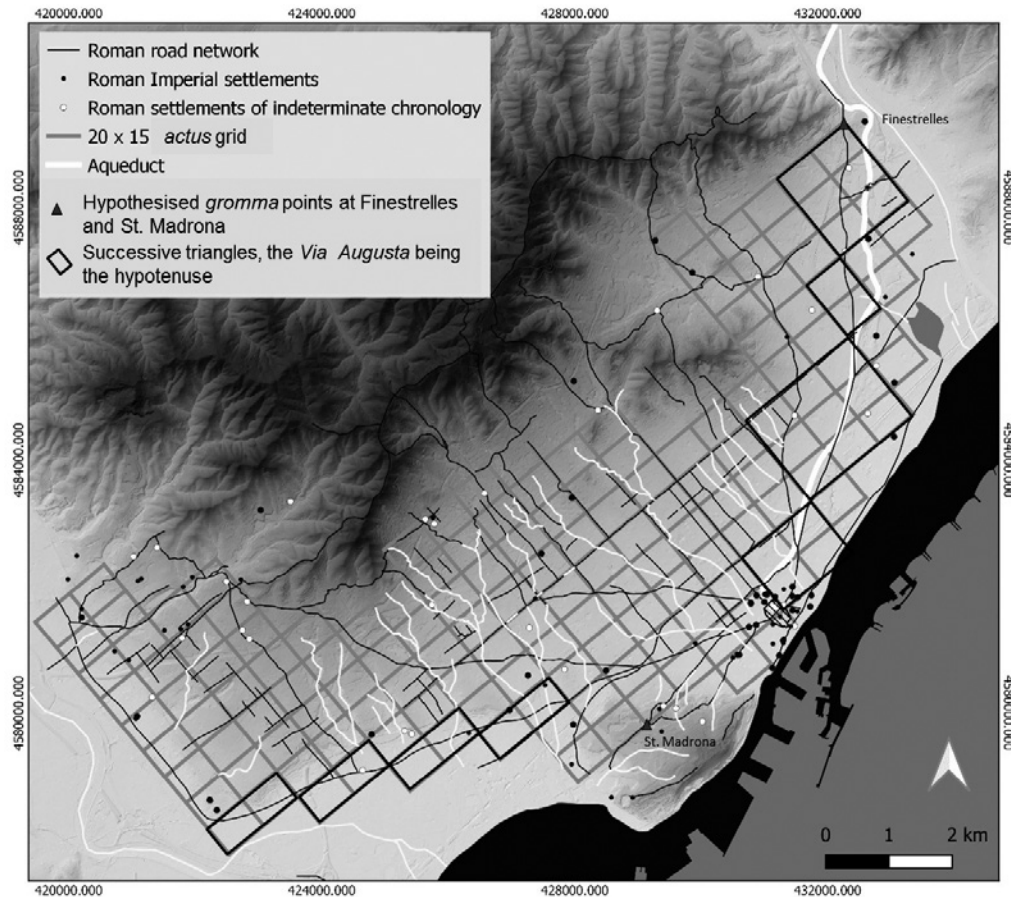


FIGURE 3. Location of the hypothesised *gromma* points at Finestrelles and Santa Madrona and how the *Via Augusta* provides, from there, the hypotenuse for the successive triangles.

In the *Tarraconensis*, it's important to emphasise the parallels between *Barcino* and the colony of *Caesaraugusta* (Zaragoza), where a foundation centuriation with a module of 15 *actus* is documented (Ariño, Gurt, Palet, 2004, 55-57). The inscriptions on the Roman bridge in Martorell suggest that the same legions that founded *Caesaraugusta*, the IIII *Macedonica*, the VI *Victrix*, and the X *Gemina*, were involved in founding *Barcino* and in the construction of public works within the territory. In fact, the Martorell bridge itself and the Roman arch there, where the main Roman road crossed the Llobregat River, might have marked the boundary between the *territoria* of *Barcino* and *Tarraco*.

The Plain of Barcelona was integrated by means of a radial road network connecting

inland areas with the Roman city on the coast. It should be noted that the territory of *Barcino* extended beyond the limits of the Plain of Barcelona and the centuriation. Its hypothesised boundaries included the Martorell bridge in the south and, in the north, the confluence of the Congost and Mogent rivers in the Vallès pre-littoral depression, in the municipality of Montmeló where a *terminus augustalis* was located (Járrega, Rodà, 1999; Ariño, Gurt, Palet, 2004, 26-27; Gurt, Rodà, 2005). The whole of the littoral ranges of hills and part of the pre-littoral depression were therefore included in the territory.

These territorial boundaries formed part of a broader programme to organise the territory that included major intervention in the road network. Town, roads and centuriation are

evidence of wholesale restructuring within the context of Augustus's reorganisation of Hispania and other provinces of the Empire (Ariño, Gurt, Palet, 2004, 126-134; Flórez, Palet, 2012). The parallel with *Caesaraugusta* is especially significant since the foundation of that city, like that of *Barcino*, is best understood as part of the Augustus's programme in Hispania (Beltrán, 2016). Moreover, the 15x20 module has also been attested in *Tarraco*, *Emporiae* and *Valentia*, other places with Augustan chronologies (Ariño, Gurt, Palet, 2004, 126-134; Ortega, 2021).

4. THE IMPACT OF CENTURIATION ON RURAL SETTLEMENT

Barcino's Augustan centuriation has been related to an intensification of settlement in the early Imperial period, especially noticeable in the immediate surroundings of the city, along the littoral and in the Llobregat valley (Palet, 1997; Miró, Ramos, 2013). Despite the large gaps in archaeological information from certain areas of the Plain of Barcelona, especially those sectors affected by urban growth in the second half of the 19th century, the pattern of settlement points to a close relationship between early Imperial sites, certain axes of centuriation, the route-lines of the main roads, the centuriation grid and the urban layout. The study also allows us to trace the evolution and nature of settlement from late Republican to early Imperial times and to rethink the territorial impact of *Barcino* being founded and the significance of its centuriation.

Archaeological evidence points to the importance of farming and agriculture in these settlement patterns. Most Roman sites have been identified as *villae* or farmsteads with rural structures such as vineyard ditches, elements of production (e.g. *cella vinaria*, presses, *amphorae* kilns) and storage elements such as silos and *dolia* (Miró, Ramos, 2013). Intensity of land use is implied, particularly in the surroundings of the Roman town, on the lower littoral plains and wetlands near the Besòs and Llobregat rivers, on the promontory of Montjuïc next to *Barcino* and more specifically in inland areas close to main roads and centuriation axes.

The connection between rural settlement and centuriation provides new keys to unlock the meaning of the *limitatio* within the context of the colony's foundation. In certain cases, settlements are placed at the intersection between *limites*, roads and axes of the centuriated grid. Certain sites seem to be especially significant for understanding the relationship between the distribution of rural settlements and Roman territorial structure. Their location and the orientation of walls and structures, as well as the general layout, are directly related to the grid, the alignment or crossing of *limites* or the main roads which connected the *ager* and the Roman town. This relationship is attested in inland areas, at sites such as the *villa* of Can Cortada in the Horta valley, in settlements along the Roman coastline (e.g. Can Ricart farmstead in the Poble Nou district), in the surroundings of the Roman city and on the promontory of Montjuïc with the *villa* of Sant Pau del Camp and that of Nostra Sra. del Port. Moreover, the accuracy of the reconstructed centuriation grid and the significance of the global planning of the plain in Augustan times are confirmed by the close relationship between these sites and the orientation of the grid (Fig. 4 and 5).

Looking at individual sites, Can Cortada *villa* on the inland plain, on a rural site dating from the 1st to the 6th century AD (Miró, Ramon 2013, 145), is located near a secondary Roman road (the ancient "Camí d'Horta") which linked *Barcino* with *Octavianus* (Sant Cugat del Vallès) through Valldaura and Sant Medí valley in the Collserola littoral range. The *villa* stood in the north-west corner of a *centuria* and most of the excavated structures associated with the *pars rustica* are perfectly aligned with the orientation of the centuriated network. This suggests the presence of the grid even in these inland areas of the Plain of Barcelona (Fig. 4).

In the low littoral and alluvial plain of the Besòs, the Can Ricart site occupied a similar situation. The farmstead lay next to a coastal path over the line of dunes, near marshes and wetlands. The chronology begins in the late Republican period, with structures dating from the 2nd-1st centuries BC. The best preserved remains correspond to an early Imperial farmstead, founded in the 1st century AD and

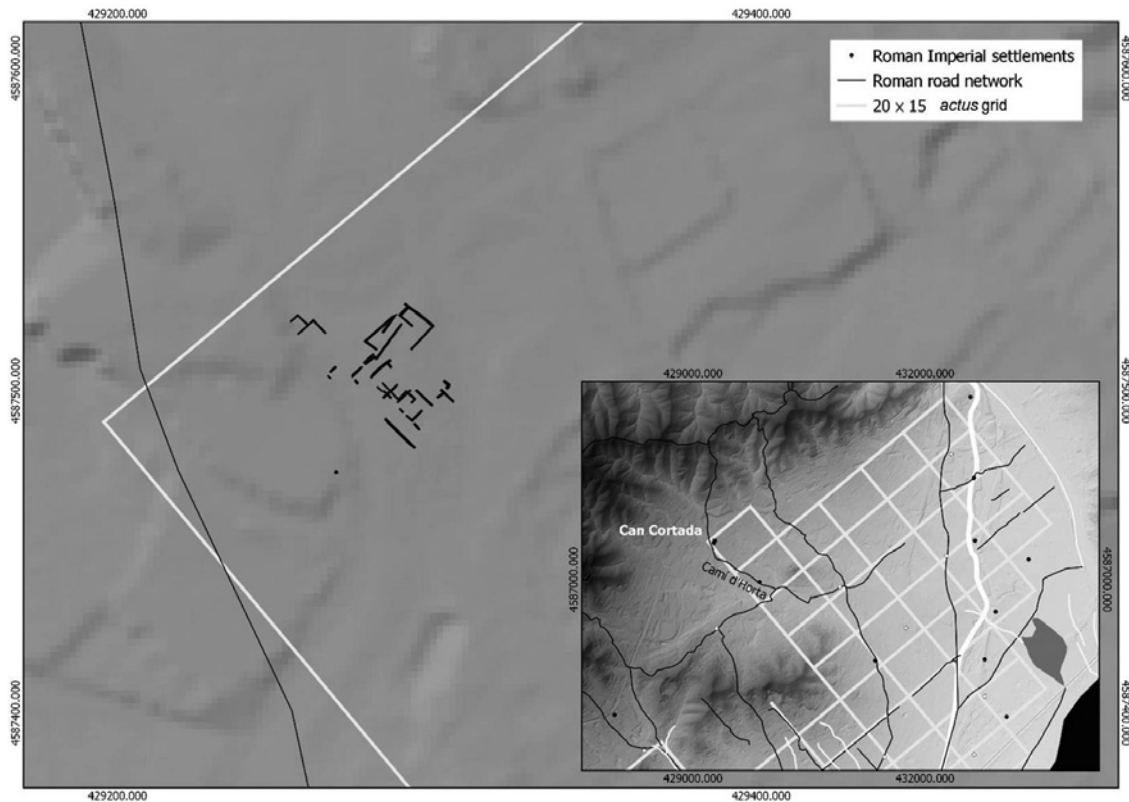


FIGURE 4. Can Cortada *villa* located in the centuriation of *Barcino*, showing the relationship between the excavated structures and the centuriated grid orientation.

deserted in the 5th. The structures attested are aligned with the centuriation grid and, since the settlement lay near the ancient coastline, it seems likely that the centuriation extended northwards towards the alluvial delta of the Besòs and close to the Roman shoreline.

Two sites at the foot of the Montjuïc promontory also present interesting examples of the congruence of centuriation and settlement patterns. The structures of the rural settlement of Sant Pau del Camp are oriented in line with the grid, as well as with a branch of the *Via Augusta* in the direction of Montjuïc (the current Carrer de Sant Pau). It should be noted that, in this sector, the road does not follow a straight line but changes direction, diagonal to the grid. Further south, the *villa* of Nostra Senyora del Port is also oriented in line with the centuriation, with a slight deviation probably due to its proximity to the road that surrounded Montjuïc (the current Carrer de la Minería and Carrer Nostra Sra del Port).

Another remarkable case is that of the Pont del Treball-La Sagrera *villa*, excavated in advance of the high-speed train civil engineering works at La Sagrera railway station (Alcubierre, Hinojo, Rigo, 2014). The structures of the urban *pars*, dating from the 1st to the 4th centuries AD, were oriented along the axes of the centuriation. In this case, the imperial *villa* was built taking as its basis the hypotenuse of the triangle in a *centuria* of 20x15 *actus*. This axis marks exactly the centre (the axis of symmetry) of the structures corresponding to a large rectangular courtyard and different associated buildings from Early Imperial times. To the south, the rustic *pars* was also attested, with different areas oriented in the same way (Fig. 5 and 6).

Apart from the evidence of the centuriation regarding rural settlement, rescue excavations have provided outstanding traces of its preservation in more urban settings. Excavation beneath Sant Antoni Market, located in the Eixample district of Barcelona, revealed the intersection of the *Via Augusta*, abandoned here

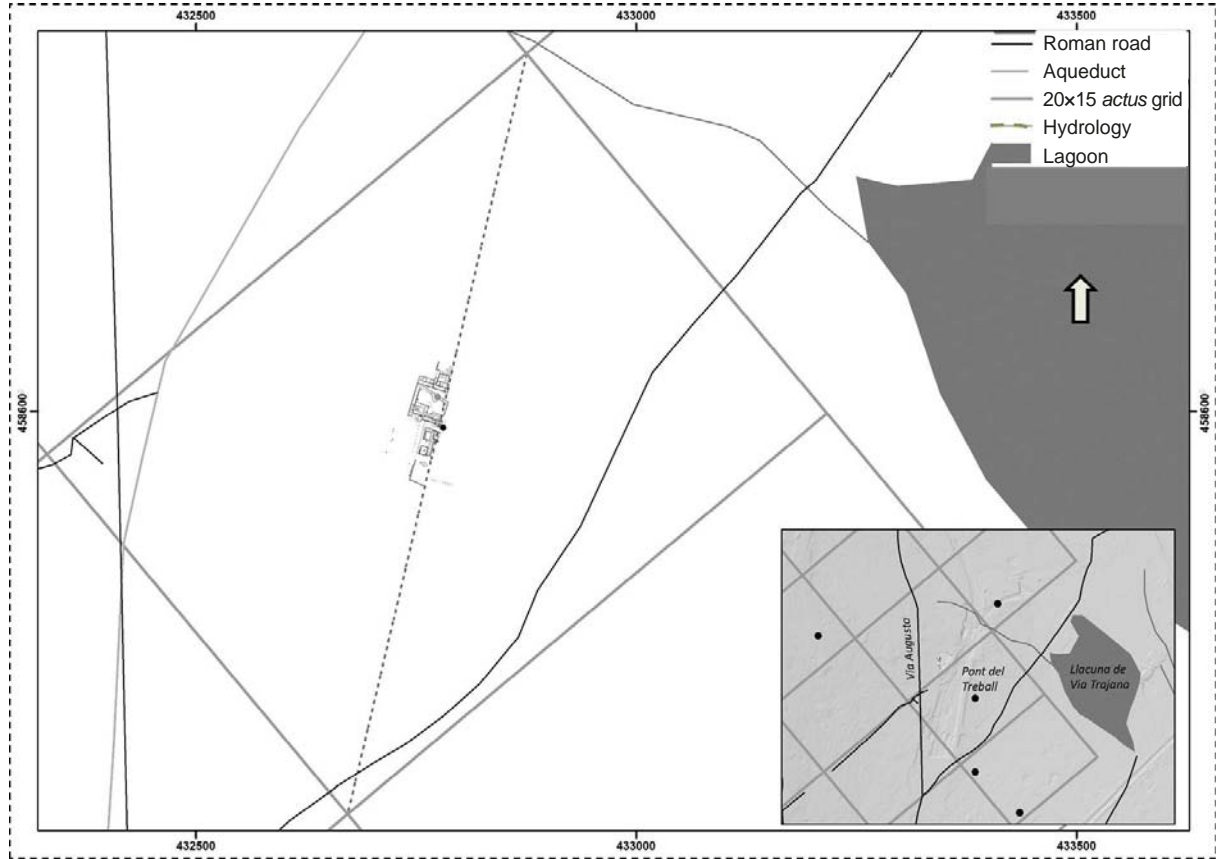


FIGURE 5. Pont del Treball–La Sagrera *villa* located within a *centuria* of *Barcino*, the building's axis of symmetry being the hypotenuse of the triangle.



FIGURE 6. View of the archaeological excavations at the Pont del Treball–La Sagrera site during the works carried out for the new railway station (Photo: Josep Maria Palet).



FIGURE 7. View of the archaeological remains attested under Sant Antoni market in Barcelona (Photo: Josep Maria Palet).

in the 2nd century AD after a flood, with a *limes* of the centuriation (Hinojo, Miró, in press). This line of division for the agrarian landscape was a deep road preserved along 27 metres (Fig. 7). It's on a parallel alignment with the *decumani* and corresponds to an axis of the centuriation deduced by archaeomorphological analysis, offset by 6-8 metres (Fig. 8). The archaeological map of Barcelona's Eixample is largely unknown. However, the only extensive archaeological intervention carried out in this central area of the city has attested the *Via Augusta* and a *decumanus* of the centuriation, two outstanding elements that suggest a much richer supply of archaeological elements in the area.

Underneath a building on the Avinguda del Portal de l'Àngel, archaeologists uncovered a section of paved road corresponding with a *kardo minor* of the centuriation. The road was perpendicular to the *decumanus maximus* and subdivided the first *centuria* next to the north-west

gate of the town, at a distance of 2 *actus* (approximately 71 metres) of the *kardo*, reproducing an ideal centuriated landscape in this access area next to the city (Fig. 9).

The fact that Roman roads and centuriation had symbolic importance can arguably be inferred from the distribution and orientation of a number of funerary monuments. The plan of an Early Imperial mausoleum excavated in Carrer dels Arcs, located at around 71 metres (2 *actus*) from the north-west gate of the city, is oriented in line with the *decumanus maximus*, the inland main road that connected *Barcino*, the plain, and the Collserola littoral range (the ancient Camino de Jesús, at present Carrer dels Arcs/Avinguda del Portal de l'Àngel) (Fig. 9). This can also be observed in the plan of the mausoleum discovered in Sant Agustí Nou, a monument placed near the south-west gate of *Barcino* and next to the *Via Augusta* (here the modern day Carrer de l'Hospital). The

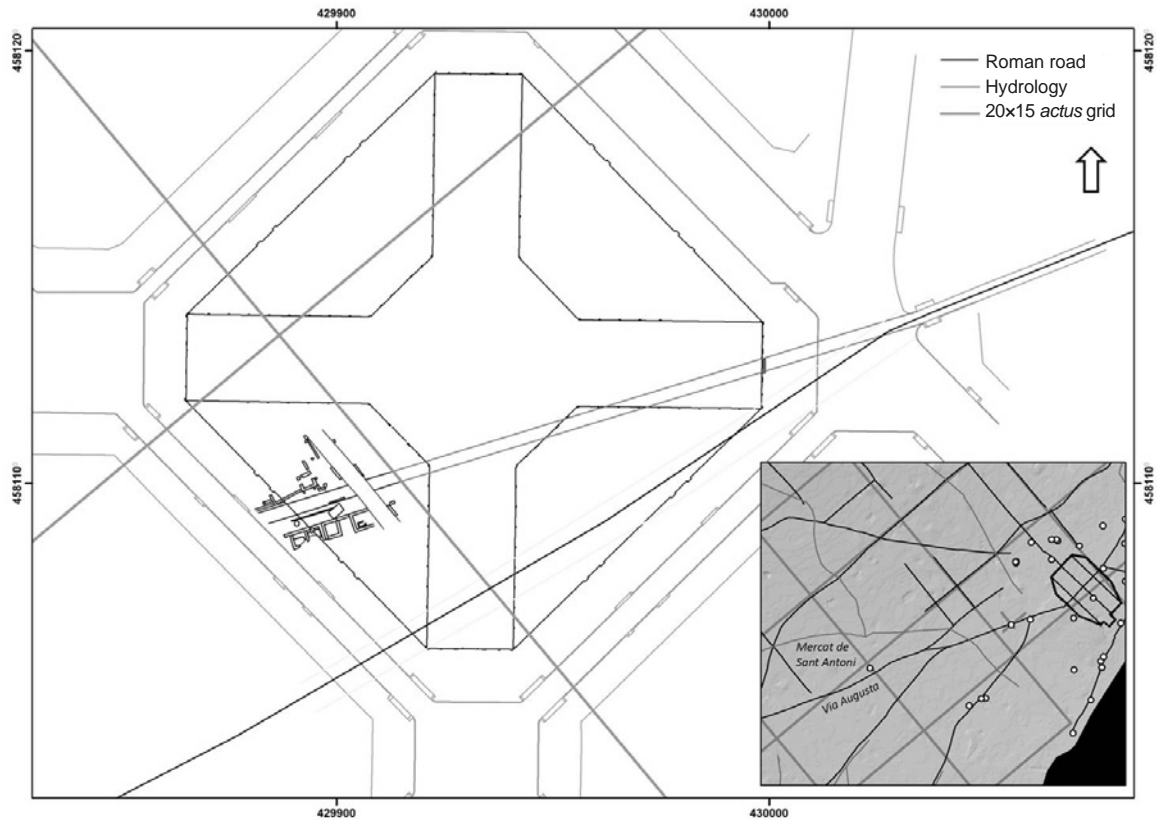


FIGURE 8. Plan of the crossroads between the *Via Augusta* and a *limes* of the centuriation in relation with the general grid, preserved under Sant Antoni market in Barcelona.

orientation of the walls corresponds to the hypothesised grid but not with the main road next to which it is located and which crosses the grid diagonally.

One more example is the burial area with several funerary monuments and structures excavated in the Drassanes Reials. These were linked to a littoral path south to *Barcino* (today Carrer Josep Anselm Clavé and Carrer d'En Gignàs). The necropolis and road follow the dune ridge parallel to the shoreline. In this case, the funerary monuments follow the orientation of the path, avoiding the theoretical axes of the centuriation which seems not to be present in this area. The path appears to determine both the location of the burials and the orientation of the structures.

The Plain of Barcelona is also one of the study cases where palaeoenvironmental research has been most fruitful. For the Roman period, a larger amount of pollen data is available,

although a lack in the chronological definition of data limits accurate interpretations (Riera, 1995).

Pollen diagrams indicate an absence of widespread loss of woodland on a regional scale across the Plain of Barcelona in the Roman period (Palet, Riera, 2009; Riera, Palet, 2008). Although some sequences indicate open areas, the landscape appears to have been generally characterised by the presence of woodland, with only limited felling. Woodland was dominant in inland parts of the Llobregat plain but with evidence of human disturbance, allowing the expansion of shrubs. A similar situation was also recorded in the northern sector of Barcelona, where the Besòs pollen diagram indicates, for the Roman period, the presence of large woodlands of mixed holm oak (Riera, 1995; Riera, Palet, 2008; Palet, Riera, 2009). In addition, the scarcity of charcoal particles in the sedimentary records suggested limited clearings and human activity that was pre-eminently

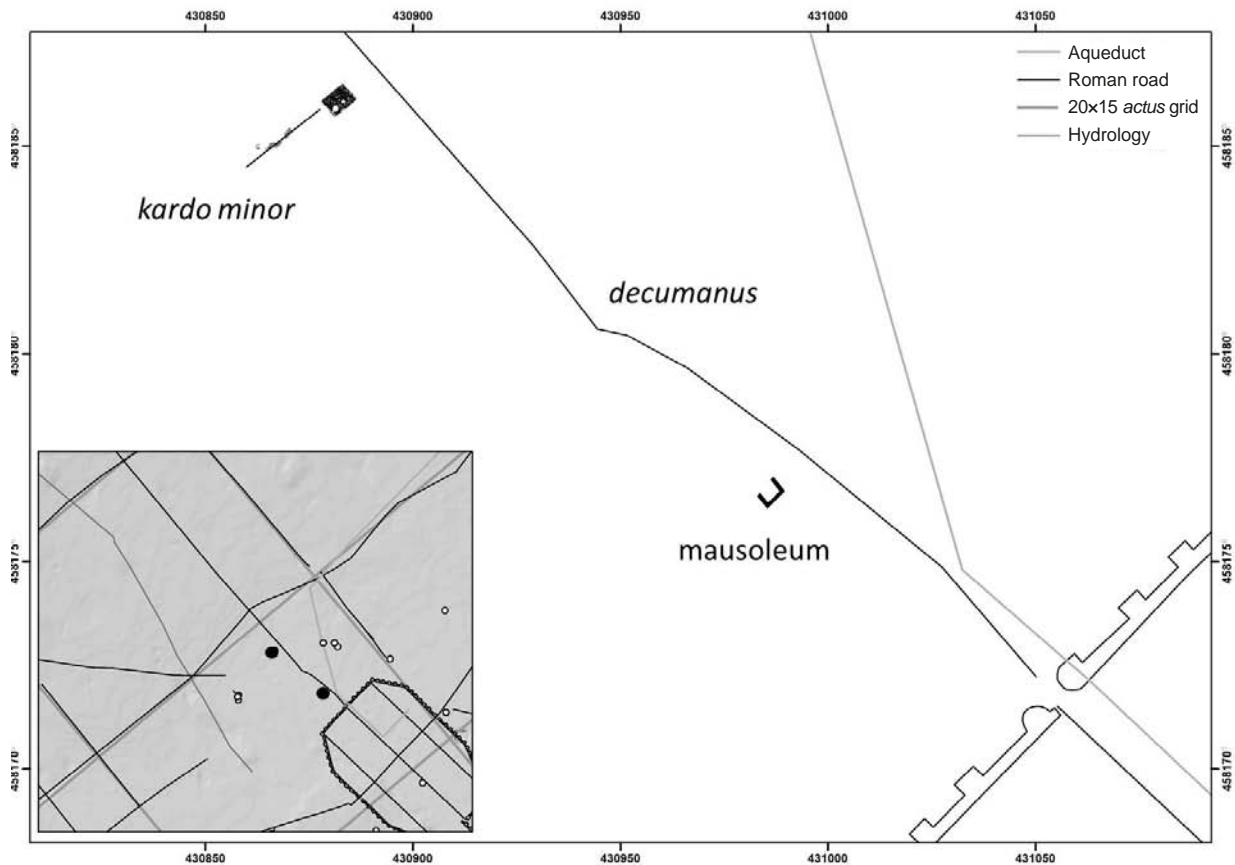


FIGURE 9. Plan of the mausoleum excavated in Carrer dels Arcs, the *decumanus maximus* and centuriated grid.

stable. There is also evidence of agricultural activity, especially in littoral areas and around the Llobregat Delta plain (Palet, Riera, 2009). Pollen records show an increase in crops, such as grapes, cereals and rye, during the Roman period. In addition, the expansion of hemp production is well attested across the plain as a whole.

On a more local scale, pollen data at Montjuïc highlight a certain expansion in the cultivation of grape vines during this period, though part of the promontory would still have been covered by woodland. Recent bioarchaeological research at the Sotstinent Navarro site, located near the north-east gate of *Barcino*, shows a huge expansion in the cultivation of grape vines in the area surrounding the Roman city (Miró, 2017). Anthracological and various bioarchaeological data from the Turó de la Rovira Iberian site, an inland promontory occupied in the 3rd century

BC, suggest an open, deforested landscape around the settlement and the expansion of shrubs, as well as agricultural activity, even before the Roman foundation (Riera, *et al.* 2018).

Paleoenvironmental evidence helps to provide greater insight into the significance and function of centuriation. The Plain of Barcelona seems to have been heavily structured, including a centuriated landscape and a new road network, together with considerable intensification of settlement. At the same time, a complex land use system seems to have developed in Roman times, characterised by the unequal exploitation and transformation of the territory, limited woodland clearance at a regional level and relative expansion of agriculture (Palet, Riera, 2009).

These data underline the representative and symbolic character of centuriation, closely linked to the concept of the Roman city (Purcell 1990: 15). In the central sector of the plain near

the city and in the coastal areas towards the Besòs and Llobregat rivers, the impact of the founding of *Barcino* seems to be more extensive and agricultural activities more than likely occupied larger areas. The pollen records therefore suggest the existence of an intensive, specialised but localised agriculture, which suggests significant landscape change, albeit on a local scale.

5. CONCLUSIONS

On the Plain of Barcelona, the indigenous settlement pattern indicates relative stability until *Barcino* was founded. This Augustan foundation had a great impact on the territory, creating a new territorial structure and resulting in a series of changes in settlement patterns, locally intensive land use, the occupation of littoral areas and parts of the inland plain and a marked concentration of settlement in relation to the road network, centuriation and the coastal plain.

Augustan centuriation had a strong impact on the arrangement and structuring of the territory of *Barcino* until the end of the Roman period in the 5th century, as shown in the chronology and orientation of *villae* and farmstead structures in relation to the reconstructed grid. Furthermore, the study allows us to rethink the significance and function of centuriation, in particular highlighting its representative, symbolic nature alongside the economic. A strong spatial organisation has been demonstrated, together with complex land use. Pollen evidence shows a landscape characterised at a regional level by the absence of generalised expansion on the part of farming or extensive loss of woodland, suggesting the presence of field systems in specific areas around rural settlements. The intense structuring associated with centuriation would not have necessarily led to extensive exploitation of the whole territory (Palet, Orengo, Riera, 2011).

Centuriation had a fiscal and planning purpose, *ager divisus et adsignatus* representing a system of dividing and allocating land. However, it has been pointed out that the concept of centuriated landscape also seems to be related to religious ideas and the founding

ritual of a city. It carried symbolic value, associated with the ideal model of Roman landscape (Palet, Orengo, 2011) and how the ideal territory of a Roman town should be designed and organised (López 1994). It was a true conceptual appropriation of the landscape based on a specific mythical and religious idea. This aspect has also been highlighted in relation to the centuriation of *Tarraco* (Palet, Orengo 2011, Palet, Orengo, Riera, 2011).

At a regional level, the lack of evidence for intense human impact in the palaeoenvironmental record is consistent with the presence of areas with no evidence of settlements and others where rural settlement was concentrated. Large areas of centuriation would be characterised by a low intensity of occupation. The territory of *Barcino* therefore reflects a complex reality, with the existence of woods and fields not assigned within the hypothesised grid, or of *centuriae* that were not fully cleared.

However, this general picture must be nuanced. In the absence of a generalised transformation of the landscape, the impact that certain settlements and the intensive exploitation of their surroundings would have on a local scale should be also relevant. In this respect, installations such as rural hydraulic aqueducts for domestic and agricultural purposes must be added to the evidence of agrarian activities. The connection between *villae* and centuriation demonstrates a project aimed at enhancing land-use according to a Roman economic model, while at the same time reinforcing its representative character.

Centuriated landscapes therefore respond to complex socio-environmental interactions so that an interdisciplinary approach is needed in order to understand them in all dimensions; socially, economically, culturally and ecologically. A recent study carried out by T. Haas in the *Pontino ager*, south-east of Lazio (Haas, 2017), an area characterised by a wet coastal plain, shows the importance of centuriation to enhance underexploited areas, one of the first Roman projects in this respect, carried out between the end of the 4th century and early 3rd century BC. Centuriation is an instrument that facilitated use of the landscape and management of resources but it also embodied the Roman concept of space. The

centuriated littoral plain of *Barcino* therefore reflects a complex, diverse reality. The perspective provided by landscape archaeology reinforces the symbolic and representative nature of centuriation, beyond its economic function and as an instrument of conquest. In fact, centuriated landscapes can also be defined as “transported landscapes”, in which the ideal Roman city was conceptually recreated in distant provinces⁷.

BIBLIOGRAPHY

- ALCUBIERRE, D.; HINOJO, E.; RIGO, A. (2014). “Primers resultats de la intervenció a la vil·la romana del Pont del Treball a Barcelona”. *Tribuna d’Arqueologia 2011 – 2012*, 372-397.
- ARIÑO, E.; GURT, J.M.; PALET, J.M. (2004). *El pasado presente. Arqueología de los paisajes en la Hispania romana*. Salamanca-Barcelona: Edicions de la Universitat de Barcelona.
- ALBERCH, R.; CABALLE, F. (2001). *La ciutat a través del temps. Cartografia històrica. Índex general. Història de Barcelona*. Barcelona.
- BELTRAN, F. (2016). “Colonia Caesar Augusta: el impacto sobre el territorio y las comunidades indígenas”. *Revista de Historiografía*, 25, 301-315.
- BERGER, J.F.; JUNG, C. (1996). «Fonction, évolution et ‘taphonomie’ des parcellaires en moyenne vallée du Rhône. Un exemple d’approche intégrée en archéomorphologie et en géoarchéologie». In: CHOUQUER, G. (dir.). *Les formes du paysage. Vol. 2. Archéologie des parcellaires*. Paris: Éditions Errance, 95-112.
- CLAVEL-LEVEQUE, M. (1983). *Cadastres et espace rural. Approches et réalités antiques*. Paris: Éditions du CNRS.
- CHOUQUER, G.; CLAVEL-LEVEQUE, M.; FAVORY, F.; VALLAT, J.P. (1987). *Structures agraires en Italie Centro-méridionale. Cadastres et paysage ruraux*. Paris: Collection de l’École Française de Rome, 100.
- CHOUQUER, G.; FAVORY, F. (1991). *Les paysages de l’Antiquité. Terres et cadastres de l’Occident romain*. Paris: Éditions Errance.
- FLÓREZ, M.; PALET, J.M. (2012). “Análisis arqueomorfológico y dinámica territorial en el Vallès Oriental (Barcelona) de la Protohistoria (s. VI-V a.C.) a la alta Edad Media (S. IX-X)”. *Archivo Español de Arqueología*, 85, 167-192.
- FRANCHESELLI, C.; MARABINI, S. (2007). *Lettura di un territorio sepolto: la pianura Lughese in età romana, Studi e scavi*, 17. Bologna: Antequem.
- GALERA, M.; ROCA, F.; TARRAGO, S. (1982). *Atlas de Barcelona. Siglos XVI al XIX*. 2ª Ed. Barcelona: Publicacions del Col·legi Oficial d’Arquitectes de Catalunya.
- HAAS DE, T. (2017). “Managing the marshes: An integrated study of the centuriated landscape of the Pontine plain”. *Journal of Archaeological Science Reports*, 15, 470-481.
- HINOJO, E.; MIRÓ, C. (in press). “La necrópolis Altoimperial del mercado de Sant Antoni en Barcelona. *Morir en Hispania*, 261-278.
- IRC I = *Inscriptions romaines de Catalogne I. Barcelone (sauf Barcino)*, Paris, 1984.
- GURT, J.M.; RODÀ, I. (2005). “El pont del Diable. El monumento romano dentro de la política augustea”. *Archivo Español de Arqueología*, 78, 147-165.
- JÀRREGA, R.; RODÀ, I. (1999). “El terminus augustalis de Montornès: noves dades epigràfiques”, *Lauro*, 16, 5-12.
- JULIÀ, R.; RIERA, S. (2012). “Proposta d’evolució del front marítim de Barcelona durant l’Holocè a partir de la integració de dades geotècniques, intervencions arqueològiques i cronologies absolutes”, *Quaderns d’Arqueologia i Història de la ciutat de Barcelona*, època II, any 2012, núm. 8, 16-37.
- LÓPEZ, P. (1994). *La ciudad romana ideal. I. El territorio*. In PEREIRA-MENAUT, G. (ed.), *La economía política de los romanos I*, Santiago de Compostela.
- MATTEAZI, M. (2019). *Il paesaggio trasformato La pianura a sud di Padova tra Romanizzazione e Tarda Antichità*. Oxford: British Archaeological Reports, S2921.

7. Research carried out within the R&D project: “Transported Mediterranean landscapes: an integrated analysis of long-term land-use dynamics at both sides of the Mediterranean” (PGC2018-093734-B-I00).

- MIRÓ, C. (2017). “La muralla romana: Estudis arqueològics recents i perspectives de treball future”. In RIU-BARRERA, E (ed.). *Intervenir a la muralla romana. Una visió comparativa*. Barcelona:MUHBA Documents, 12, 78-91.
- MIRÓ, C.; RAMOS, J. (2013). “Un exemple d’exploració de la carta arqueològica de Barcelona: les vil·les i els petits assentaments agrícoles. Una primera radiografia del territorium”, *Quaderns d’Arqueologia i Història de la ciutat de Barcelona*, època II, any 2013, núm. 9, 138-155.
- ORENGO, H.A.; PALET, J.M. (2010). “Methodological insights into the study of centuriated field systems: a landscape archaeology perspective”, *Agri centuriati: an international journal of landscape archaeology*, 6 (2009), 171-185.
- ORENGO, H.A.; PALET, J.M. (2016). “Introduction. Archaeomorphology as Landscape Archaeology: New Approaches and Perspectives”. In BURGERS, G.J.; KLUIVING, S.; HERMANS, R. (ed.). *Multi-, inter- and transdisciplinary research in Landscape Archaeology. Proceedings of the 3rd International Landscape Archaeology Conference in Rome (LAC2014) (Rome, 17-20 September 2014)*. Amsterdam: University Library, Vrije Universiteit Amsterdam.
- ORTEGA, M.J. (2021) *Origen y evolución del paisaje histórico de la llanura de Valencia (siglos V a.C.-XIII d.C.). Estudio de la estructuración y ocupación del territorio entre las épocas ibérica y feudal*. Valencia: Serie de Trabajos Varios, Servicio de Investigación Prehistórica de la Diputación Provincial de València.
- PALET, J.M. (1997). *Estudi territorial del Pla de Barcelona: estructuració i evolució del territori entre l’època ibero-romana i l’altmedieval (segles II-I aC - X-XI dC)*. Estudis i memòries d’arqueologia de Barcelona, 1. Barcelona: Centre d’Arqueologia de la Ciutat, Institut de Cultura.
- PALET, J.M.; FIZ, I.; ORENGO, H.A. (2009). “Centuriació i estructuració de l’ager de la colònia de Barcino: anàlisi arqueomorfològica i modelació del paisatge”, *Quaderns d’Arqueologia i Història de la Ciutat de Barcelona*, 5, 106-123.
- PALET, J.M.; ORENGO, H.A. (2011). “The Roman centuriated landscape: conception, genesis and development as inferred from the Ager Tarraconensis case”, *American Journal of Archaeology*, 115 (3), 383-402.
- PALET, J.M.; ORENGO, H.A.; RIERA, S. (2011). “Centuriación del territorio y modelación del paisaje en los llanos litorales de *Barcino* (Barcelona) y *Tarraco* (Tarragona): una investigación interdisciplinar a través de la integración de datos arqueomorfológicos y paleoambientales”, *Agri Centuriati. An International Journal of Landscape Archaeology*, 7 (2010), 113-129.
- PALET, J.M.; RIERA, S. (2009). “Modelació antropològica del paisatge i activitats agropecuàries en el territori de la colònia de *Barcino*: aproximació de de l’arqueomorfologia i la palinologia”. In: CARRERAS, C.; GUITART, J. *Barcino I. Marques i terrisseries d’àmfores al Pla de Barcelona*. Barcelona, IEC-ICAC, 131-140.
- PURCELL, N. (1990). “The Creation of Provincial Landscape: the Roman Impact on Cisalpine Gaule”. In BLAGG, Th.; MILLET, M. (eds.), *The Early Roman Empire in the West*. Oxford: Oxbow Books, 7-29.
- RIERA, S. (1995). *Evolució del paisatge vegetal holocè al Pla de Barcelona, a partir de les dades pol·líniques*. Barcelona: Col·lecció de Tesis Doctorals microfitejades 2525. Publicacions de la Universitat de Barcelona.
- RIERA, S., NADAL, J., LIVARDA, A., BOUCHARD-PERRON, J.A., LÓPEZ BULTÓ, O., ROSELLÓ, E., MORALES, A. (2018). “Estudi bioarqueològic de la intervenció arqueològica al Turó de la Rovira: configuració paisatgística i explotació dels recursos naturals”. In *Anuari d’Arqueologia i Patrimoni 2018*. Barcelona: Servei d’Arqueologia de Barcelona, 352 – 377.
- RIERA, S., PALET, J.M. (2008). “Una aproximació transdisciplinar a la història del paisatge mediterràneo: la evolució de los sistemas de terrazas con muros de piedra seca en la sierra de Marina (Badalona, Llano de Barcelona)”. In GARRABOU, R.; NAREDO, J.M. (ed.). *El paisaje en perspectiva histórica. Formación y transformación del paisaje en el mundo*

mediterráneo. Monografía de Historia rural,
6: 47-90. Zaragoza: Sociedad Española de
Historia Agraria, Prensas universitarias de
Zaragoza.

ROTH-CONGÉS, A. (1996). “Modalités
pratiques d’implantation de cadastres
romains: quelques aspects”, *MEFRA* 108,
299-422.

Modellazione e analisi dei geodati per la ricostruzione del paesaggio di *Privernum* (Priverno, Lazio, Italy)

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ABSTRACT

La deduzione della colonia di *Privernum*, nel corso del II sec. a.C., segna il completamento del processo di romanizzazione del settore meridionale dell'area pontina.

La città era al centro di una conca intermontana, tra i rilievi calcarei dei Monti Lepini, Ausoni e Seiani, lungo un corridoio naturale di collegamento tra la valle Latina e la Pianura Pontina, quindi fra le grandi arterie che in età antica univano Roma alla Campania.

Al fine di comprendere le dinamiche di trasformazione del paesaggio privernate e proporre una rappresentazione del territorio in età romana, si è proceduto ad un'analisi degli aspetti ambientali e antropici mediante la trascrizione in ambiente GIS dei dati derivanti dalle diverse fonti della ricerca topografica. Il contributo fornisce una panoramica dell'insieme dei geodataset prodotti, evidenziando il processo di acquisizione, modellazione e rappresentazione dei dati spaziali, anche nell'ottica della produzione di cartografie tematiche a più scale.

PAROLE CHIAVE: Topografia antica, *Privernum*, paesaggio, GIS, geodati, cartografia tematica.

Geodata modeling and analysis for the reconstruction of the landscape of *Privernum* (Priverno, Lazio, Italy)

ABSTRACT

During the 2nd century BC, the foundation of the colony of *Privernum* marks the completion of the Romanization process of the southern sector of the Pontine area.

The city was at the center of an intermontane basin between the limestone reliefs of the Lepini, Ausoni and Seiani, along a natural corridor connecting the Latina valley and the Pontine Plain, therefore between the great roads that united Rome with the Campania.

To understand the dynamics of transformation of the landscape and propose a representation of the territory in Roman times, an analysis of the environmental and anthropogenic aspects was carried out by transcribing into a GIS the data deriving from the different sources of topographic research. The contribution provides an overview of the set of geodatasets produced, highlighting the process of acquisition, modeling and representation of spatial data, also with a view to producing thematic maps at multiple scales.

KEYWORDS: Ancient topography, *Privernum*, landscape, GIS, geodata, thematic cartography.

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1. INTRODUZIONE

Il lavoro che qui si presenta è parte delle attività di ricerca condotte sulla città e sul territorio di *Privernum* (Priverno, LT – Lazio, Italy), nel settore meridionale della Pianura Pontina (Fig. 1).

Tali studi sono stati avviati ormai da oltre quarant'anni dalla cattedra di Topografia Antica della Sapienza Università di Roma, sotto la direzione di Margherita Cancellieri³. In precedenza, solo parte del territorio in esame era stato indagato in maniera sistematica da H. H. Armstrong prima e, sul finire degli anni '20 del secolo scorso, da Giuseppe Lugli⁴.

Negli ultimi anni l'analisi territoriale è stata ripresa con un progetto di dottorato di ricerca avente come oggetto la ricostruzione del paesaggio dell'*Ager Privernas* (Carinci, 2014), mentre le trasformazioni della città tra tarda antichità e Alto Medioevo sono state l'argomento di un secondo progetto che ha consentito un riesame e un approfondimento dell'evidenza archeologica del settore urbano e periurbano anche per le fasi romane (Leopardi, 2017).

Oltre a ripercorrere i risultati del lavoro di ricostruzione del paesaggio antico, in questo contributo si intende esporre l'approccio teorico e tecnico adottato nella gestione informatizzata dei numerosi dati raccolti e le soluzioni scelte per l'organizzazione degli archivi di geodati, soprattutto in relazione al problema dell'eterogenea origine delle informazioni e della loro rappresentazione.

Nella prima parte del presente articolo verrà fornito un quadro complessivo delle dinamiche

di trasformazione del territorio in relazione ai processi di occupazione, soprattutto per le fasi tra età romana e Alto Medioevo, e ci si soffermerà, a titolo di esempio, sugli interventi che hanno interessato la complessa rete idrografica. In particolare, il lavoro di ricostruzione delle modifiche intercorse alle linee d'acqua è stato scelto per evidenziare le problematiche connesse alla traduzione geometrico-spaziale di dati provenienti da fonti diverse (cartografia storica, aerofotointerpretazione, analisi dati LiDAR, etc.). A partire quindi dalla rappresentazione degli elementi afferenti all'idrografia, nella seconda parte si fornirà un resoconto delle soluzioni adottate in sede di definizione logica dei dati archeologici, esplicitando le modalità utilizzate per la loro rappresentazione geometrica e semantica, al fine di esporre un *modus operandi* in ambiente GIS basato su principi eminentemente cartografici e improntato ad una restituzione delle informazioni in scale differenti.

2. PRIVERNUM E IL SUO TERRITORIO (F.C.)

Il territorio in esame è caratterizzato da una varietà geomorfologica che spazia dai rilievi calcarei dei Monti Lepini e Ausoni e dalle vallate intermontane alla duna eolica (c.d. "duna rossa di Priverno") che, addossata alle pendici sud-orientali dei Monti Seiani, digrada dolcemente verso la Pianura Pontina (Cosentino, 1998; Cerreti, 2003).

Si tratta di luoghi ricchi di acque, sia superficiali che sotterranee, che hanno reso necessarie numerose opere di bonifica nel corso dei secoli⁵. Tali interventi hanno comportato enormi trasformazioni soprattutto nel reticolo idrografico; in particolare, i due maggiori bacini fluviali del comprensorio, l'Amaseno e l'Ufente - quest'ultimo indicato dalle fonti antiche come confine naturale dell'*ager Privernas*⁶ - oggi non scorrono

5. Una sintesi storica sulla sequenza di lavori di bonifica nella Pianura Pontina è in Buonora, 1995, 301-322.

6. Secondo alcuni autori antichi, il fiume Ufente si allungava nella piana pontina andando a chiudere a sud-ovest quello spazio che doveva coincidere con l'*ager Privernas* (Fest. 212 L), attraverso un percorso lento e tortuoso (Claud. I, 257), per poi proseguire e disperdersi nelle paludi sottostanti Terracina (Strab. V, 3, 6); bloccato dalle dune costiere, solo a stento riusciva a sfociare in mare (Verg., Aen. VII, vv. 801-802).

3. Una prima sintesi dei lavori in Cancellieri, 1983; Cancellieri, 1986; Cancellieri, 1987; Cancellieri, 1990.

4. Armstrong inizia la sua ricerca topografica su *Privernum* dando una visione d'insieme della città e di tutto il territorio circostante attraverso ricognizioni sistematiche e posizionando le evidenze archeologiche su base cartografica. Pubblica nel 1911 gli esiti del suo studio sull'*American Journal of Archaeology*, articolandolo in tre sezioni, *Privernum* I, II e III (Armstrong, 1911abc). I lavori di Giuseppe Lugli, in parte rimasti inediti, prendono in esame l'area privernate come parte di un più ampio studio sulle dinamiche insediative della piana pontina. In particolare, l'indagine a tappeto condotta da Lugli sull'*Ager Pomptinus*, pubblicata solo con Anxur-Tarracina e Circeii nei volumi della *Forma Italiae* (Lugli, 1926; Lugli, 1928), lascia inedita la Carta di Setze, che comprendeva, oltre al centro urbano di Setia, anche *Privernum* e il suo territorio; il materiale inedito è conservato presso l'Accademia di San Luca a Roma (Biblioteca Romana "A. Sarti" - Fondo Lugli).

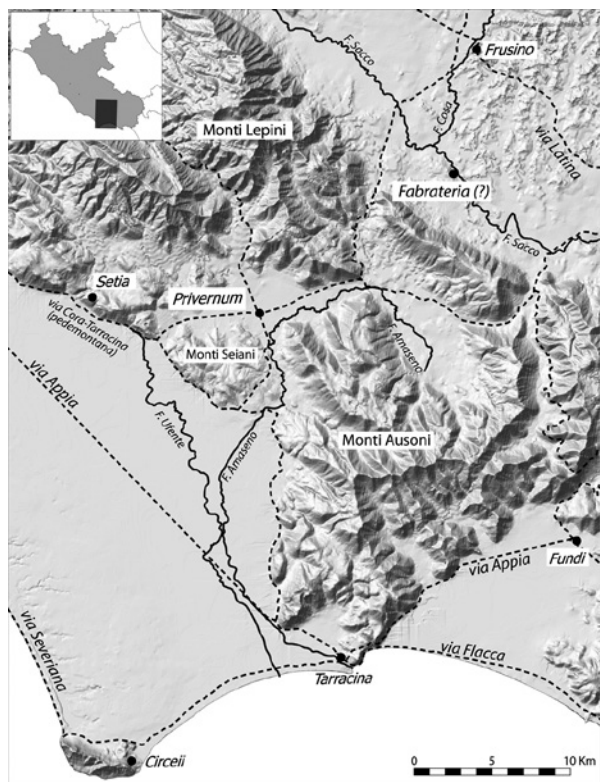


FIGURA 1. Inquadramento topografico del territorio di *Privernum*.

più nei loro alvei originari. Al contempo, il territorio è interessato da un continuo processo di consumo di suolo soprattutto per l'avanzamento dei fronti di cava e per l'urbanizzazione di ampie porzioni delle propaggini collinari e delle aree pianeggianti.

I resti della città di *Privernum*, la cui deduzione coloniale è ascrivibile ai decenni a cavallo tra il II e il I sec. a.C., sono parzialmente visibili al centro della cosiddetta Piana di Ceriara/Mezzagosto, una conca intermontana delimitata dai massicci calcarei dei Monti Lepini e degli Ausoni (Fig. 2).

Il substrato calcareo risulta coperto dai prodotti del carsismo superficiale con formazione di terre rosse che si attestano sulle aree di fondovalle e sui pendii. La pianura è invece il risultato del colmamento, nel corso del Pliocene e del Quaternario, di una depressione aperta tra i rilievi calcarei; tale riempimento è costituito da materiali trasportati dal fiume Amaseno e dai suoi affluenti (depositi alluvionali) o dilavati dai pendii (Cosentino, 1998).

I processi di colmamento sono riconoscibili anche per le fasi più recenti. In particolare, il settore urbano di *Privernum* è caratterizzato da un sistema artificiale di drenaggio delle acque di superficie (Amici, 2019) che ha consentito, quasi certamente per tutto l'Alto Medioevo, una conservazione delle quote di calpestio definite in età tardo-repubblicana. Con l'entrata in disuso di tale sistema, la cui realizzazione deve essere inquadrata nell'ambito della fondazione della città, si assiste a progressivi depositi di livelli alluvionali, con un innalzamento del piano di campagna di circa 2 metri (Leopardi, 2015); fenomeni analoghi sono ben leggibili attraverso analisi pedologica in altri settori della piana, al di fuori della città antica (Carinci, Leopardi, 2018). L'area periurbana è interessata ancora oggi da allagamenti, alluvioni e ristagni d'acqua; tali fenomeni hanno richiesto interventi di controllo delle acque, ben riconoscibili nel confronto tra le diverse produzioni dell'Istituto Geografico Militare (IGM) in scala 1:25.000 e tra le varie realizzazioni della carta tecnica regionale (CTR).

La città era all'incrocio di due tracciati viari che si sviluppavano lungo i due principali corridoi naturali di collegamento tra la Valle Latina e la fascia costiera e, quindi, il porto di *Tarracina*.

Le ricerche condotte negli ultimi decenni sull'area urbana hanno evidenziato una continuità di vita della città fino al pieno XII secolo⁷, quando sembra potersi ipotizzare un graduale spostamento dell'abitato sul vicino colle dove tuttora sorge il centro di Priverno, la cui configurazione urbana sembra poter essere inquadrata tra la fine del XII e gli inizi del XIII secolo.

La lunga persistenza dell'abitato di fondo valle, sede di diocesi sicuramente alla metà dell'VIII e fino al pieno XI secolo, trova un parziale parallelo nella continuità di vita, anche se con variazioni funzionali, di un consistente numero di impianti a carattere rustico e residenziale che sono stati riconosciuti sul territorio (Fig. 3).

Si evidenzia come la vicinanza alle vie naturali, terrestri e fluviali è certamente l'elemento caratterizzante le principali attestazioni del ter-

7. Per le evidenze di età romana si veda Cancellieri, 2001, 227-239; Cancellieri, 2010; Cancellieri, 2012b. Per un'analisi delle fasi tardo-antiche e alto medievali, invece, Cancellieri, Ceci, 2003; Bruni, 2008; Speciale, 2006; Amici, 2016; Leopardi, 2017.



FIGURA 2. Veduta da sud-est della piana di Ceriara/Mezzagosto. La linea tratteggiata indica l'ipotesi ricostruttiva dell'estensione dell'area urbana di *Privernum*.

ritorio. Un tratto riconoscibile fin dalle fasi più antiche, con le presenze riferite all'età del Bronzo e del Ferro distribuite lungo le fasce di mezzacosta e in prossimità di sorgenti. A partire dalla media età repubblicana si registra un aumento delle attestazioni, da leggere in connessione all'occupazione e all'organizzazione del più ampio territorio pontino. Occupazione che viene sancita con la sistemazione agraria del settore sud della Pianura, con *limites* orientati secondo i punti cardinali e che si incrociano ortogonalmente a formare quadrati di 10 *actus* di lato⁸.

Nello stanziamento all'interno del territorio privernate, dunque, particolarmente favoriti sembrano essere stati i pianori collinari a ridosso della viabilità principale, in cui le ampie e numerose aree di frammenti fittili lasciano supporre la presenza di agglomerati rurali.

A seguito della deduzione coloniale di *Privernum* si assiste ad un'intensificazione dello sfruttamento del territorio, con la nascita di complessi produttivi, distribuiti lungo le fasce pedemontane, sia ai margini della pianura pontina che nelle vallate interne.

Tali processi sono accompagnati da importanti interventi sull'assetto idrogeologico dell'area. Alcune delle dinamiche di trasformazione del paesaggio, che è stato possibile ricostruire per l'area circostante la città di *Privernum*, possono essere esemplificative del lavoro svolto e dei risultati ottenuti.

A ovest della città, il Fosso Iavona e il Fosso Ceriara confluivano originariamente nel fiume Ufente, mentre oggi risultano incanalati all'interno di un collettore di bonifica che si immette nel fiume Amaseno, parte del progetto di risistemazione idraulica dell'agro pontino del 1934, ancora in corso di realizzazione durante le riprese fotografiche del Volo Base nel 1954 (Carinci, 2017, 133).

Negli stessi scatti sono ancora riconoscibili due bacini lacustri (Fig. 3), ben documentati nella cartografia storica e oggi parzialmente interessati dalla pesante urbanizzazione dell'area. In particolare, in una carta del 1785 redatta da Gaetano Astolfi sono ben caratterizzati due specchi d'acqua: il primo denominato "*Laghetto*" e il secondo "*Stagno di Pruneto*".

8. L'organizzazione agraria della Pianura Pontina e il rapporto con la via Appia sono ampiamente documentati in Cancellieri, 1985, 44-48.

9. La carta di Gaetano Astolfi, *Provincia di Campagna, Pianta delle Paludi Pontine*, è edita in Frutaz, 1972, II, tav. 202, XLII, 2.

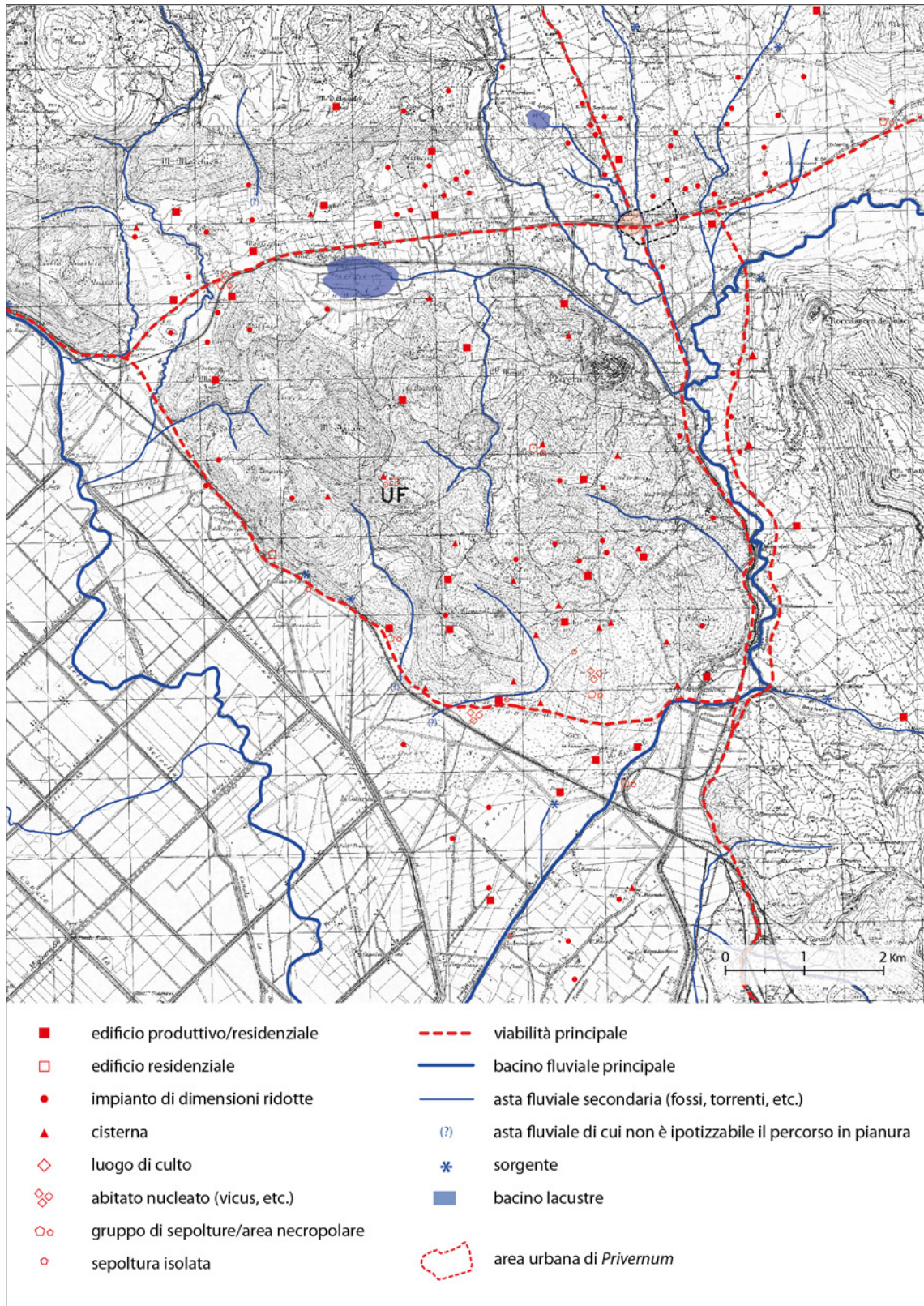


FIGURA 3. Ipotesi ricostruttiva del paesaggio antico dell'agro priverenate (base cartografica IGM 25v).

A est del lago di Pruneto esce il fosso detto *Scolo del Pecoro* che, seguendo un percorso da ovest verso est, lungo il margine sud della piana, raccoglie tutte le acque intermontane e va a immettersi nel fiume Amaseno. Visto il ruolo di collettore dei fossi a nord e a sud della Piana di Mezzagosto, non è da escludere una fase antica di irreggimentazione delle acque in questo settore, che potrebbe spiegare l'assenza di materiale archeologico affiorante sul terreno lungo la fascia meridionale della Piana. In effetti, se i dati raccolti non consentono di riconoscerlo immediatamente come legato ad un'iniziativa volta a contenere l'estensione del Lago di Pruneto in una fase antica, è pur vero che le presenze archeologiche sembrano posizionarsi intorno ad un'area depressa più ampia rispetto a quella pertinente al lago in età moderna e perimetrabile mediante cartografia.

Il fiume Amaseno, proveniente dall'area del Frusinate e ricordato anche da Virgilio nell'Eneide (XI, vv.543-547), costeggia la piana di Mezzagosto/Ceriara sul versante orientale, a ridosso dei Monti Ausoni. Una gran mole di documentazione d'archivio testimonia una serie di disastri ambientali legati alle inondazioni di questo corso d'acqua, che hanno comportato nel corso del tempo molteplici interventi di regimazione delle acque. I cambiamenti del corso fluviale sono leggibili su un ampio apparato cartografico prodotto tra Seicento e Ottocento che, messo in relazione con l'attuale situazione, evidenzia uno spostamento del fiume più a est. Interessante è, a tal proposito, uno schizzo topografico del 1637, conservato nella Biblioteca Vaticana (De Rossi, 2013), in cui si vede una grande ansa intorno all'impianto abbaziale di Fossanova. Qui il fiume prosegue oltre il cosiddetto *Fosso per lo sfogo delle Rotte*, in direzione ovest, fino a incrociare e sottopassare la "strada Romana per Napoli" che corre lungo la riva sinistra, mentre oggi il suo corso, completamente deviato a est, entra rettificato nella piana pontina. L'ipotesi di un percorso del fiume Amaseno spostato verso ovest rispetto alla posizione odierna accentuerebbe il ruolo strategico, in funzione della viabilità fluviale, dei numerosi siti individuati lungo le pendici meridionali e sud-orientali delle colline di Priverno, tra i quali gli impianti rustico-residenziali di Colle Pistasale e di località Procoio, a sud-ovest di Fossanova (Fig. 3).

Spostando l'attenzione all'imbocco della piana, si individuano alcune aste fluviali che dalle pendici collinari scorrono verso sud (Fosso San Carlo, Fosso La Pincolozza, Fosso Cardinale e Fosso Raffaele). Queste aste fluviali risultano nella cartografia settecentesca come particolarmente consistenti e con un percorso che le portava a confluire nell'Amaseno (qui già rettificato e nel suo attuale corso) quasi in corrispondenza della località La Torre, poco a nord della via Appia. Oggi ridotte a semplici fossi di scolo, nei momenti di precipitazioni abbondanti crescono di portata al punto da allagare lo spazio circostante, mostrando come la fascia interessata da questi alvei sia importante nell'assetto idrogeologico di questo settore. Indagini condotte alla fine degli anni '70 hanno portato alla luce opere di consolidamento spondale di età romana e residui di un paleoalveo proprio in corrispondenza di uno di questi alvei (Cancellieri, 1987, 48-53). Non è da escludere, quindi, l'ipotesi che i Romani nel loro programma di organizzazione territoriale abbiano cercato di regimare le acque del fiume Amaseno e che questo, costeggiando le colline di Colle Pistasale e del Procoio, proseguisse in direzione sud lungo quella consistente linea di scolo indicata nella cartografia storica e riconoscibile nel percorso dei fossi San Carlo (o Fosso dei *Lorenzi*), Pingolozza e Raffaele, fino quasi a incontrarsi con il vecchio corso del fiume Ufente, in località La Torre, dove sono i resti di una delle torri medievali attestate lungo tutto il corso del fiume Amaseno, chiara evidenza archeologica posta a controllo delle due aste fluviali (Fig. 4).

3. LA MODELLAZIONE DEI GEODATI PER LO STUDIO DELLE DINAMICHE DI TRASFORMAZIONE DEL PAESAGGIO¹⁰ (A.L.)

L'elevato numero di interventi di bonifica, a cui si è fatto cenno e che, in molti casi, sono tuttora in corso, ha determinato una notevole produzione cartografica, soprattutto a partire dalla seconda metà del Settecento, tra cui si conservano

10. La modellazione dei geodati è stata effettuata mediante software QGIS. Dopo un iniziale utilizzo del formato Shapefile, i geodati sono stati gradualmente inseriti in un contenitore GeoPackage per essere successivamente implementati e gestiti in un DB Postgres/Postgis.

anche documenti più antichi come la carta di Leonardo da Vinci della *Royal Library* di Londra. L'eterogeneità di tale documentazione, risultato ovviamente dell'evoluzione della scienza della rappresentazione della Terra, dipende in larga parte dalle finalità di redazione. Si passa, infatti, dalle più grandi carte delle paludi pontine, di inquadramento generale, alle carte di progetto della bonifica, con stralci di dettaglio accompagnati da relazioni e sezioni trasversali. A queste carte è possibile affiancare le mappe catastali del Pio Gregoriano e del Catasto d'Impianto, che offrono uno spaccato dell'evoluzione dell'area tra gli inizi del XIX e gli anni '20 del secolo scorso.

Ai fini della ricostruzione degli elementi ambientali e antropici caratterizzanti il paesaggio antico e le sue dinamiche di trasformazione, l'analisi della cartografia storica è stata chiaramente accompagnata da un continuo rimando alle informazioni da fotointerpretazione e ai dati paleoambientali ricavabili da diverse fonti¹¹; ciò ha consentito, in fase di trascrizione, anche variazioni nel livello di accuratezza dei dati, da intendere come differenza fra il valore reale e quello riportato di una certa misura, in larga parte dipendente dalle scale e dai sistemi di rappresentazione impiegati nelle diverse fonti.

Il lavoro di redazione dei geodati è stato sempre improntato a finalità eminentemente cartografiche dell'utilizzo dei software GIS; l'organizzazione delle informazioni, pertanto, si è rivelata utile innanzitutto ad una corretta estrazione dei dati finalizzata alla rappresentazione e alla visualizzazione. Si reputa più funzionale tale

11. Sono stati, ad esempio, analizzati i dati provenienti dalla progettazione di opere pubbliche, come il nuovo tracciato della S.S. 156var (Archivio Azienda Strade Lazio) per l'analisi della piana di Mezzagosto/Ceriara, o gli studi sulle aree soggette a subsidenza (progetto *sinkholes*) condotti dall'ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale del CNR – Nisio 2009) nell'area sud-occidentale del comune di Priverno, nella località Gricilli. Le indagini condotte dal Groningen Institute of Archaeology, che a partire dagli anni Ottanta del secolo scorso ha condotto una serie di ricerche multidisciplinari nella regione pontina volte alla ricostruzione "dell'occupazione umana e dell'uso del suolo" (Pontine Region Project in Attema, 2019, 103-118), sono state integrate con quanto prodotto dalla Società Geoambiente nell'ambito di un PRIN coordinato da M. Cancellieri e che ha visto impegnate la "Sapienza" Università di Roma e l'Università degli Studi di Salerno (i risultati di queste indagini, attualmente ancora inediti, sono stati gentilmente forniti dalla prof.ssa Margherita Cancellieri, che si ringrazia).

approccio, in quanto solo una corretta trascrizione del dato può determinare una ricaduta positiva anche sulle potenzialità analitiche dello strumento (principalmente topologiche e quantitativo-statistiche). Lungi dal voler proporre in questa sede un impianto teorico di riferimento, per il quale si rimanda all'ampia letteratura esistente, si ritiene opportuno sottolineare l'importanza di un approccio epistemologico che basi sulle regole della cartografia il trattamento informatizzato delle informazioni spaziali, soprattutto in sede di definizione del modo di rappresentare la componente geometrico-spaziale dell'informazione. In questo senso, la cartografia fornisce l'imprescindibile impianto teorico-pratico su cui fondare il trattamento dei dati geografici¹².

Nell'ambito del lavoro effettuato, le informazioni archeologiche sono state strutturate in tre dataset corrispondenti alle tre principali geometrie (punti, linee, poligoni), raggruppando le entità esclusivamente sulla base dello sviluppo spazio-planimetrico e distinguendo la tipologia delle evidenze su base alfanumerica (in questo modo si è mantenuto un numero limitato di geODB). Ulteriori dataset sono stati realizzati per la descrizione degli aspetti ambientali e paleoambientali, delle tracce da osservazioni remote e per la rappresentazione delle ipotesi ricostruttive dei principali elementi infrastrutturali (viabilità, condotte idriche, canali, etc.).

Ovviamente, come accennato in precedenza, l'eterogenea origine dei dati ha imposto estrema cautela soprattutto in sede di osservazione dei dati e di redazione dei layout cartografici.

Per quanto concerne la componente alfanumerica dei dataset archeologici, si è cercato di limitare quanto più possibile il numero dei campi

12. Su questo si veda in particolare Macchi Janica, 2018 e Tyner, 2014. La veloce evoluzione che le scienze in generale vivono dall'introduzione del calcolatore e dal continuo affinamento degli strumenti di misurazione non sempre è stata accompagnata da un'attenta riflessione epistemologica. Nello specifico caso dell'archeologia, un esempio di questo problema può essere riconosciuto prima nell'introduzione delle tecniche di rilievo mediante laser scanner e, più di recente, nella diffusione di software, dall'elevata *usability*, per il *photo-matching* e lo *structure from motion*. Troppo spesso l'applicazione di tali tecniche di rilievo indiretto porta, accanto alla facilitazione del processo di misurazione, a bypassare in maniera indiscriminata l'analisi autoptica dei manufatti, di fatto riducendo e non incrementando l'informazione, soprattutto per quanto concerne la sua componente qualitativa.

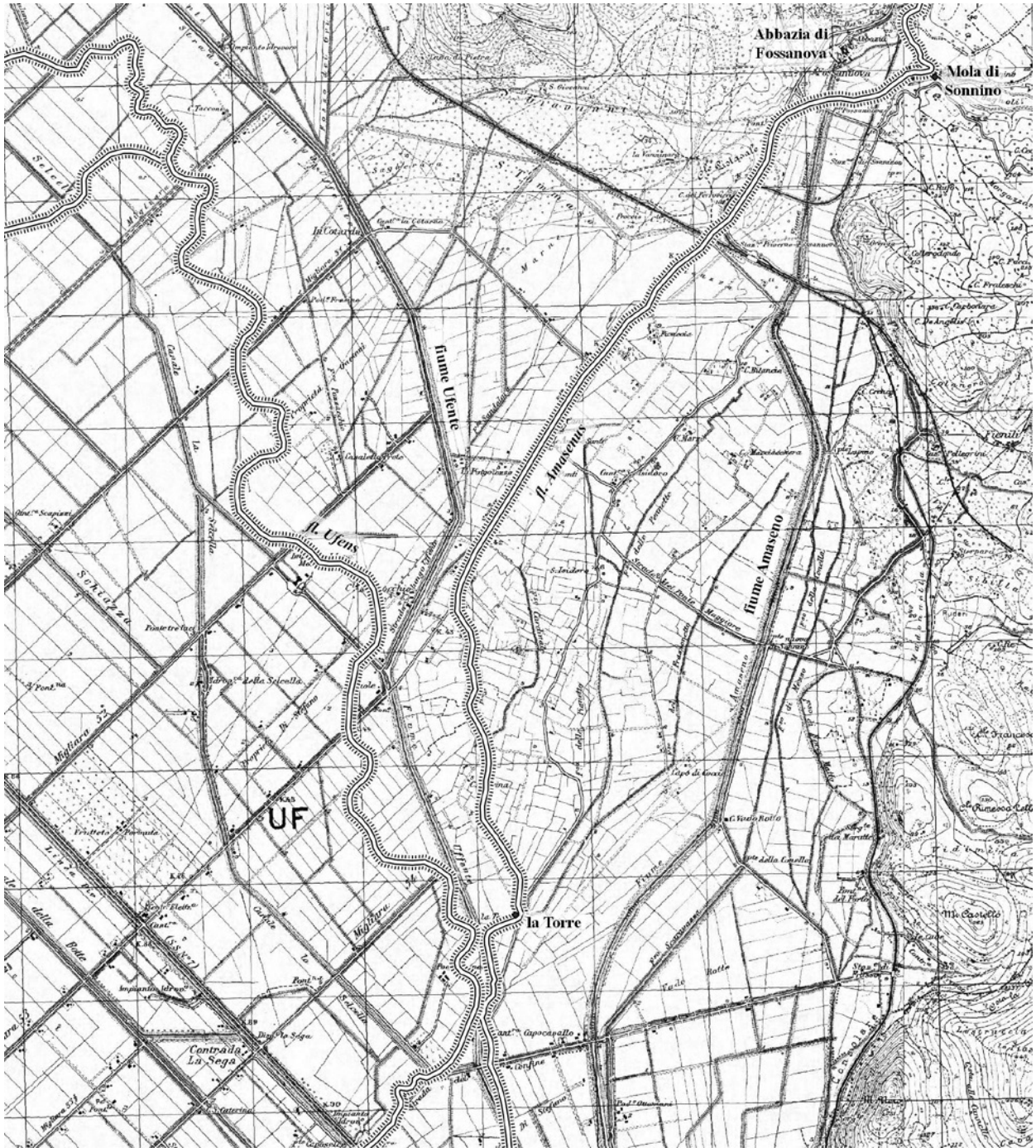


FIGURA 4. Ricostruzione dei tracciati antichi dell'Amaseno e dell'Ufente all'interno della Pianura Pontina (base cartografica IGM 25v).

agli aspetti descrittivi dell'oggetto (definizione, descrizione e cronologia), all'origine dell'informazione e ai criteri della rappresentazione spaziale (metodo di georeferenziazione, base di riferimento utilizzata, etc.). Inizialmente la cronologia

è stata suddivisa in macro-fasi, inserendo tre campi 'vero/falso' dedicati ad età protostorica, romana e medievale. Questo criterio è stato utile in sede di prima elaborazione dati, al fine di consentire una successiva analisi di dettaglio degli

elementi datanti, dalla quale è stato possibile ricavare una maggiore precisione della componente informativa, che è confluita in un unico campo di testo nel quale inserire le fasi di occupazione del sito¹³. L'informazione alfanumerica è stata modellata quindi sulla normativa SI (Sito archeologico)¹⁴ dell'Istituto Centrale per il Catalogo e la Documentazione (ICCD) del Ministero per i Beni Culturali, pur riducendo il numero di paragrafi e campi all'insieme descritto in precedenza (oggetto, origine dell'informazione e criteri di rappresentazione spaziale).

La componente geometrico-spaziale dei dataset archeologici è stata inizialmente redatta su cartografia in scala 1:5.000, per poi essere generalizzata prima al 10.000 e successivamente al 25.000, con una duplicazione dei dataset al fine di una corretta sovrapposizione cartografica e una riduzione del numero di geometrie, soprattutto per quanto concerne quei siti che ad alta scala erano stati rappresentati mediante differenti geometrie. Si tenga presente, a tal proposito, che la modellazione di questi dati è stata sempre effettuata su basi cartografiche predefinite, entro una riduzione massima al 25.000 (mappe catastali, CTR al 5.000 e al 10.000, tavolette/sezioni IGM al 25.000¹⁵), non essendo stata realizzata cartografia dedicata nemmeno per l'area urbana di *Privernum*. Anche in presenza di dati acquisiti direttamente con rilievo strumentale, quindi, è stato necessario operare correttivi della componente spaziale per consentire una precisa aderenza tra entità geometrica e base georiferita, al fine di mantenere un errore di rappresentazione omogeneo (derivante dalla base) e ottenere una corretta sovrapposizione.

13. Ai fini di una corretta compilazione del campo si è preferito gestirlo mediante relazione con una lista valori contenuta in apposita tabella, che consente di restituire una stringa alfanumerica con riferimento a tutte le fasi storiche individuate per il sito e interrogabile mediante operatore "like", in linea con quanto sviluppato dall'Istituto Centrale per l'Archeologia (MiBACT) per la gestione dei geodati da attività di Archeologia Preventiva.

14. http://www.iccd.beniculturali.it/it/ricercanormative/40/si-siti-archeologici-3_00

15. Si è preferito lavorare sempre con basi raster per una più agevole differenziazione con i numerosi dataset prodotti, adeguando di volta in volta le informazioni alla cartografia di produzione più recente. Per il 25000 al momento sono a disposizione le sezioni IGM della serie 25DB, mentre per le CTR al 5000 sono state pubblicate le levate prodotte nel 2014.

Per quanto concerne i siti caratterizzati da differenti tipologie di evidenze, ad esempio nel caso di aree di frammenti fittili con importanti variazioni nella concentrazione di materiale e/o per la presenza congiunta di strutture o altri elementi emergenti, si è preferito descrivere in maniera distinta i singoli elementi, utilizzando il tipo di geometria ritenuto più adatto, pur considerandoli come parte di un'unica unità topografica superiore. Questa distinzione è stata poi eliminata in sede di generalizzazione dei dati, privilegiando l'elemento dominante sotto il profilo geometrico-spaziale.

Criteri analoghi sono stati seguiti per la creazione delle basi di dati spaziali relative all'idrografia e alla viabilità antica, che costituiscono gran parte del lavoro effettuato a partire dalla lettura incrociata dei diversi dati territoriali (ricognizioni di superficie, cartografia storica, fotointerpretazione, etc.). Ovviamente per questi strati informativi la componente cronologica è per lo più derivata dall'origine del dato, quindi in larga parte attribuibile alle fonti cartografiche d'età moderna.

Un ruolo importante ha avuto inoltre il lavoro di georeferenziazione delle carte, ove prodotte secondo principi geodetici (Fig. 5). Tale processo è avvenuto sempre, o quasi sempre, cercando di evitare deformazioni dell'originale, principalmente mediante semplici algoritmi di ridimensionamento e roto-traslazione, in modo da mantenere costantemente la possibilità di controllo degli errori intrinseci alla rappresentazione storica e/o alle naturali deformazioni del supporto, anche se questo ha determinato una riduzione dell'accuratezza della sovrapposizione¹⁶. Questo sistema di lavoro è stato possibile per quel materiale acquisito in digitale mediante riproduzione diretta e ad alta risoluzione – ad esempio per le mappe del Catasto Gregoriano e per la cartografia reperita negli Archivi di Stato di Roma e Latina.

Come già accennato in precedenza, dinanzi al notevole numero di dataset prodotti, soprattutto a seguito dei diversi processi di generalizzazione, si è cominciato a pensare all'individuazione di una struttura dati che consentisse di mantenere

16. Per la georeferenziazione delle carte sono stati utilizzati gli applicativi GDAL implementati nell'ambiente software di QGIS.

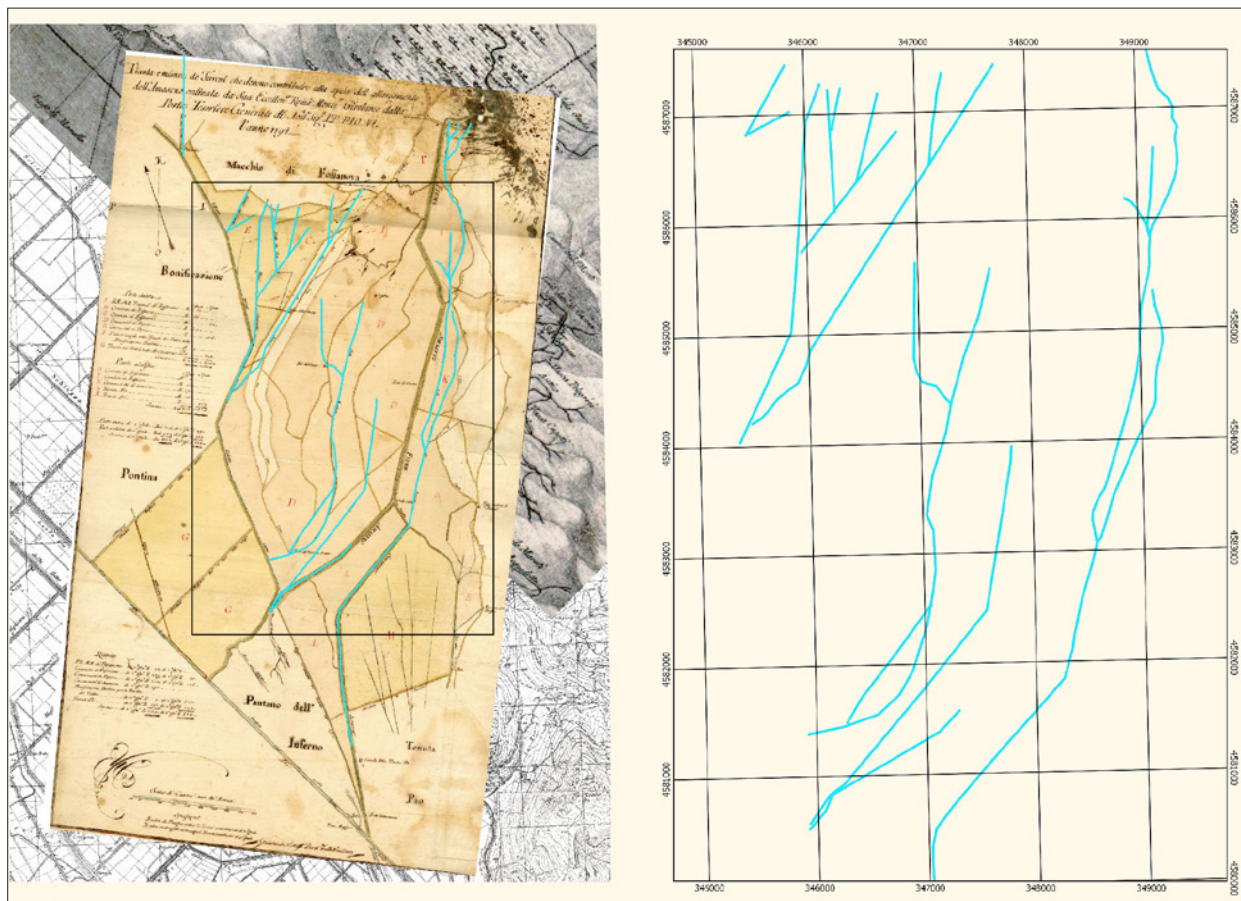


FIGURA 5. Estrazione da cartografia storica dello strato informativo relativo all'idrografia.



FIGURA 6. Il modello relazionale utilizzato punta alla conservazione dell'integrità dei diversi archivi di geodati, prodotti per rappresentazione delle informazioni a scale differenti.

l'integrità delle singole informazioni e al contempo una facile e veloce estrazione delle entità spaziali utili per la redazione cartografica, oltre che per specifiche analisi spaziali e topologiche.

La soluzione adottata è di rappresentare i singoli strati informativi all'interno di un modello dati relazionale, nel quale le componenti qualitative dell'informazione vengono trascritte in una tabella alfanumerica priva di geometria, che costituisce la scheda madre in relazione 1:N con le tabelle con geometria, nelle quali vengono rappresentate le componenti spaziali dell'informazione ovvero le diverse modalità di trascriverle (Fig. 6). In questo modo si conserva l'integrità dell'archivio e al contempo viene facilitata la rappresentazione multi-scala, con l'adozione di un sistema multi-*feature* per le entità complesse descritte nella cartografia a scala più alta.

Inoltre, questo approccio sta favorendo, nella prosecuzione delle indagini sull'agro privernate, un graduale passaggio ad una rappresentazione spaziale più dettagliata. Quindi, mantenendo inalterata la struttura semantica dei dati, una prospettiva aperta sembra essere quella di pervenire ad un database topografico impostato a scala 1:5.000, da cui derivare in maniera quanto più speditiva possibile le rappresentazioni a scala più bassa.

BIBLIOGRAFIA

- AMICI, Carla Maria (2016). "L'edificio di culto di *Privernum*: l'evoluzione architettonica". *Orizzonti. Rassegna di Archeologia*, Anno XVII, 159-166.
- AMICI, Carla Maria (2019). "*Privernum*: l'opera idraulica". *Atlante Tematico di Topografia Antica*, 29, 33-50.
- ARMSTRONG, Henry H. (1911a). "*Privernum* I: the Volscian City". *American Journal of Archaeology*, XV, 44-59.
- ARMSTRONG, Henry H. (1911b). "*Privernum* II: the Roman City". *American Journal of Archaeology*, XV, 170-194.
- ARMSTRONG, Henry H. (1911c). "*Privernum* III: Roman Remains in the Territory of the Roman Colony". *American Journal of Archaeology*, XV, 386-402.
- ATTEMA, Peter *et alii* (2019). "Vecchie e nuove ricerche multidisciplinari nel territorio di Sezze e nelle zone adiacenti (Agro pontino, Lazio)". *IpoTesi di Preistoria*, 11, 103-118.
- BRUNI, Paola (2008). *La diocesi di Privernum e la sua ecclesia*, Tesi di Dottorato di Ricerca in Archeologia (curriculum Antichità Post-Classiche), XX Ciclo, Dipartimento di Scienze dell'Antichità, "Sapienza" Università di Roma.
- BUONORA, Paolo (1995). "Il progetto della Natura e il progetto dell'arte. Per una storia del sistema idraulico pontino". In: ROCCI, Giovanni Rosario (ed.). *Pio VI, le Paludi Pontine. Catalogo della mostra (Terracina, 25 luglio-30 settembre 1995)*. Terracina, 301-322.
- CANCELLIERI, Margherita (1983). "Lo sbocco meridionale della Valle interna dei Lepini: *Privernum* e il suo territorio". *Bollettino dell'Istituto di storia e di arte del Lazio meridionale*, XI, 35-41.
- CANCELLIERI, Margherita (1985). "Pianura Pontina". In: *Misurare la terra: Centuriazione e coloni nel mondo romano. Città, agricoltura e commercio: materiali da Roma e dal suburbio (Catalogo della mostra di Roma, aprile-giugno 1985)*. Modena: Edizioni Panini, 44-48.
- CANCELLIERI, Margherita (1986). "Le vie d'acqua dell'area pontina". *Quaderni del Centro di studio per l'archeologia etrusco italiana*, 12, 143-156.
- CANCELLIERI, Margherita (1987). "La media e bassa valle dell'Amaseno, la via Appia e Terracina: materiali per una carta archeologica". *Bollettino dell'Istituto di storia e di arte del Lazio meridionale*, XII, 41-104.
- CANCELLIERI, Margherita (1990). "Il territorio pontino e la via Appia". *Quaderni del Centro di studio per l'archeologia etrusco italiana*, 18, 61-71.
- CANCELLIERI, Margherita (2001). "*Privernum* dalle origini al tardo antico". In: *Luoghi e tradizioni d'Italia. Lazio meridionale*. Roma, 227-239.
- CANCELLIERI, Margherita (2010a). "Case e mosaici a *Privernum*. Parte I: La *domus* dell'Emblema figurato". *Musiva & Sectilia*, 4, 15-35.
- CANCELLIERI, Margherita (2010b). "Case e mosaici a *Privernum*. Parte II: La *domus* della Soglia nilotica", *Musiva & Sectilia*, 4, 63-141.

- CANCELLIERI, Margherita (2012). “I mosaici della *domus* dell’*émblema* figurato di *Privernum*”. In: PARIS, Rita; DI SARCINA, Maria Teresa (ed.). *Museo Nazionale Romano, Palazzo Massimo alle Terme. I mosaici*. Roma, 27-40.
- CANCELLIERI, Margherita; CECI, Francesca (2003). “Tra età romana e tardo antico: il riutilizzo delle *domus* romane di Priverno (Latina - Italia) come aree funerarie tardo antiche e altomedievali”. *Histria Antiqua*, II, 243-254.
- CARINCI, Francesca (2014). *Ricostruzione sincronica e diacronica dell’ager Privernas*. Tesi di Dottorato di ricerca in Archeologia (Curriculum Topografia Antica), XXVI Ciclo, Dipartimento di Scienze dell’Antichità, “Sapienza” Università di Roma.
- CARINCI, Francesca (2017). “La fotografia aerea per la ricostruzione del paesaggio dell’*ager Privernas*”, *Archeologia Aerea. Studi di Aerotopografia Archeologica*, 11, 131-135.
- CARINCI, Francesca; LEOPARDI, Antonio (2018). “Nuovi dati per la lettura del territorio di *Privernum* tra tarda Antichità e alto Medioevo”. In: SOGLIANI, Francesca (ed.). *VIII Congresso Nazionale di Archeologia Medievale (Matera 12-15 settembre 2018)*, vol. II. Firenze: All’insegna del giglio, 153-156.
- CERRETI, Claudio (2003). “Il quadro geografico del Lazio come base dell’antropizzazione”. In: SOMMELLA, Paolo (ed.). *Atlante del Lazio antico. Un approfondimento tematico delle conoscenze archeologiche*. Roma, 1-26.
- COSENTINO, Domenico; PAROTTO, Maurizio; PRATURLON, Antonio (1998). *Lazio. Guide Geologiche Regionali*. Roma.
- DE ROSSI, Giovanni Maria (2013). *Fossanova e San Tommaso. Sulle orme di San Tommaso d’Aquino a Fossanova: un percorso tra agiografia e topografia*. Roma: Espera.
- FRUTAZ, Aimé-Pierre (1972). *Le carte del Lazio (voll. I-III)*. Roma.
- LEOPARDI, Antonio (2015). “Alcune riflessioni sulle trasformazioni di *Privernum* tra tarda Antichità e alto Medioevo”. In: ARTHUR, Paul (ed.). *Atti del VII Congresso Nazionale di Archeologia Medievale (Lecce, 9-12 settembre 2015)*. Firenze: All’insegna del giglio, 237-241.
- LEOPARDI, Antonio (2017). *Le origini della città medievale. Il caso di Privernum*. Tesi di Dottorato di Ricerca in Scienze del Patrimonio Culturale, XXIX Ciclo, Dipartimento di Beni Culturali, Università del Salento.
- LUGLI, Giuseppe (1926). *Anxur-Tarracina (Forma Italiae, I)*. Roma.
- LUGLI, Giuseppe (1928). *Circeii (Forma Italiae, II)*. Roma.
- MACCHI JANICA, Giancarlo (2018). “GIS, Critical GIS e storia della cartografia”, *Geotema*, 58, 179-187.
- SPECIALE, Lucinia (2006). “Una chiesa e una città. La cattedrale di *Privernum*”. In: QUINTAVALLE, Arturo Carlo (ed.). *Atti del VIII Convegno AISAME*. Parma, 120-131.
- TYNER, Judith. A (2014). *Principles of Map Design*. New York: Guilford Press.

El proyecto SIG/2020 de Munigua (Villanueva del Río y Minas, Sevilla)

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RESUMEN

Después de más de 60 años de trabajos arqueológicos en Munigua, se ha llegado a un punto en el que la densidad de datos de que se dispone permite abordar la comprensión de la ciudad como parte de un territorio. Por lo tanto, en el año 2020 se ha iniciado un proyecto piloto que pretende, mediante la implementación de un SIG, fusionar y gestionar el gran caudal de información almacenada. El fin último del proyecto es desarrollar una herramienta de trabajo, accesible en el servidor del IAA, y crear un modelo en el que todas las relaciones exteriores de la ciudad conocidas hasta el momento estén representadas.

PALABRAS CLAVE: IAA, Munigua, Sevilla, SIG.

The Munigua-GIS/2020-Project (Villanueva del Río y Minas, Seville, Spain)

ABSTRACT

After more than 60 years of archaeological work in Munigua, a point has been reached where the density of available data allows us to approach the understanding of the city as a part of a wider territory. A pilot project was therefore launched in 2020 which aims, through the implementation of GIS, to merge and manage the large amount of information collected. The project's ultimate goal is to create a working tool that can be accessed via the DAI server, creating a model in which all the external relations of the city known to date are represented.

KEYWORDS: DAI, Munigua, Seville, GIS.

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1. HISTORIA DE LA INVESTIGACIÓN EN MUNIGUA

El yacimiento de Munigua se encuentra situado al norte del río Guadalquivir, en las primeras estribaciones de la Sierra Morena, a escasa distancia de la ribera del río. La ciudad romana está edificada en el valle del arroyo Tamohoso, un tributario del Guadalquivir, y se localiza sobre una colina que se eleva unos 50 m por encima de aquel.

Si bien las investigaciones sistemáticas del yacimiento no empezarán hasta los años cincuenta del siglo xx, la ciudad era conocida, al menos, desde el siglo xvi, ya que en 1565 Ambrosio de Morales hace referencia a *Mulva* en una carta fechada en ese año y dirigida a Fray Alonso Chacón: «Las inscripciones de Alcolea son muy lindas: beso a V. Paternidad las manos por ellas y espero las de Mulva» (Cortés – Quentas Zayas, 1773, 217) y, casi treinta años antes, otro documento —una concesión minera fechada en 1537— alude a la comarca como «la sierra que se dice del Castillo de Mulga ó Murga» (González, 1831, I, 12). En la centuria siguiente, Rodrigo Caro nuevamente alude a Mulva entre las ciudades romanas de la zona. No obstante, si bien estas alusiones demuestran que la existencia de la ciudad formaba parte en ese momento del fondo general de conocimientos que se tenían sobre el pasado del entorno de Sevilla, no será hasta 1756 cuando a D. Tomás de Gusseme (Carriazo, 1979, 273-275), a la sazón gobernador de Lora del Río y miembro honorario de la Academia de las Buenas Letras de Sevilla, le llegan noticias de la existencia de unas ruinas. Por ello realiza en mayo de 1757 un dibujo de la colina con los vestigios del santuario de Terrazas, que muestra que su estado de conservación era entonces similar al que tendría hasta los años setenta-ochenta del siglo xx, cuando se acometió la restauración del edificio. A través de él esta noticia llega a dos miembros de la academia sevillana, D. Sebastián Antonio de Cortés y D. José de las Quentas Zayas, quienes a finales de 1756 emprenderán un viaje de reconocimiento cuyos resultados consignarán en un informe presentado ante la Academia el 26 de marzo de 1757 (Cortés – Quentas Zayas, 1773), informe ilustrado con un mapa en el que se muestra la localización tanto del yacimiento como de los pueblos de los alrededores.

A partir de entonces, y a pesar del referido informe, el sitio caerá en el olvido más absoluto. Tan solo Raymond Thouvenot, que debía desconocer el informe de los académicos sevillanos, en 1940 incluirá a Munigua en su capítulo sobre las fortificaciones de las ciudades, malinterpretando el sitio como los restos de un castillo, seguramente influido por el nombre popular «castillo de Mulva» que recibía el lugar, denominación que sin duda se debe al aspecto un tanto castrense que ofrece el muro de retención del santuario de Terrazas.

Será en el año 1956 cuando el Instituto Arqueológico Alemán se haga cargo de las investigaciones en el sitio, hito que marcará el inicio del estudio sistemático del yacimiento. En ese año el departamento de Madrid del IAA, que había sido reabierto dos años antes, llegará a Munigua de la mano de D. Félix Hernández, en ese momento Arquitecto Conservador de la Sexta Zona y muy vinculado tanto al Instituto como al mundo científico alemán —en 1964 será investido doctor *honoris causa* por la Universidad Técnica de Berlín—. Desde 1956 hasta hoy se han venido organizando campañas anuales que ni siquiera ha conseguido interrumpir la pandemia de COVID-19 de 2020.

Durante estos más de 60 años se pueden distinguir tres etapas fundamentales en la investigación: en la primera, que se desarrollará hasta 1967 bajo la dirección de Wilhelm Grünhagen (Schattner *et al.*, 2005b, 258), los investigadores harán hincapié en la topografía del yacimiento, concentrándose en la documentación y estudio de los edificios públicos más destacados del sitio como son el santuario de Terrazas, el Foro, el templo de Podio y el de Mercurio, el edificio de acceso o las termas.

La segunda etapa se extenderá entre 1967 y 1997. Este momento viene marcado por la personalidad de Theodor Hauschild (Schattner, 2009), quien ya venía participando como estudiante en las campañas de excavación de Munigua desde 1959,³ y que a partir de 1984 asumirá

3. Dos años antes, en 1957, ya había participado junto con el arquitecto Walter Wunsch en la campaña que se desarrolló en el mes de mayo de ese año. No obstante, será a partir de 1959 cuando, tras su incorporación al IAA de Madrid, pasará a ocuparse de una problemática específica, concretamente el mausoleo de la necrópolis este (Schattner, 2009, 26).

la dirección de los trabajos. En esta fase, la atención de los investigadores se dirige a la vida cotidiana de la ciudad, y los trabajos se desplazan a la parte baja del yacimiento; de los grandes edificios públicos a la zona de construcciones de carácter habitacional con el fin de acrecentar los conocimientos sobre el urbanismo de la ciudad, su organización y desarrollo.

A partir de 1997 se iniciará una nueva línea de investigación que por primera vez se centra no en la ciudad en sí sino en su entorno inmediato y que pretende determinar las bases económicas de la urbe (Schattner *et al.*, 2005b, 255-258) con el fin de llegar a penetrar en los motivos que expliquen su origen, desarrollo y permanencia en el tiempo y sobre todo aclarar el aparente contraste entre la magnitud de los edificios públicos documentados y la reducida superficie del área doméstica, que se estima podía albergar poco más de unas quince unidades familiares.

Asimismo, se pretende analizar el poblamiento rural que depende de la ciudad, no solo minero, sino también agrícola y ganadero, y determinar las fuentes de aprovisionamiento de los materiales constructivos. Así pues, el proyecto se planteó como una prospección extensiva del territorio con vistas a localizar y estudiar las áreas de captación de recursos, tanto minerales como agropecuarios, por medio del estudio de su trama geológica y de su organización y explotación.

A tal fin se llevaron a cabo, por un lado, campañas de prospección extensiva (Schattner *et al.*, 2003, 82-84; Schattner *et al.*, 2005a, 93-99; Schattner *et al.*, 2006, 66-69; Schattner *et al.*, 2009, 3733-3734) en toda el área de influencia de la ciudad a lo largo de la ribera del Huesna, en un radio de 8 km de Munigua, con el fin de determinar el grado de ocupación de la comarca en época romana y la tipología de los asentamientos. Estas campañas han conducido al descubrimiento de más de 100 nuevos yacimientos de diversa cronología desde la prehistoria hasta las edades moderna y contemporánea y han permitido un primer acercamiento a la organización del poblamiento rural de la zona (Schattner *et al.*, E.p.). Esto se completó con la prospección geofísica de las áreas de fundición conocidas, con el fin de identificar los escoriales y definir su extensión y potencia; la prospección de los sectores mineros de Pilar de la Pepa y Puerto Cid (Schattner *et al.*, 2003, 77-78), así como los de

El Pedroso y Navalázaro (Schattner *et al.*, 2006, 69-70; Schattner *et al.*, 2009, 3734-3735) —situados a más distancia de la ciudad— y, finalmente, la excavación de los talleres metalúrgicos urbanos y periurbanos (Schattner *et al.*, 2009, 3735) y la prospección microespacial de los escoriales documentados en la ciudad (Schattner *et al.*, 2003, 76-77; Schattner *et al.*, 2004), incluyendo el análisis de muestras seleccionadas con el fin de precisar tanto los metales producidos como las áreas de aprovisionamiento.

Todo ello permitió, por un lado, determinar que, por lo menos entre los siglos I a.C. y I d.C., Munigua se desarrolló como un centro productor de cobre para, desde época flavia, centrarse exclusivamente en el hierro. Por otro lado, se pudo establecer que mientras que la ciudad se abasteció de los yacimientos cupríferos del entorno, el mineral de hierro procedía de filones situados a cierta distancia de la ciudad, en el sector de Navalázaro (Schattner *et al.*, 2012, 167), lo que autoriza, lógicamente, a extender los límites de la ciudad hasta esta zona. Aún más, el análisis de las escorias permitió comprobar que el primer tratamiento del mineral en bruto se hacía a pie de mina, mientras que en la ciudad propiamente dicha se llevaban a cabo las operaciones de forja (Schattner *et al.*, 2005b, 274).

2. EL PROYECTO SIG DE MUNIGUA

Como puede suponerse, la trayectoria investigadora seguida desde 1957 hasta la actualidad ha generado un volumen ingente de documentos en forma de fotografías, planimetrías, dibujos de materiales, fichas de prospección, diarios de excavación... que en la actualidad se encuentran depositados en la sede madrileña del IAA. En su archivo⁴ se custodian (Lám. 1) más de 22.100 fotografías, tanto analógicas como digitales, así como 4.453 documentos, tanto planimetrías como dibujos de materiales. Se ha llevado a cabo un ambicioso programa de catalogación y digitalización, aún en proceso de desarrollo, con el fin de, por un lado, asegurar las condiciones de su conservación y, por

4. Datos proporcionados por el personal de archivo y fotografía de la sección madrileña del Instituto Arqueológico Alemán.

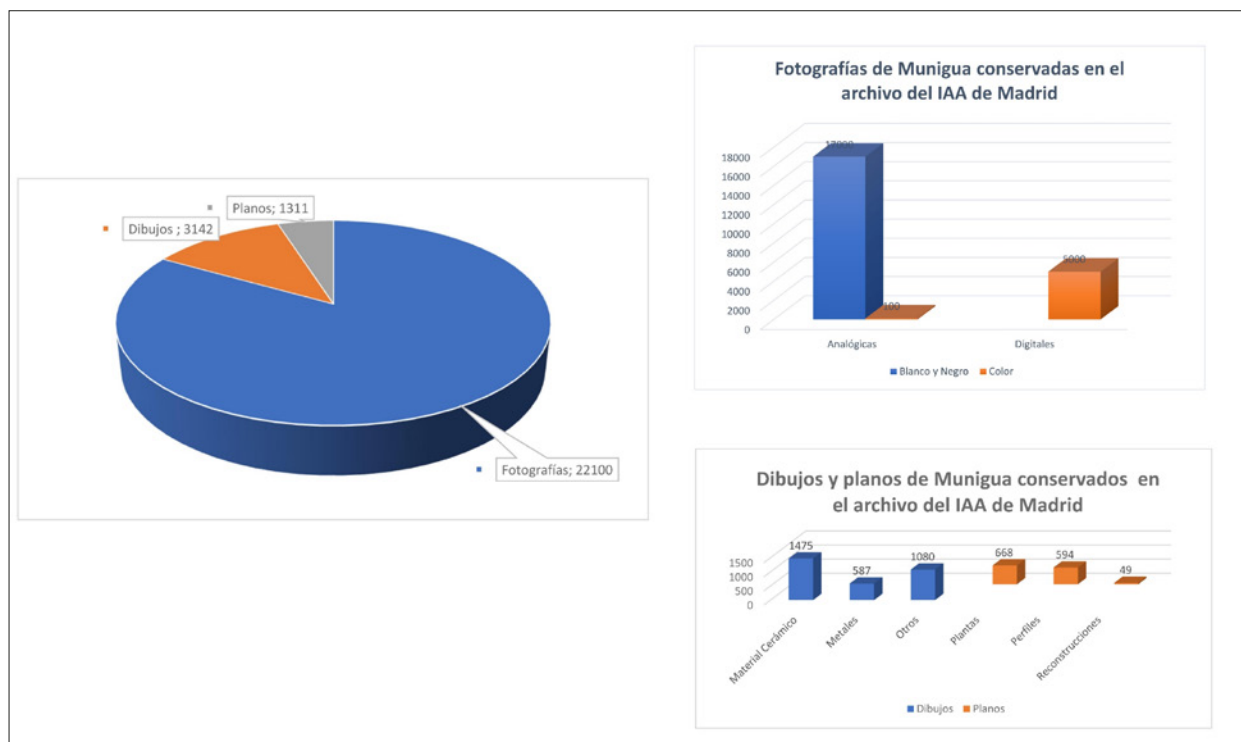


LÁMINA 1. Material gráfico procedente de Munigua depositado en los archivos de la sección madrileña del IAA.

otro, facilitar el acceso de los investigadores a este inmenso caudal de información científica.

Llegados a este punto, y habida cuenta del inmenso *corpus* de documentación con el que ya se contaba y de la trayectoria investigadora que hemos venido relatando, en la campaña de 2020 se ha iniciado una nueva línea de trabajo. Si en un primer momento, como hemos visto, la labor científica se centró en la ciudad en sí para saltar a su entorno más inmediato con el proyecto de las bases económicas, analizando la organización, estructura, explotación y poblamiento del área dependiente directamente de Munigua, el siguiente paso es dar el salto del micro al macroespacio. Esto es, estudiar la inserción en el territorio, entendido éste en un sentido más amplio, tanto del municipio de Munigua como de la red de yacimientos subordinados.

A tal fin se ha puesto en marcha la realización de un SIG de todo el territorio integrado en el *hinterland* de Munigua.⁵ Se han establecido unos límites espaciales (Lám. 2) marcados por la locali-

zación de los poblados con los que las familias de Munigua mantenían relaciones, o en los que tenían parientes según el testimonio de la epigrafía conservada (Schattner, e.p., 311-313): la ciudad de *Italica* (Santiponce) por el oeste, *Axati* (Lora del Río) por el este y *Carmo* (Carmona) —situada ya en la ribera sur del río Guadalquivir— por el mediodía. El proyecto se ha desarrollado entre los meses de septiembre y noviembre de 2020.

En una primera fase, se ha realizado un vaciado de la literatura especializada con el fin de elaborar una hoja de cálculo con todos los yacimientos romanos identificados en la zona de referencia. En la misma se incluye, si está disponible, una caracterización del sitio en cuestión así como su cronología. En un segundo paso, se ha procedido a georreferenciar los yacimientos, empleándose para ello la proyección ETRS89 (husos 29 y 30), que desde 2007 es, por Real Decreto,⁶ sistema de referencia geodésico oficial en España, sustituyendo al anterior sistema ED50. Esto ha obligado a transformar muchas de las coordenadas de que

5. <https://www.dainst.org/project/4681393>

6. R.D. 1071/2007, de 27 de julio.



LÁMINA 2. Área de estudio cubierta por el proyecto SIG/2020 de Munigua.

se disponía, ya que en los trabajos anteriores al año 2007, caso de incluir coordenadas, éstas estaban tomadas en relación con el *datum* ED50, cuando no se trata de coordenadas Lambert en el caso de trabajos más antiguos.

Asimismo, se ha llevado a cabo una búsqueda exhaustiva de cartografía histórica que ha permitido compilar una importante colección de mapas tanto históricos como actuales cuya cronología va desde 1739 hasta la última edición del Mapa Topográfico Nacional.

Finalizada esta fase, en un segundo momento se ha cargado toda la información empleando un *software* especializado, QGIS, con el fin de combinar la hoja de cálculo de yacimientos con la colección cartográfica recogida. De esta manera se representará gráficamente la información alfanumérica de la hoja de cálculo sobre el soporte cartográfico (Láms. 3-4). Todo ello será alojado en el servidor del IAA (iDAI.geoserver) bajo el nombre genérico de «GIS Munigua», y será ac-

cesible a los investigadores previo registro en el mencionado servidor.

Una vez estén concluidos los trabajos, se dispondrá de una herramienta que permitirá, por un lado, manejar el gran volumen de información acumulada y, por otro, la actualización continuada de la misma. De esta forma, se podrán plantear sobre los datos almacenados distintas cuestiones de carácter espacial, interrelacionando temáticas diferentes. En resumen, será un instrumento de gran utilidad para determinar la forma en que Munigua y su red de yacimientos se relacionan con otros yacimientos de su medio, lo que ampliará notablemente el ámbito de los estudios, de una escala local a otra regional. Este proyecto dará pie, en el futuro, a abordar nuevas líneas de trabajo con miras a profundizar en el conocimiento de las redes económicas, comerciales y sociales establecidas entre el municipio Muniguense y los yacimientos de su entorno. Todo ello ofrecerá un gran abanico de posibilidades dentro de la llama-

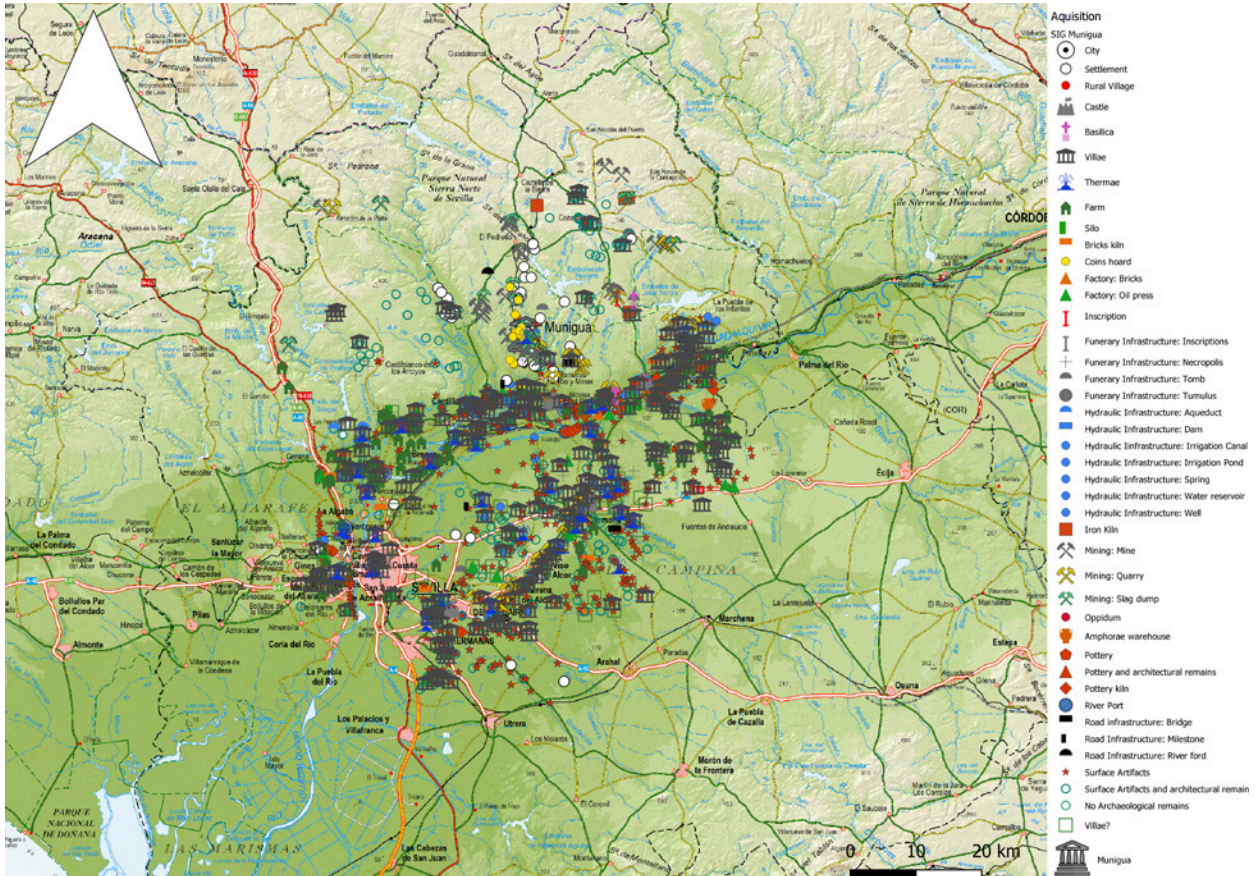


LÁMINA 3. Localizaciones documentadas, proyectadas sobre el mapa topográfico.

da arqueología del paisaje, como pueden ser el análisis e identificación —tanto sincrónico como diacrónico— de patrones de asentamiento, de las relaciones entre los diferentes elementos del paisaje, del acceso a las distintas fuentes de recursos o la determinación de las áreas de captación de los mismos, entre otros. En suma, el proyecto permitirá profundizar en la comprensión de las dinámicas territoriales, la investigación de los modelos de ocupación/explotación del territorio y la forma en que se articulan las redes de influencia e intercambios o las relaciones entre Munigua y el fértil valle del Guadalquivir.

3. EL SIG DE MUNIGUA: EJEMPLO PRÁCTICO DE UTILIZACIÓN

Un ejemplo de las posibilidades que ofrece la nueva línea emprendida por el equipo de Munigua con la realización de este SIG es el uso de

cartografía histórica en relación con las localizaciones documentadas. Esto ofrece grandes posibilidades al investigador del pasado, ya que en muchos de estos planos aparecen reflejadas infraestructuras, topónimos, caminos, etc. que pueden estar enmascarados en los mapas más modernos o incluso haber desaparecido de estos.

No hace falta remontarse mucho en el tiempo para encontrar información interesante. Así, por ejemplo, en las primeras series del Mapa Topográfico Nacional, que datan de las décadas iniciales del siglo xx,⁷ se aprecia con gran claridad toda una red de caminos y sendas rurales que ya no aparecen en las últimas ediciones, bien porque han caído en desuso o porque se les han solapado otras infraestructuras como carreteras, pantanos, etc.

7. La fecha exacta de edición varía en función de cada hoja específica. En el caso del SIG de Munigua es de 1908 (hojas nº 942 y 964); 1917 (hoja nº 986); 1918 (hojas nº 919, 920, 940, 941, 962, 963, 984, 985, 1002, 1003 y 1004) y 1922 (hoja nº 921).

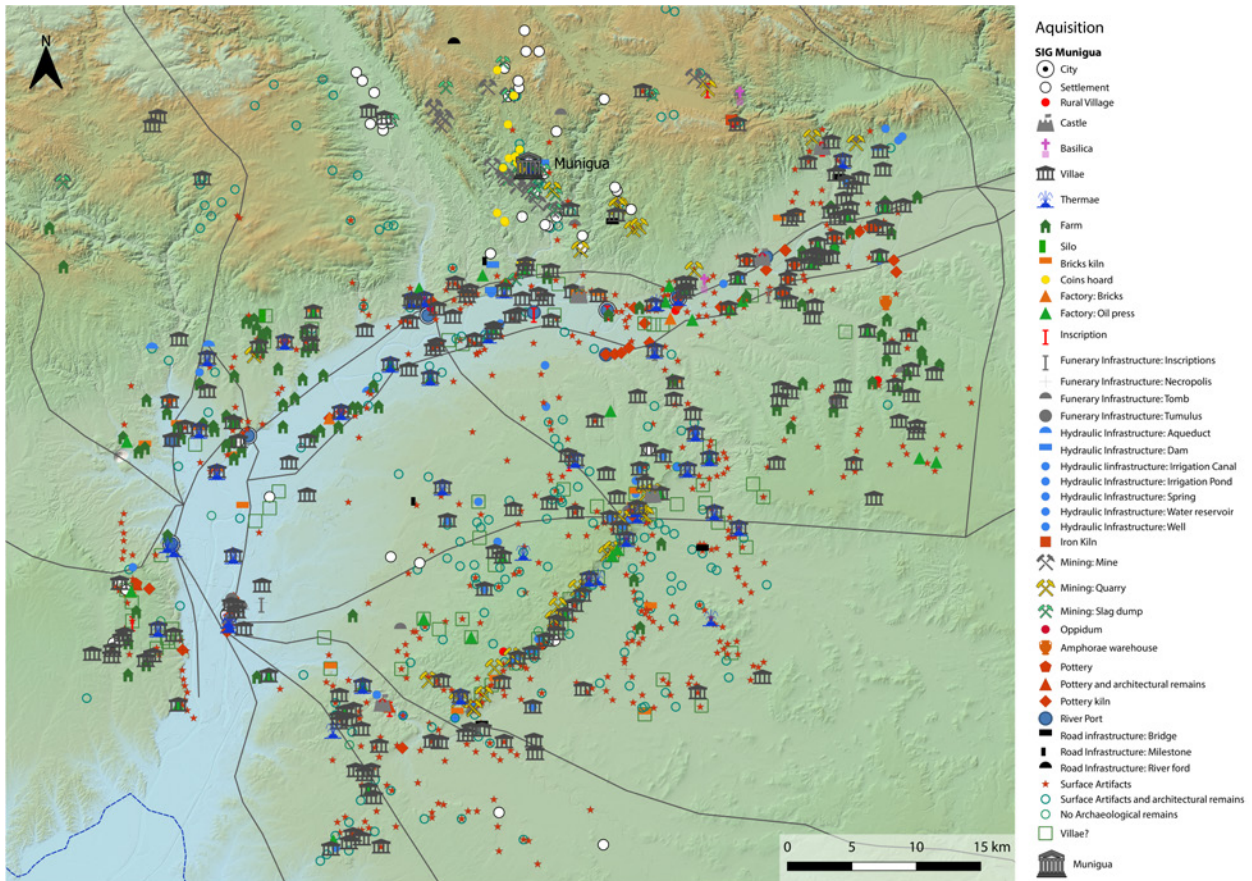


LÁMINA 4. Localizaciones documentadas, proyectadas sobre el mapa con relieve sombreado.

Al proyectar sobre estos mapas nuestra red de yacimientos se puede comprobar como muchos de ellos están en conexión con esta red de caminos, lo que indica que, en muchos casos, estas sendas están fosilizando antiguas veredas, el trazado de alguna de las cuales se remonta a época romana o incluso a momentos anteriores.

Así, cabe destacar que prácticamente todas las villas documentadas están en relación con vías rurales que aún aparecían en la primera edición del mapa topográfico, en la que el trazado de dichos caminos se detecta de una forma más nítida al no estar aún establecida la moderna red de carreteras. Algunas de estas veredas ya aparecen representadas en el citado mapa de Cortés y de las Quentas Zayas, e incluso fueron descritas por Fernando Colón en su *Cosmografía de España*.⁸ Al superponer la localización de los yaci-

8. [...] Caçalla es lugar de mil vecinos e esta en sierra morena e en este lugar ay muy buenos vynos e es aldea de

mientos documentados se puede comprobar como muchos de ellos aparecen jalonando estas vías (Lám. 5).

Por otra parte, al observar el patrón de distribución de yacimientos se comprueba rápidamente como, en el caso de la sierra, una buena parte se alinean con las vías que, en sentido norte/sur,

Sevilla e fasta Sevylla ay doce leguas e van por el pedroso dos leguas e por Cantyllana cinco leguas e por brenes una legua [...] (Colón, 1988, II, 104).

[...] Villanueva del Camyno e fasta tosyna ay una legua Riberas abaxo del Guadalquebyr que queda a la mano dizquierda e antes que llegemos a tosyna con tres tiros de ballesta pasamos a Guadalqeybr por varca que corre a la mano derecha e fasta montorcaz ay una legua llena de cerros e montes baxo e suben un cerro para subyr arriba que terna tres tiros de ballesta e medio camyno pasa a guesma por vado corre a la mano dizquierda.

Villanueva del Camyno e fasta Caçalla ay siete leguas e van por el pedroso cinco leguas de cerros e syerras e valles e alcornocays e xarales en enzinays e a media legua primera pasa a guesma que corre a la mano dizquierda [...] (Colón, 1988, II, 107).

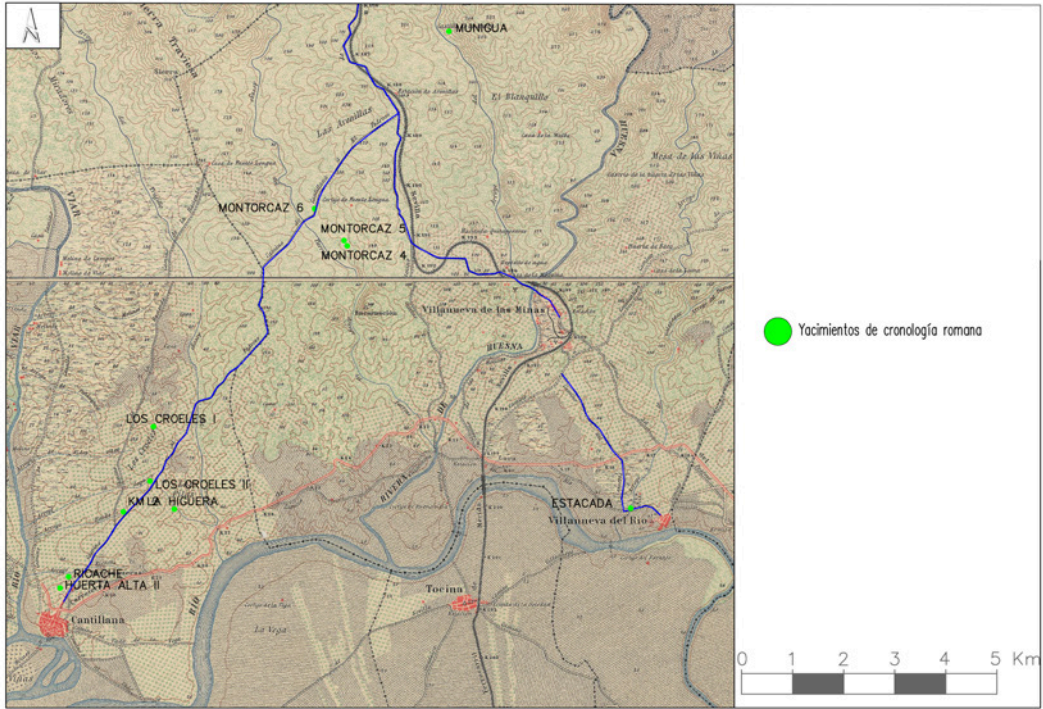


LÁMINA 5. Trazado de las vías documentadas en el plano de S.A. de Cortés y J. de las Quentas Zayas (1757), en relación con la primera edición del M.T.N. y la localización de distintos yacimientos de cronología romana.

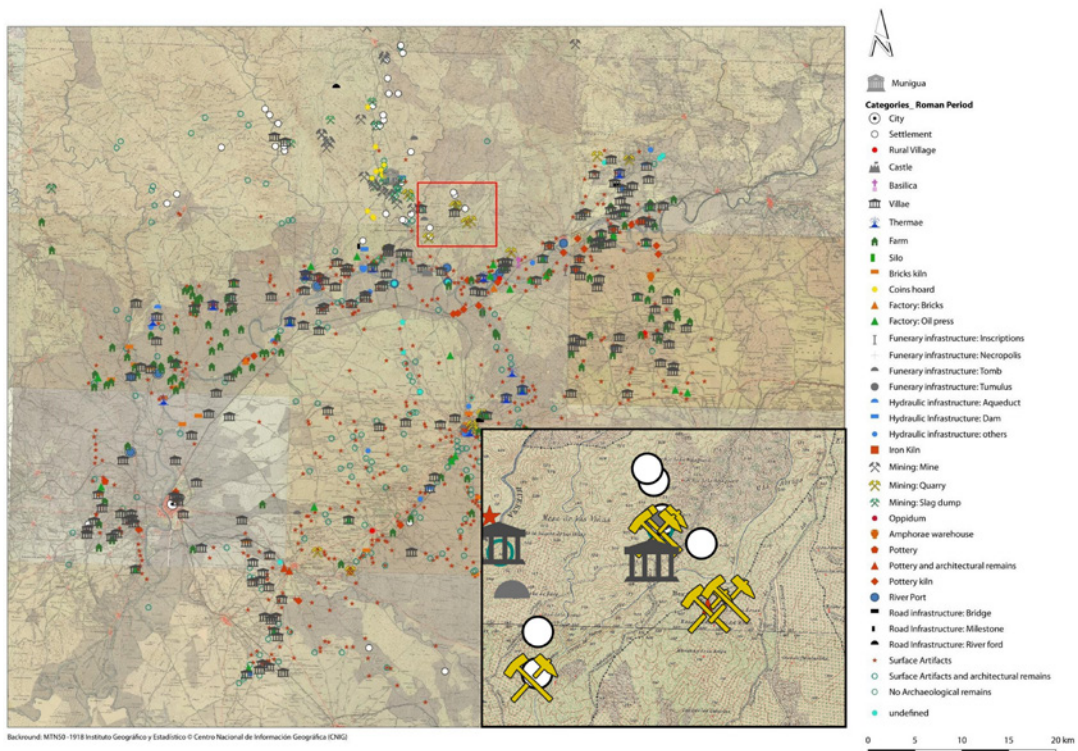


LÁMINA 6. Yacimientos cuya localización coincide con el trazado del antiguo camino de Villanueva del Río a Constantina.

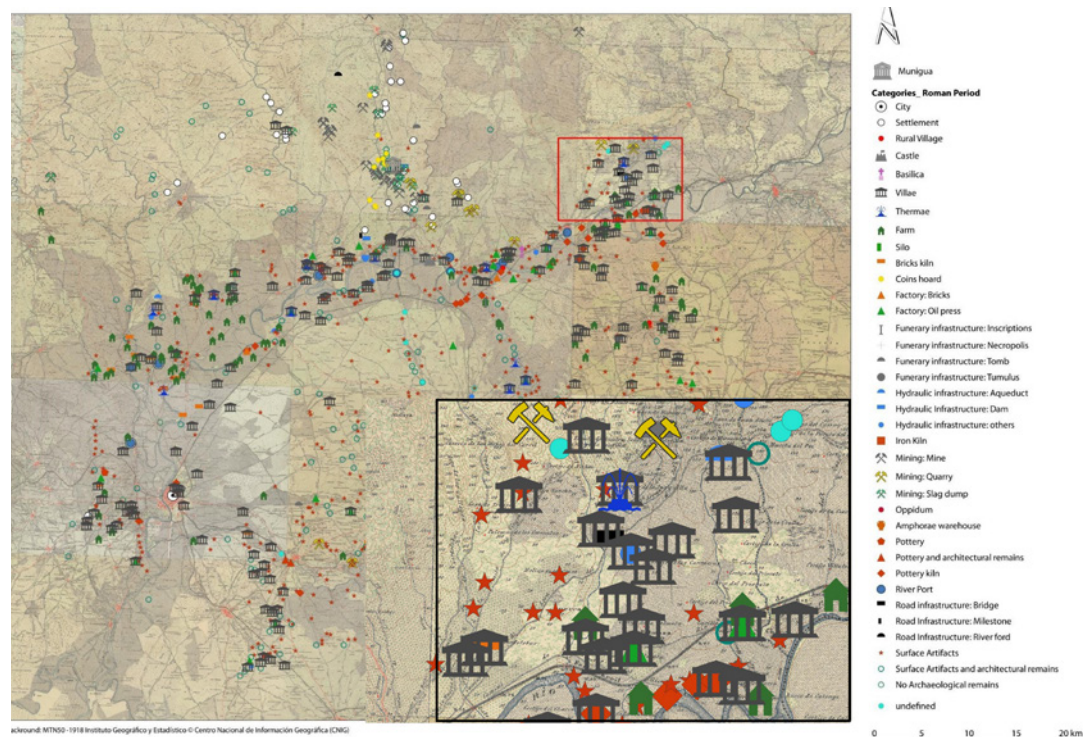


LÁMINA 7. Yacimientos cuya localización coincide con el trazado de los caminos desde Lora del Río al área de Constantina.

comunicaban esta con el fértil Valle del Guadalquivir. Un ejemplo de ello es el camino de Villanueva a Constantina (Lám. 6), que enlaza lo que constituirían dos importantes zonas de producción y distribución de metales desde la prehistoria hasta nuestros días.

En el área de Lora (Lám. 7), los antiguos caminos que, ya desde la Prehistoria, constituían un acceso natural al área minera de Constantina vía Setefilla,⁹ aprovechando en muchas ocasiones los cauces de los torrentes, están también en relación con un gran número de localizaciones.

Por otro lado, buena parte de esta red viaria que sigue un trazado norte/sur, paralelo al de los valles de los ríos Viar y Huesna, puede ponerse en relación con los escoriales y evidencias de minería documentados en el área de explotación de

Munigua (Lám. 8). A partir de esto, es razonable deducir que la cronología de dichos caminos, o al menos su trazado en lo esencial, puede retrotraerse hasta este periodo y de hecho vino en buena medida determinado por la necesidad de adaptarse a la localización de las explotaciones metalíferas. Esta hipótesis se está viendo confirmada por el registro arqueológico, ya que cada vez son más los elementos como vados, puentes o bermas fortificadas con piedras que coinciden con el trayecto de estas vías.

Todo esto, a su vez, ofrece grandes posibilidades a la hora de determinar, por un lado, la interconexión y jerarquización de los distintos yacimientos documentados, y, por otro, la forma en la que produce la inserción de Munigua, entendiendo por Munigua ya no solo el yacimiento en sí sino la ciudad y toda el área integrada en su red, en la organización general del territorio y, finalmente, cómo se relaciona la red de Munigua con la de otros importantes enclaves de la zona, como pudieran ser *Carmo*, *Oducia*, *Ilipa* o la propia *Hispalis*.

9. María Eugenia Aubet cita, por ejemplo, la llamada *Vereda de la Carne* que se dirigiría a NE siguiendo el curso del Arroyo del Pilar, que bordea la Mesa de Setefilla por el oeste, así como otras veredas secundarias que seguirían dirección NO aprovechando otros torrentes (Aubet *et al.*, 1983, 13-14).

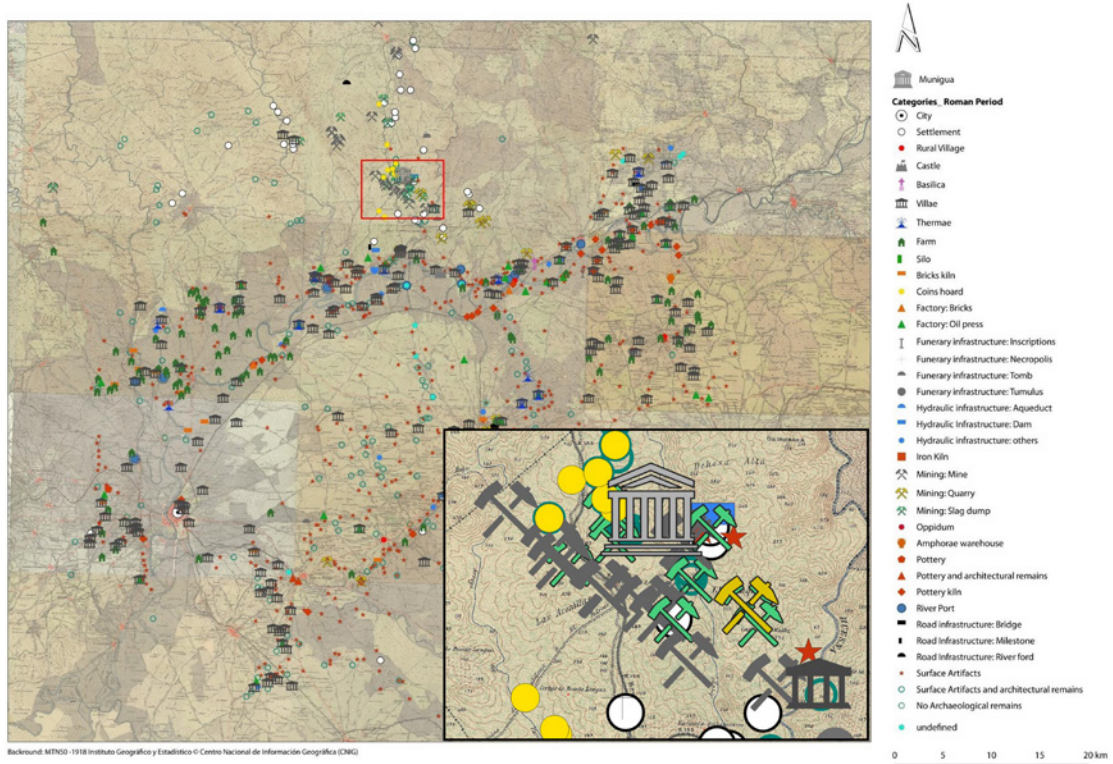


LÁMINA 8. Escoriales y evidencias de minería en relación con los caminos reflejados en la primera edición del M.T.N.

En fin, se trata de una nueva línea que el equipo de Munigua acaba de emprender, que por un lado permite gestionar y dar uso a la gran cantidad de información generada desde la llegada del IAA a Munigua, y por otro lado es coherente con el desarrollo de las investigaciones desde 1956 hasta la actualidad. Esperamos que sea, al menos, tan fructífera como las ya abordadas en estos casi 65 años de historia común.

BIBLIOGRAFÍA

AUBET, M.^a Eugenia *et alii* (1983). *La Mesa de Setefilla, Lora del Río (Sevilla). Campaña de 1979. Excavaciones arqueológicas en España*, 122. Madrid: Ministerio de Cultura, Subdirección General de Arqueología y Etnografía.

CARRIAZO, Juan de la Mata (1979). «El descubrimiento de Munigua y la espiral de oro del cerro de Montorcaz». *Madrid Mitteilungen*, 20, 272-281.

COLÓN, Fernando (1988). *Descripción y Cosmografía de España: Manuscrito de la Biblioteca Colombina. Edición facsímil de la Sociedad Geográfica. Imprenta del patronato de huérfanos de administración militar, Madrid 1910*. Sevilla: Padilla Libros.

CORTÉS, Sebastián Antonio; QUENTAS ZAYAS, José de las (1773). «Noticia de dos inscripciones anecdotas en que se hace memoria de un municipio antiguo llamado Muniguense, descubiertas por D. Sebastián Antonio de Cortes, y D. Joseph de las Quentas Zayas. En la Academia, de 26 de Marzo de 1757». *Memorias literarias de la Real Academia Sevillana de Buenas Letras*, 1, 171-215.

GONZÁLEZ, Tomás (1831). *Noticia histórica documentada de las célebres minas de Guadalcanal, desde su descubrimiento en el año de 1555, hasta que dejaron de labrarse por cuenta de la Real Hacienda*. Madrid: Miguel de Burgos.

- SCHATTNER, Thomas G. (e.p.). «Zum Bau- und Wirtschaftsboom während der Kaiserzeit im *Municipium Flavium Muniguense* – Munigua». En: LEHMANN, Janine; SCHEDING, Paul (eds.). *Explaining the Urban Boom. A Comparison of Regional City Development in the Roman Provinces of North Africa and the Iberian Peninsula*, 290-324.
- SCHATTNER, Thomas G. (2009). «Theodor Hauschild en Munigua». *Butlletí Arqueològic*, 31, 25-48.
- SCHATTNER, Thomas G. *et alii* (2003). «Munigua 2001. (Villanueva del Río y Minas, Sevilla)». *Anuario de Arqueología de Andalucía* 2000, II, 76-84.
- SCHATTNER, Thomas G. *et alii* (2004). «Munigua 2001. (Villanueva del Río y Minas, Sevilla)». *Anuario de Arqueología de Andalucía* 2001, II, 60-64.
- SCHATTNER, Thomas G. *et alii* (2005a). «Súncinto informe de las investigaciones arqueológicas en Munigua, 2002». *Anuario de Arqueología de Andalucía* 2002, II, 93-103.
- SCHATTNER, Thomas G. *et alii* (2005b). «Avances sobre la producción metalúrgica en Munigua». *Habis*, 36, 253-276.
- SCHATTNER, Thomas G. *et alii* (2006). «Súncinto informe de las investigaciones arqueológicas en Munigua». *Anuario de Arqueología de Andalucía* 2003, II, 66-77.
- SCHATTNER, Thomas G. *et alii* (2009). «Súncinto informe de las investigaciones arqueológicas en Munigua, 2004». *Anuario de Arqueología de Andalucía* 2004 (I), Sevilla, 3733-3750.
- SCHATTNER, Thomas G. *et alii* (2012). «Minería y metalurgia antiguas en Munigua. Estado de la cuestión». En: OREJAS, Almudena; RICO, Christian (eds.). *Minería y metalurgia antiguas. Visiones y revisiones. Homenaje a Claude Domergue*. Madrid: Casa de Velázquez, 151-168.
- SCHATTNER, Thomas G. *et alii* (e.p.). «Die Wirtschaftsgrundlagen der Stadt». En: *Mulva VII, Madrider Beiträge*.

Peltuinum. City and landscape between tradition and new techniques

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ABSTRACT

Peltuinum was a Roman city located in central Italy, approximately in the middle of a wide valley defined by the highest mountains of the Apennines. The first investigations of Sapienza University took place in the years 1983-85, subsequently a new series of excavations started in 2000 and, since 2001, excavations have been carried out annually. The archaeological area is known above all for its monumental remains. In addition to public buildings, past archaeological investigations have revealed various residential structures. Within the broader archaeological project, a three-year research project (2016-2019) was carried out in order to collect aerial photogrammetric data regarding the walled city and the very first suburban area. The goal of this activity was to pinpoint new anomalies from aerial photography, exploiting the low-cost digital technologies available and creating a three-dimensional hub capable of collecting and linking traditional archaeological documentation to 3D geometry. Observing the landscape from a privileged point of view such as an aerial perspective, and virtually modelling the archaeological structures excavated during the different annual excavation campaigns, gave us the chance to more accurately identify potential buried buildings, necropolises and evidence relating to the city's road system.

KEYWORDS: Landscape archaeology, aerial photo interpretation, digital archaeological data management, archival research, Roman urbanism, *Peltuinum*.

1. THE ROMAN CITY OF *PELTUINUM*

The ancient city of *Peltuinum* is located in central Italy, in the Abruzzo region (in the province of L'Aquila) on a plateau surrounded by the highest mountains of the Apennines: the Gran Sasso, the Maiella and the Sirente (Fig. 1)³. The area of the ancient city is now included in two municipalities (Prata d'Ansidonia and San Pio delle Camere), divided between the two administrative areas by the "Tratturo". The plateau emerges within a valley once occupied by

a lake, which then naturally dried up (Migliorati 2014, 249; Migliorati 2008, 341). It was located in the ancient territory of the Vestini⁴ and, already in pre-Roman times, was a strategic stopping point during the herding of livestock from central Italy (*Sabina*) to northern Puglia (*Apulia*)⁵. In the middle of the 1st century BC, *Peltuinum* was planned and founded in this location in order to manage and control such transhumance and therefore also the resulting economic income.

4. An Italic people who occupied the area of the modern Abruzzo region, between the Gran Sasso and the northern bank of the Aterno River.

5. Occupation by the Vestini is attested by a large necropolis, located outside the north-west sector of the walls of the ancient centre, providing a chronological arc from the 7th century BC to the 1st century AD (D'Ercole-Martellone 2014; Acconcia *et al.* 2011). For an in-depth analysis on the pre-Roman phase of the area, see Migliorati, 2008.

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3. Regarding the geomorphological context on which the Roman city was founded and the relationship between morphological system and architecture, see Migliorati, 2014; Migliorati-Canino, 2014.

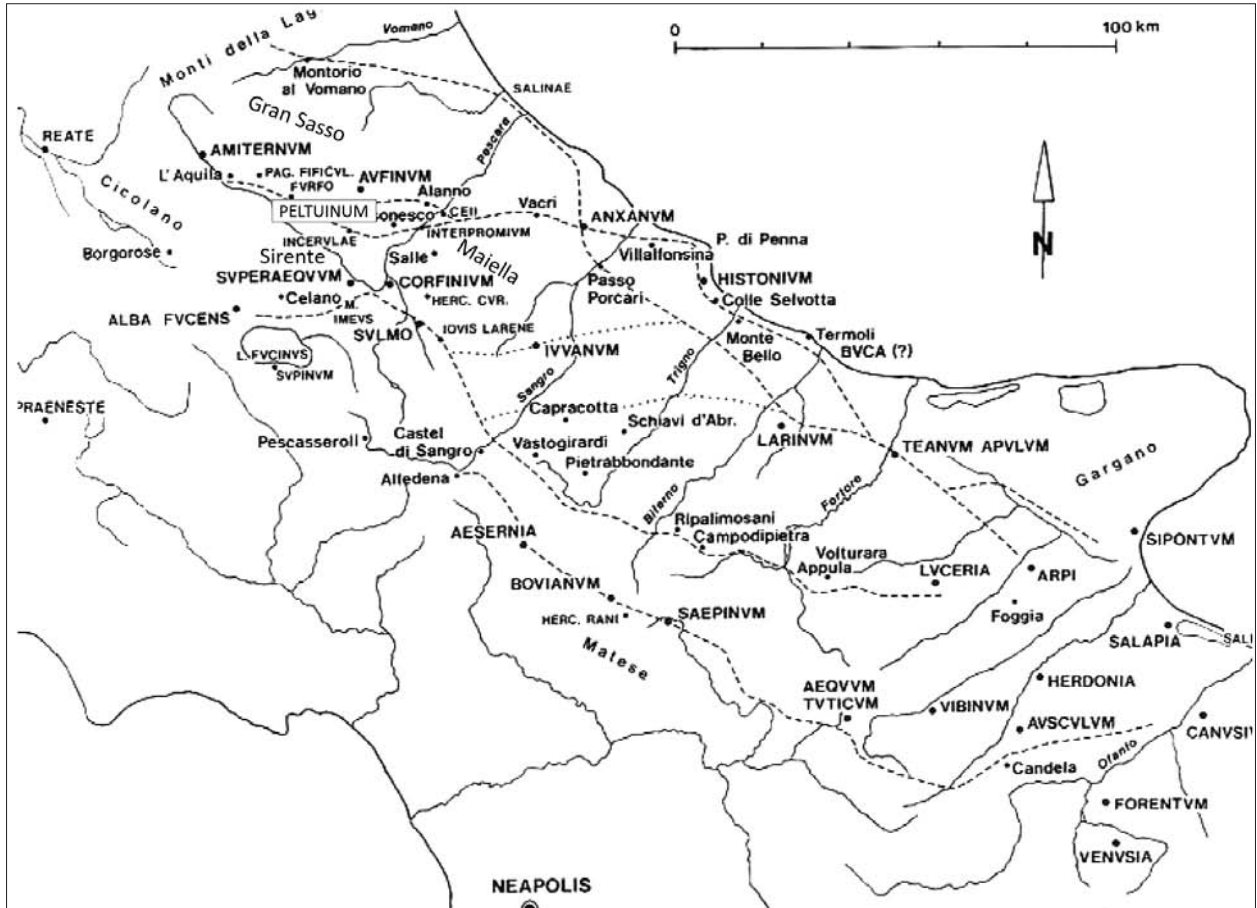


FIGURE 1. Location of the Roman city of *Peltuinum* in its regional context, with an indication of the main sheep tracks in Apennine Italy (image modified by author from original in van Wouterghem 1999).

In the age of Augustus, the city was an object of interest for the *Princeps* and was later involved in the works conducted by Claudius (41-54 AD) in the Fucino area (Migliorati, 2007). Stratigraphic excavations and structural analysis show that, despite various earthquakes affecting the area, *Peltuinum* survived until at least the 5th century AD, when it was finally destroyed and abandoned because of a more violent earthquake (Migliorati 2014, 256-257; Migliorati 2011-2012)⁶. Afterwards, the city system turned into small scattered settlements, although the west gate continued to be used as a checkpoint for the passage of livestock along the “Tratturo Magno”.

6. A catastrophic event that was so violent it also had disastrous consequences in Rome.

Today, the archaeological area is mainly known for its monumental remains (Fig. 2): the city walls (Migliorati-Casazza-Sgrulloni, 2018; Migliorati 2014, 252), theatre and sacred complex, whose dedication is still uncertain (Migliorati, 2014, 2008; Bianchi, 2012; Sommella, 1995). The position of these structures is due both to the original morphological structure of the area and to the presence of pre-Roman cultic elements, which probably influenced the choice of the location to erect the main temple of the city (Migliorati, 2008).

Archaeological research in *Peltuinum* began in 1983, thanks to an agreement between Sapienza University and the Archaeological Superintendence of Abruzzo, with the collaboration of the “Comunità Montana Gran Sasso-Monti della Laga” and local authorities. During the excavations carried out in the 1980s,

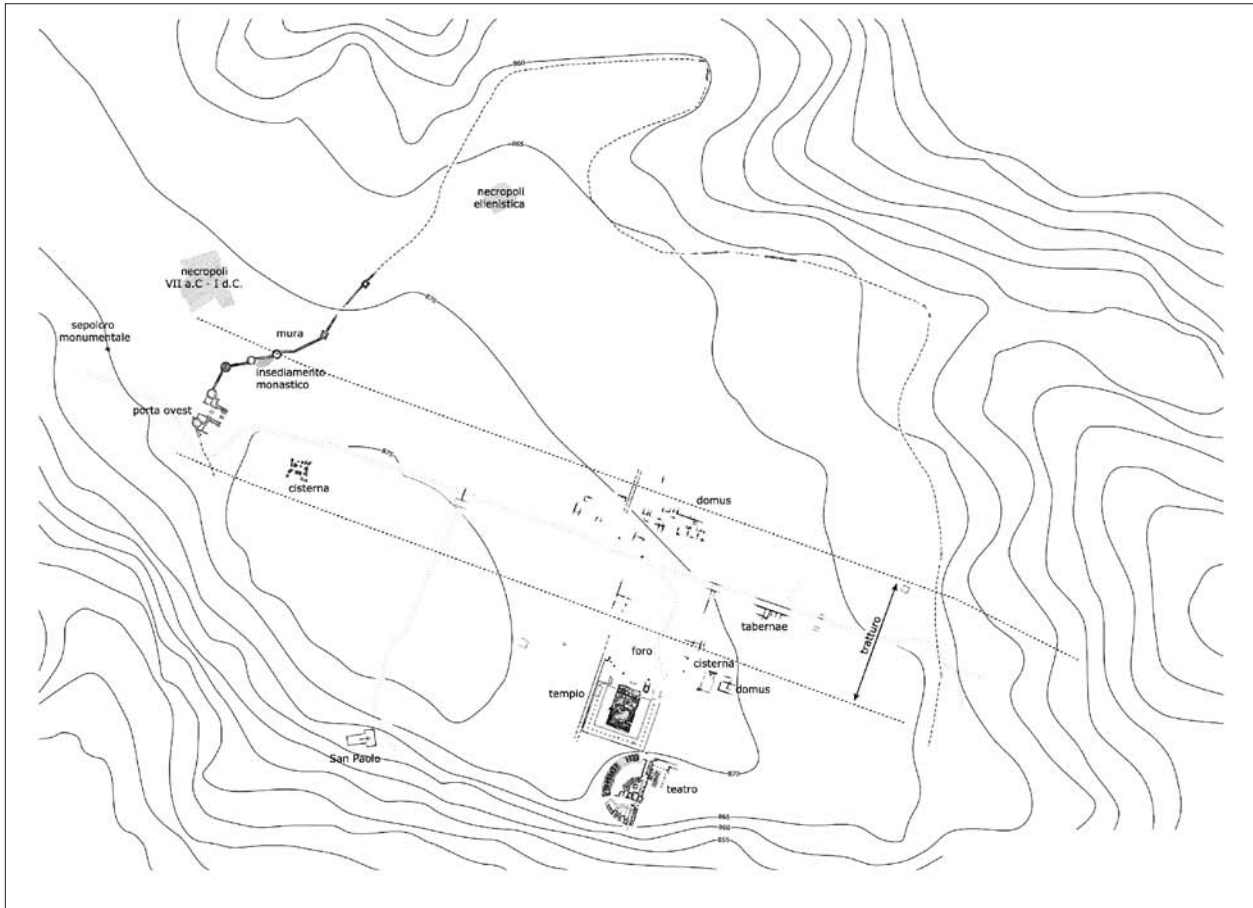


FIGURE 2. *Pelutium*: Location of archaeological presences on an orographic basis (Sapienza - Department of Ancient World Studies - *Pelutium* research area).

important remains were brought to light, such as a section of the western walls with one of the urban gates, the temple of the forum, a part of the theatre and some remains of houses. Between 1986 and 1996, the Archaeological Superintendence expanded the excavation areas and carried out consolidation work. In 2000, research resumed by Sapienza (the URBANITAS project of the EU) and, since 2001, excavation has continued annually under the direction of Luisa Migliorati.

Since the 2000s, investigations have concentrated mainly on the public area of the city and its buildings, the theatre and sacred complex, built around the second half of the 1st century BC in the central-southern area of the plateau. However, surveys have also been conducted in many other different areas of the plateau in order to answer specific questions

regarding the urban planning of the ancient city and its different phases.

In particular, the theatre has been completely uncovered and all the phases of use have been defined: from the 1st century BC to the 5th century AD (Migliorati *et al.*, 2017; Nepi, 2014; Nepi, 2012). After a disastrous earthquake that caused the buildings to collapse in the 5th century, a long period began in which building materials were recovered from the area. Between the 9th and 11th centuries, when the buildings had already been abandoned and largely destroyed, a fortified watchtower was built on the southern half of the theatre, with the function of controlling the valley south of the plateau. This fortification was part of a system that included several other similar structures, placed on the various hills overlooking the valley (Migliorati 2014, 260). This system of

fortifications guaranteed control of the valley floor and the possibility of communication between the various structures, even over long distances.

In later times, a small settlement developed in front of the fortress, separated from it by a road. This was related to the work being carried out to recover and rework the construction materials taken from the ruins of the theatre and the nearby temple. A series of monocellular buildings were used as a place for processing the recovered materials and at the same time also as a shelter for the workers themselves. This small nucleus of buildings consisted of different rooms overlooking a road that led directly to the church of San Paolo⁷. In fact, the building materials were recovered and adapted to be reused as new building material, not only for the construction of the church of San Paolo but also for other buildings of Christian worship and for the numerous villages built near the destroyed Roman city (Migliorati, 2014, 257-260)⁸. On the plateau itself, a monastic complex was built by using the north-west walls as a support, taking building materials from the urban area, already largely abandoned at that time. The complex has been recognised as a convent dedicated to Santa Maria Sidonia and dates back to the 7th century.

The terrace of the forum was in close connection with the theatre. The orographic terrace, at the end of which was set the sacred complex made up of the temple and the porticus, did not have suitable geological stability due to the alternation of inhomogeneous layers⁹. The conscious choice to use a non-homogeneous construction surface involved preventive ground

levelling works for the forum terrace. Moreover, it also determined the decision to position the lower part of the theatre in such a way that it could function as a buttress to counter the thrust of the upper terrace, already occupied by the imposing architecture of the temple-porticus complex.

1.1 *Peltuinum*: between archive research and new archaeological discoveries

Since 2015, research has also been carried out every year in the forum area. Compared to the theatre area, the terrace of the forum had already been more thoroughly investigated in previous excavation campaigns carried out in the 1980s and 1990s. For example, the sacred temple-*porticus* complex had already been completely excavated and musealised. Nevertheless, the scientific documentation relating to these past investigations is somewhat superficial and incomplete. There is a large number of photographs (mainly black and white) from the excavations in the 1980s. However, the written and graphic documentation is not as extensive, this being rather heterogeneous and non-standardised.

For the excavations of the 1990s the situation is worse. The scientific documentation is not kept in the archive (except for some sporadic and brief reports) and the main reference for the data relating to the excavations carried out during those years is merely a monograph published in 1996 (Campanelli, 1996).

In recent years, archive documentation has been the subject of study and revision, with the aim of acquiring new data from the limited documents available. For example, among the documentation relating to the first series of excavation campaigns in the 1980s, there is only a single archaeological map defining the positioning of the excavation trenches (Fig. 3). In this document, the trenches have all been indicated on the map but not in a specific, measured way. However, it is possible to compensate for this deficiency thanks to the contribution of the new data collected annually in each excavation campaign, through the surveys that take place in the various areas of the ancient city. Furthermore, new surveys are always complemented by new

7. Some architectural and epigraphic elements present in the church of San Paolo testify to a foundation phase prior to the year 1000. The construction, therefore, may have exploited the further ruin of the Roman public structures following the earthquake of 29 April 801 (Migliorati 2014, 258-259).

8. An analysis of the materials found to date leads to a chronology of use ranging from the 12th/13th century to the 17th. For a detailed analysis and chronological classification of the materials found in one of the rooms completely brought to light (room ε), see Sgrulloni, 2015.

9. The plateau is characterised by a structure made up of different geological layers of variable thickness. Layers of silt alternate with layers of more or less cemented gravel, with rare thin layers of sandstone and the presence of limestone in the northern sector of the plateau.

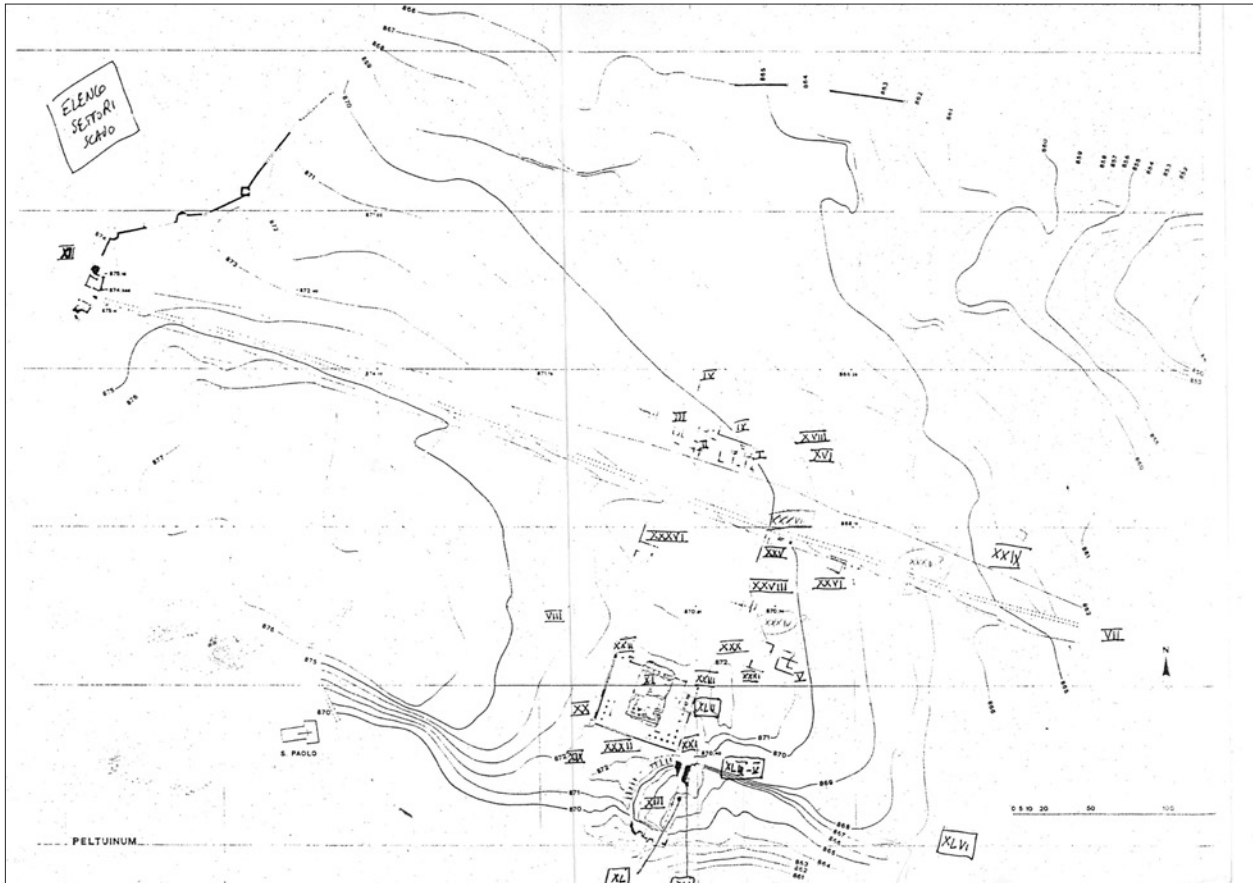


FIGURE 3. Archaeological map of *Pelutium* that defines the positioning of the trenches made during the excavations of the 1980s, with subsequent additions in pencil (Sapienza - Department of Ancient World Studies - *Pelutium* research area).

survey techniques (such as the use of aerial photography). In this way, by integrating the various types of data, it is possible to recover old information and plan future investigations.

An interesting example of fruitful integration between old and new data took place following the 2015 excavation campaign, when a fragment of a particular artifact (Fig. 4) was found in the forum area, in trench 79 (Fig. 5, C) (Migliorati-Canino, 2016). Thanks to the examination of the photographic archive documentation, it is known that a similar artifact had already been found in 1983 and the place of its discovery was indicated on the map as trench VIII (Fig. 5, A). In the excavation journal there is only a brief description accompanying two photographs, which show an artifact preserved in its entirety (Fig. 6).



FIGURE 4. *Pelutium*: Fragment of an architectural artifact, found during the 2015 excavation campaign in Trench 79, within the *forum* area (photo by D. Canino).

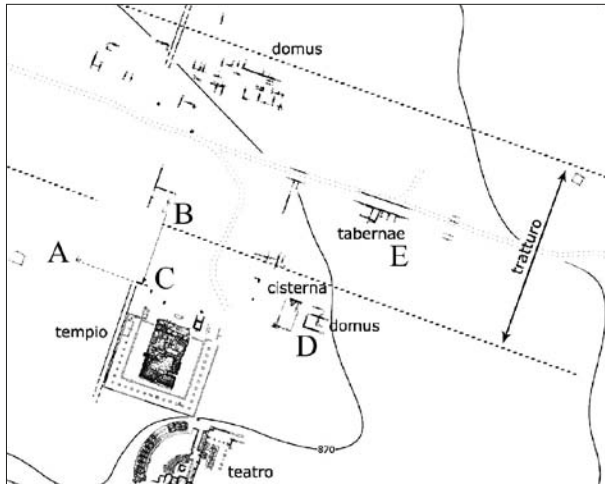


FIGURE 5. *Peltuinum*: Location of the trenches carried out during the excavation campaigns of the 1980s on an orographic basis. A: Trench VIII; B: Trench XXXVI; C: area of the Trench 79, opened in the 2015 excavation campaign; D: Trench V; E: Trench XXVI (Sapienza - Department of Ancient World Studies - *Peltuinum* research area).

Unfortunately, no clear indications are provided to identify the exact positioning of trench VIII and the artifact. However, it was possible to observe that the places where the two artifacts were found seem to be aligned with each other and are located close to the same road¹⁰. Furthermore, the distance between the artifact found in trench VIII (Fig. 5, A) and that in trench 79 (Fig. 5, C) is equal to the distance between the latter and another quadrangular structure, found further north in the 1980s. This last small quadrangular structure is depicted on the map and the area is identified as trench XXXVI (Fig. 5, B). Looking at the map, these three points define two segments in relation to each other at an angle that appears to correspond to a right angle. Also in this case, the structure is close to a road but, unfortunately, there is no description in the documentation of the 1980s so, at the moment, the real identity of this structure is not known, nor is it possible to clarify whether this may have been in connection with the other two artifacts.

10. This road is visible from the aerial photographs and has been partially documented archaeologically in the past excavation campaigns.

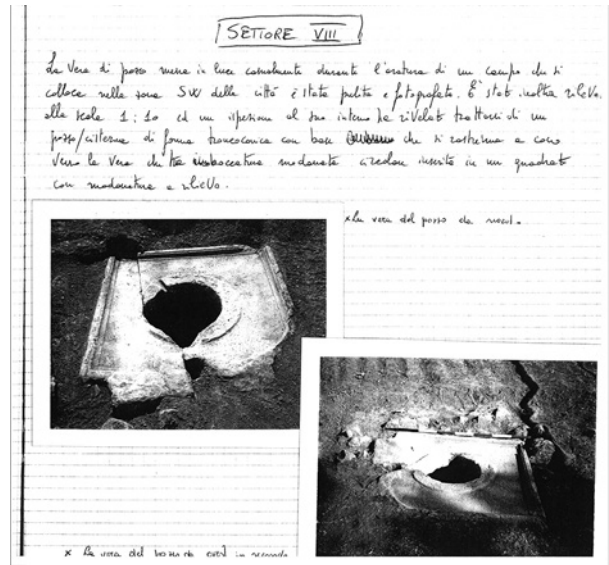


FIGURE 6. Excavation journal on 23 September 1983, Trench VIII, page 48 (Sapienza - Department of Ancient World Studies - *Peltuinum* research area).

The artifact found in 2015 has clear processing marks with a point chisel both inside the central cavity and on the lower face, while laterally the processing is with a tooth chisel, used to remove the protuberances left by the point chisel in order to achieve a finer finish. This suggests that the block was embedded within a floor and may have acted as a closure of a well (Migliorati-Canino, 2016, 61-62)¹¹. Regardless of the real nature of the structures found in trench XXXVI, the two artifacts found in trench VIII in 1983 and trench 79 in 2015 are certainly connected with water, either its disposal or its supply (as the consistent traces of limestone deposits on the lower face of the block found in 2015 seem to imply). Given our present state of knowledge, it is not

11. The two artifacts found in *Peltuinum* are very similar to another one from a production settlement located outside the walls of the Roman *Mutina*. The artifact is defined as well-equipped with a pourer, which connected it to a small rectangular basin. It came to light a few years ago, during excavations for an underground car park, and is now visible inside the Novi Sad Archaeological Park. It was placed on an alluvial deposit of modest thickness, dated between the 2nd and 3rd centuries AD, and it seems to have been used until Late Antiquity as it was sealed by a second alluvial layer dated to the 5th-6th century AD (Labate *et al.*, 2009, 435-436).

possible to determine whether such hydraulic structures were related to a private or public use or even less if their position is due to a cadenced distribution at fixed distances. In any case, these observations, which are the result of the integration between new excavation data, analysis of the old archive documentation and aerial photography, constitute an interesting starting point for planning future investigations, in particular with regard to the city's urban supply and disposal systems.

1.2 Reconstructing the characteristics of the ancient city with the contribution of old archive data

As regards the methods of water supply, the investigations carried out at *Peltuinum* during past excavation campaigns have already provided a range of other data. First of all, we should note that the availability of water has certainly influenced the dynamics of the plateau's population since the 8th century BC. In fact, the outcrop of an aquifer probably already attracted people to the site in pre-Roman times, even though the valley floor contains numerous springs which could also have been useful for reasons related to agricultural exploitation, as well as for the herds of livestock passing through.

At a lower scale factor, the presence of water has also influenced some important architectural decisions, such as the choice of the site to construct the most important building for urban worship: the temple of the forum. In fact, this choice seems to have been conditioned by the desire to confirm the sacredness of the area, linked to an outcrop point of the aquifer. This hypothesis seems to be confirmed by the exact correspondence between the outcrop point of the aquifer and the median point of the rear of the temple, the one corresponding to the position of its religious statue.

Today it is an unequivocal fact that the Roman city was certainly served, at least in part, by a water distribution system. This arrangement has been attested, for example, in trench XXVI (Fig. 5, E), which was investigated in the 1985 excavation campaign. The trench was opened south of the *Via Claudia Nova*, near the southern

limit of the sheep track. Here were found the remains of some structures interpreted as *tabernae* (Fig. 7). In particular, a section of a wall was uncovered that had been made partly with blocks and partly in *opus reticulatum*. Between the two sections of the wall was a threshold of white limestone, with sliding grooves for a double closing door. To the north of the threshold (and aligned with it), a walkway was unearthed, forming the southern limit of the *Via Claudia Nova*. At this point, above the surface of the road, a section of lead *fistula aquaria* was found. Other traces of water pipes, both lead *fistulae* and fictile tubules, have been found at various points of the urban system, for example, near the cisterns¹².

The water supply of the Roman city was also guaranteed by cisterns. Small cisterns were already in use in pre-Roman times but in Roman times two larger cisterns were also built, one near the west gate and one in the forum area. Near the west gate there is a first cistern (approx. 16 × 14 m), positioned in a small depression in the highest part of the plateau. Given this structure's location near the west gate, we can also assume it was connected to a trough, used to refresh transhumant herds. Similarly, the cistern near the forum has been excavated entirely; it is larger than the previous one (approx. 20 × 16 m) and the filling system seems to be more varied, including the preservation of snow melt (Migliorati-Canino, 2014, 132).

However, there are also data regarding the existence of an aqueduct, the *Aqua Augusta*, that might have reached *Peltuinum*, going from the hill to the north of the city and crossing the intermediate valley over arches, the memory of which still remains in the toponym Vodarce¹³. From two inscriptions, we know that the aqueduct was built in the age of Tiberius and was

12. For example, a small cistern that was connected to the aforementioned point of the aquifer's outcrop dates from a period before the forum temple was built. The excavation of this cistern, carried out in the 2005 campaign, also identified a part of the adductor *fistula*, which was made with terracotta tubules inserted into each other (Migliorati 2008, 344-345).

13. This toponym is present on the IGM maps but is also still found on the current cadastral map of Prata d'Ansidonia in the variant Valle Vadarzia (Migliorati-Canino 2014, 131).

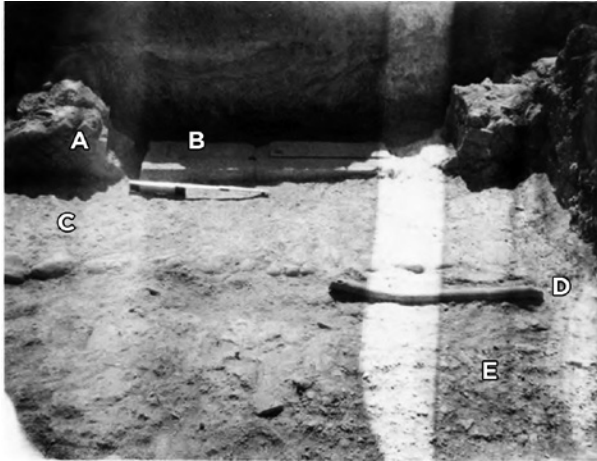


FIGURE 7. *Peltuinum*: Trench XXVI opened in 1985 south of the *Via Claudia Nova*, near the southern limit of the sheep track. A: section of the wall in *opus reticulatum*; B: threshold of white limestone; C: pavement; D: section of lead *fistula aquaria*; E: *Via Claudia Nova* (Sapienza - Department of Ancient World Studies - *Peltuinum* research area).



FIGURE 8. *Peltuinum*: Trench V (1983). Image of the *domus* south of *Via Claudia Nova* being excavated (Sapienza - Department of Ancient World Studies - *Peltuinum* research area).

renovated in 78 AD. The first inscription (*CIL*, IX 4209 = D 163) reveals that, between 23 and 37 AD, two *ediles quinquennalis*, Paolo and Floro, members of the Salviens family, brought the *Aqua Augusta* to *Peltuinum* (Migliorati-Canino, 2014, 130-131)¹⁴. The second one reveals that Sesto Vitulasio, *consul suffectus* in 78 AD, carried out *sua pecunia* an extension of the aqueduct¹⁵.

The Roman city was also served by a sewer system, although its real extent is not known. This certainly served the central urban area, as evidenced by the sewer found under the floor of a rich *domus* from the Augustan age, located near the forum area (Fig. 8). Furthermore, the excavation of the theatre unearthed evidence of its water collection system, channelled south from the orchestra through a canal that ran below the southern *aditus*.

14. *Aquam Augus[tam] / in honorem [Ti. Cae]sar[is] Augusti n[epo]l[um]q[ue] eius Pelt[ui]n[ates]] / adduxer[unt] pr[ot]o ae[tern]itate] / Caesarum; / Salviens Paul[us] et] / Florus / aed[iles] q[ui]n[qu]ennales] ded[er]unt] / (Buonocore, 2011, 326-327; Buonocore, 2007, 147-149; Buonocore-Firpo, 1998, 882).*

15. *Sex. Vitulasio L. f. / Q[ui] Nepos cos. / aq[ua]m Aug[ustam] adiect[am] / f[on]t[ibus] novis sua pec[un]ia] / pe[r]duxit et arcus / [n]ovos f[ec]it. / (Buonocore, 2007, 149-150; Buonocore-Firpo, 1998, 885).*

Perhaps following one of the earthquakes that hit the city, probably the one in the 5th century AD, the aqueduct was no longer functioning. However, the area was never totally abandoned and the people who remained living on the plateau, exploited for purely pre-agricultural purposes, were forced to use wells again, both for water supply and for disposal. Today, excavations indicate that this was the case. For example, in the excavation campaign of 2020, two adjacent wells were found (Fig. 9), one of which was certainly used, since the wall of the well was marked, for its entire height (up to the point where it was investigated), by two mirror rows of footholds, while the second one was perhaps never completed. Initial observations suggest a difference in the chronology of the materials that were used to fill in the two wells. However, only a study of the materials, currently underway, will confirm or reject this hypothesis.

The analysis of the old archive documentation was also of fundamental importance with regard to another research topic, that of residential buildings, whose investigation has been resumed in the course of the latest excavation campaigns. In the 1980s, in fact, several *domus* were excavated along the *Via Claudia Nova*. Following the



FIGURE 9. *Peltuinum*: Trench 90, sector B. The two adjacent wells found during the 2020 excavation campaign: the well on the left seems never to have been used or completed, while the one on the right retained two mirror rows of footholds, to allow descent/ascent inside (orthophoto by A. Vecchione).

analysis of the archival documentation, it was possible to place each structure already found in the past in its exact position, thanks also to a comparison with the anomalies visible on the ground, through the observation of aerial photos and satellite images.

On this basis, it was possible to direct the new investigations that led to the discovery of new housing structures. As well as the houses identified during the 1980s, the new buildings discovered along the *Via Claudia Nova* also retained traces of the walls. The construction techniques used for the walls are various. In fact, walls have been found with curtains curtains in *opus reticulatum* or *opus incertum* and even walls made of beaten clay covered with plaster and built upon a stone foundation.

The floors consisted of beaten surfaces or mosaics, neither type being associated with a specific type of walling (Migliorati-Canino, 2016, 53-55). The residential buildings with preserved mosaic flooring have revealed motifs widely used during the 1st century BC and the 1st century AD, both in the region and in the rest of Italy (Canino-Migliorati-Trivelloni, 2021). Instead, the lower-ranking structures presented simpler clay floors, which were certainly more functional, for uses other than residential ones.

Of particular interest is the above-mentioned *domus* from the Augustan age, located south from *Via Claudia Nova*, near the

forum area (trench V, Fig. 5, D; Fig. 8). During the excavations of the 1980s, three rooms with mosaic floors were brought to light. The discovery of a silver *denarius* from 29-27 BC (Campanelli, 1996, 66, no. 7) in the preparation of the mosaic of one of the rooms made it possible to establish the exact date of the first phase of the flooring¹⁶. Later, a repaving took place in the middle of the 1st century AD, as evidenced by a bronze *quadrans* from the Caligula era (Campanelli, 1996, 66, no. 6), found inside the screed¹⁷.

Although the owners of this house are not known, they must certainly have been wealthy members of the local community. In addition to the mosaic decorations, excavation diaries from the 1980s show that numerous fragments of coloured plaster and moulded white stucco have been found, revealing a certain richness of this residence. Moreover, the same position of the *domus*, which gravitates in the immediate

16. The obverse of the coin represents the head of Octavian, devoid of ornaments, looking to the left; on the back there is a military trophy placed on the bow of a ship and in the field the words IMP CAESAR.

17. The bronze *quadrans* dates back to the years 40-41 AD. On the obverse of the coin there is a *pileus* between the letters S and C and the words (C CAESAR DI) VI AUG PRON (AUG); on the back appears the inscription RCC - PON M TR IIII (PP COST T)ERT (*Pontifex Maximus, Tribunicia Potestate Quarta, Pater Patriae, Consul Tertius*). The acronym RCC means “*Remissa ducentesima*” and recalls the abolition of a tax.

vicinity of the *forum* area, together with the size of its rooms, helps to qualify it as a residence of undoubted prestige.

D.C.

2. DIGITAL SURVEY TECHNIQUES APPLIED TO *PELTUINUM* ARCHAEOLOGICAL PROJECT

The use of digital technologies in archaeology usually consists of an extensive phase of data collection in the field, which generates an enormous amount of digital data. The production of digital models is often followed by a demanding data management phase, including activities related to conservation, indexing and sharing data with institutions and colleagues. Over a five-year period (2015-2020) on *Peltuinum* archaeological site it was possible to collect a heterogeneous set of data, quantifiable in about half a terabyte; the dataset is composed of RGB images, multispectral aerial images, orthophoto maps, DSM, DTM, and CAD elaborations. The data collected represent a great resource both for the analyses strictly related to the archaeological campaign documentation, the aerial photo-interpretation study of the images and for reuse in landscape monitoring contexts; however, the limited manageability of these data has led to the designing of a digital archive that exploits 3D data as a digital access point.

The tools used to produce the graphic documentation included a Canon Eos M3 camera, equipped with a 15-45mm lens, a Canon Eos 500D with a 18-55mm lens and a telescopic pole of 3-10 metres; through this last support it was possible to integrate the images collected from the ground and extend the coverage of the photogrammetric models, with the aim of obtaining complete orthophoto planes of the areas excavated and those in progress. The topographic instrumentation used to scale, orient and geo-reference the three-dimensional models included a Leica TS06 total station and an Emlid multi-frequency RTK GNSS receiver; the images were captured at an altitude between 20 and 70 metres above ground level with a DJI Drone Phantom 3 Adv equipped with a Sony EXMOR 1 / 2.3 “ 12 MP / 2.7K CMOS camera.

2.1 Remote sensing campaigns 2015-18: the in-wall city and the *plateau* area

Between 2015 and 2018 a research project based on archaeological aerial and remote sensing survey campaigns was carried out. The main purpose of this project was to map the entire *plateau* of the ancient Roman city and identify cropmarks and possible archaeological features connected to ancient structures or buildings. This research was meant to confirm and update the aerial photo-interpretation studies conducted during the second half of the 20th century regarding the Roman city area (Adamesteanu 1963; La Regina 1964; Tartara 2008). These studies gathered information through the analysis of aerial photos taken by the surveyors of the Allied forces during WW2, currently preserved in the photographic archive of the Aerofototeca Nazionale – ICCD in Rome.

The new data were collected using a drone equipped with RGB and hyperspectral cameras, therefore without the use of active sensors such as Lidar. The raw data were processed in a standard photogrammetric workflow: data recording campaign, pictures alignment, point cloud to mesh producing, 3D models and orthomosaic output. Starting from 2015 a series of scheduled drone flights was carried out, covering the entire area of the ancient city. The approximately 30 missions were carried out over years between the months of April and November only, due to the climate conditions of this area; the missions were repeated over different seasons in order to obtain the best visibility of the cropmarks based on the crop cycle. The flights were carried out at three different altitudes between 20 and 80 metres above ground level; this decision was taken in order to have a wider perspective of the site and higher resolution orthophotos of the single sectors of the *plateau*. In areas not covered by woods or intensive cultivation, micro-relief analysis could be carried out using processed data such as DEM and DSM. The processed data and the cropmarks map were overlapped on the most recent archaeological map available and allowed the research team to reflect on some aspects of the urban layout of the ancient city (Fig. 10).

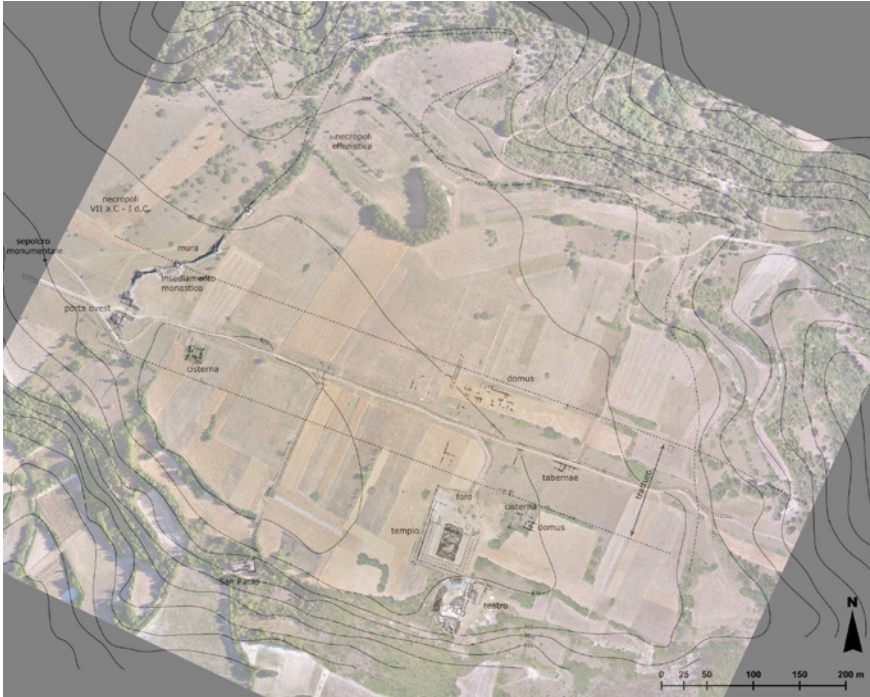


FIGURE 10. *Peltuinum*: orthophoto map of the plateau (2018) and the archaeological map (2019) (produced by A. Vecchione).

Two main necropolises were already known: a Hellenistic one within the Roman city walls, in the northern part of the *plateau*, excavated in 2013 by the University of Chieti; from the aerial photos at least three large groups of tombs are clearly visible. A second extra-urban necropolis dating back to the 7th century BC was also found. This was excavated by the local Superintendency (Acconcia *et al.* 2009; D’Ercole, Martellone 2011) and, after the aerial survey, a comparison between the archaeological maps drawn up during these two archaeological excavations and the aerial orthophotos was possible.

Inside the west gate there was a cistern, well documented during several archaeological campaigns. An elongated feature, clearly visible from RGB, NIR and NDVI images and which is divided into two segments, is connected to a cropmark and these traces are located close to the cistern. An archaeological investigation is needed in order to identify a possible connection between the cropmarks (Fig. 11). Another type of anomaly clearly visible both on historical aerial photography and on recent photos are the signs related to the urban road network of the ancient city (Fig. 12): from the altered colour in the images it is possible to see features

located north and south of the *Via Claudia Nova*. The orientation of these anomalies seems to be consistent with the already identified road network and with the orientation of the buildings located in the main public area. Furthermore, the post-ancient road system, or at least the one used to reach the church of San Paolo, is clearly visible from the DEM analysis (Fig. 13). Modern agricultural activity, natural reforestation and even archaeological excavation have partially erased the profile of the road, which was perfectly visible until 1944. The aerial survey campaign also confirmed the features identified during the 1980s that led to the 1983-86 archaeological campaigns being planned: among these, along the main road, are several cropmarks related to minor buildings and secondary roads (Fig. 14).

2.2 Digital data recording applied to the archaeological campaigns 2019-20

During the 2019 and 2020 archaeological excavation campaigns the research team focused on studying the area of the forum of the ancient city and on the post-ancient structures located

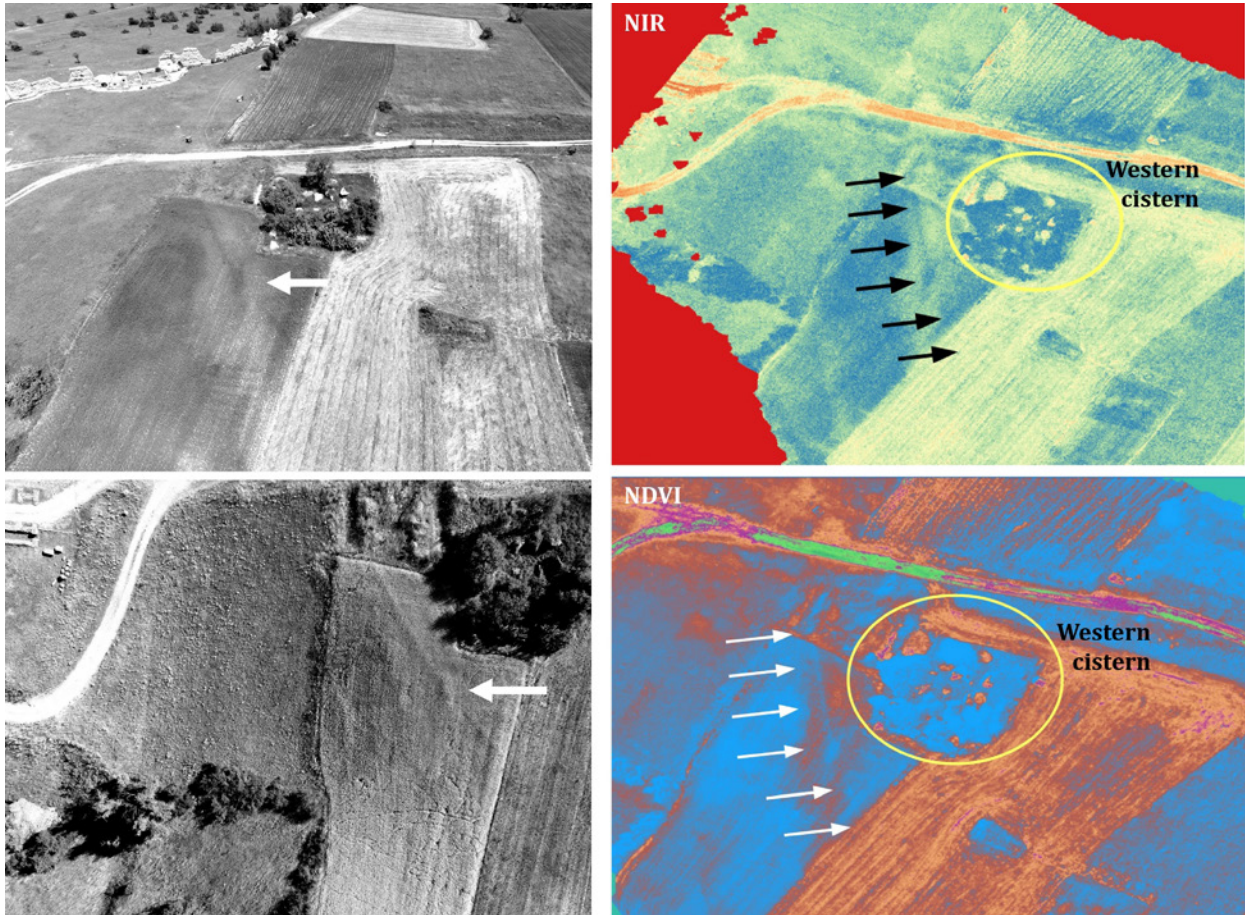


FIGURE 11. *Peltuinum*: possible archaeological feature close to the western cistern, RGB, NDVI, NIR cameras (2019) (produced by A. Vecchione).

close to the Roman theatre. From a methodological point of view it was decided to create several 3D models using a photogrammetric technique: this choice not only allowed the research team to obtain metric and colorimetric documentation but also led to the creation of a multiscale digital access point that would act as a virtual archive for recent and older documentation. A dense network of control points was distributed along the trenches. In order to obtain scaled and oriented graphic drawings on absolute geographic reference systems, the coordinates of the topographic points and part of the targets located on horizontal surfaces were acquired via the GNSS receiver. The great potential of photogrammetry methodology has been confirmed by room ϵ (Fig. 15). In this case, the survey campaign conducted in 2019 did not

allow a complete data set to be collected relating to the northern wall; in fact, the western portion is covered by a wooden support structure. Thanks to the use of images taken during the 2010 and 2011 campaigns, it was possible to develop a photogrammetric model of the portion of the masonry no longer visible. This model was later combined with the one produced in 2019 and a complete orthophoto of the entire sequence of the room was obtained.

In 2020 the archaeological excavation carried out inside room δ (Fig. 15) required a new recording campaign. Inside the post-ancient room, mainly investigated during the 2013-2014 campaigns, part of a Roman sewer was revealed, related to the theatre. In this case too, the updating of the traditional graphic documentation and integration with the

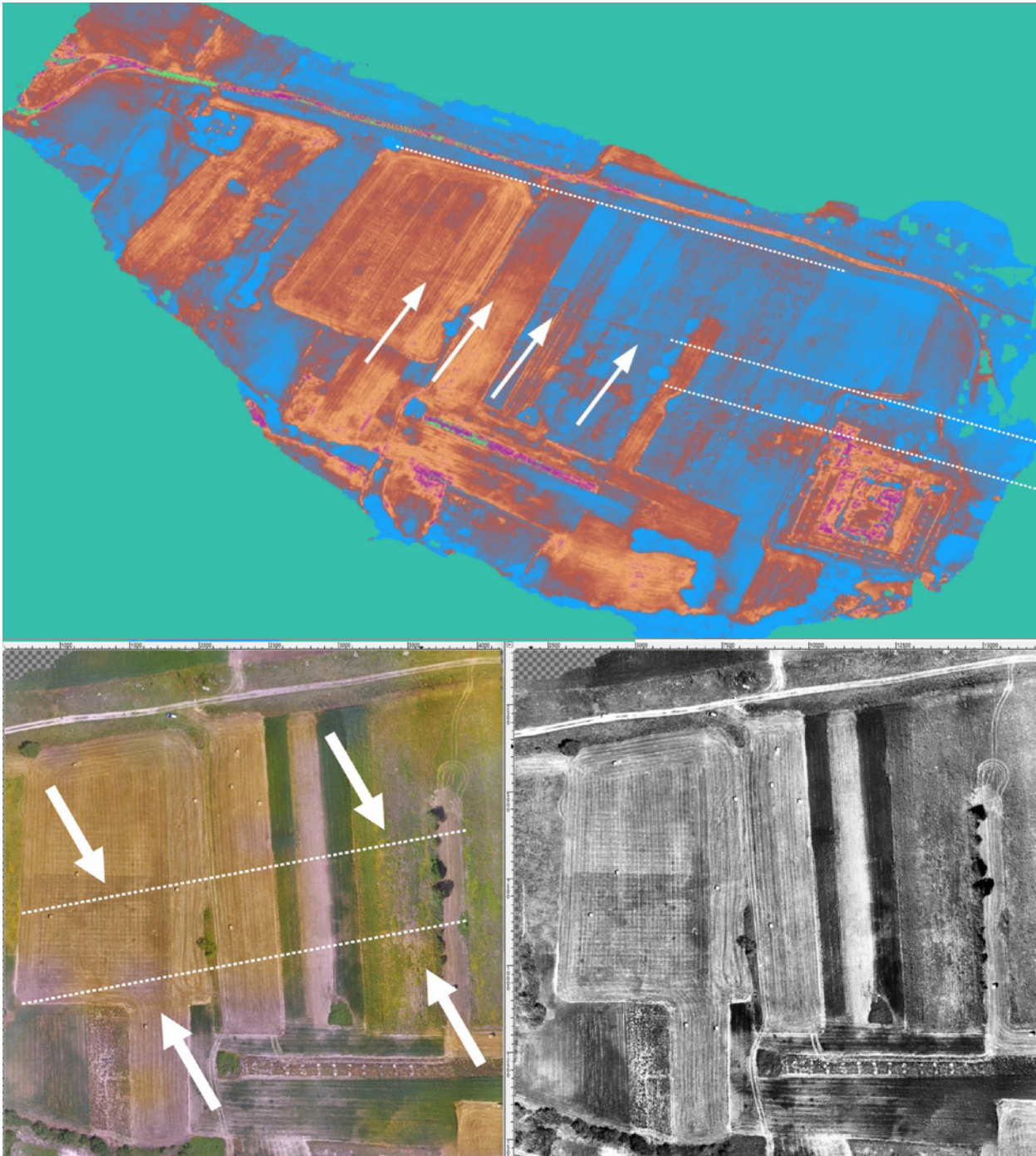


FIGURE 12. *Peltuinum*: anomalies related to the in-wall road network (2017)
(produced by A. Vecchione).

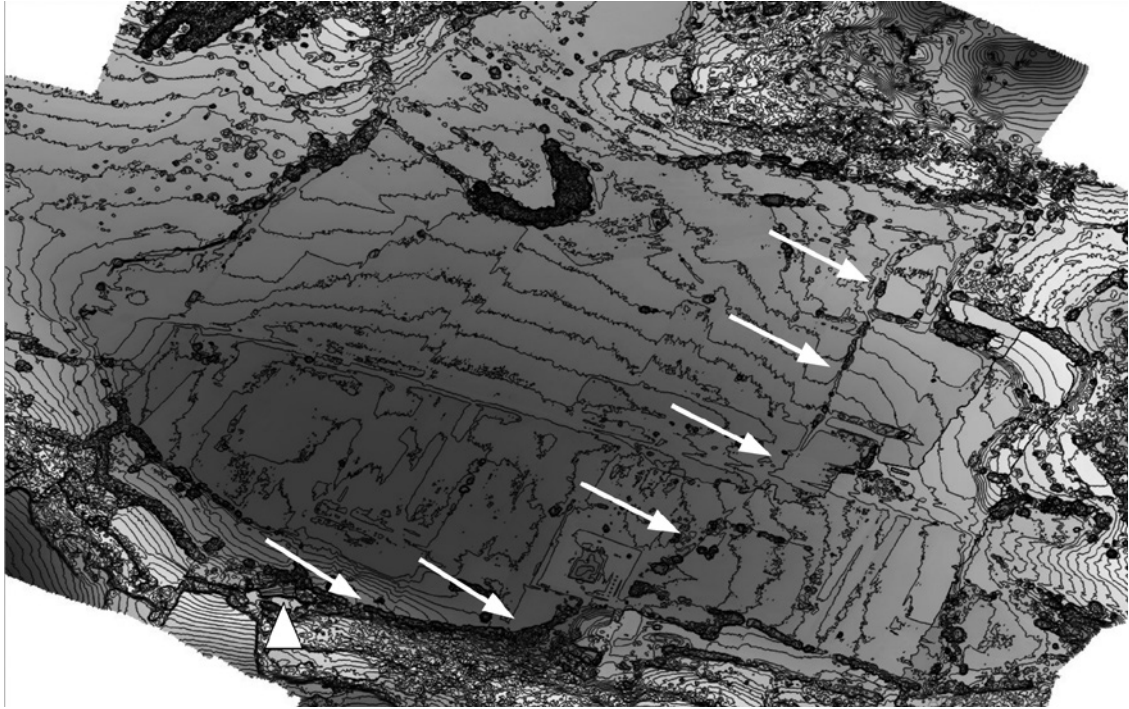


FIGURE 13. *Peltuinum*: anomalies related to the post-ancient road to San Paolo's church (2019) (produced by A. Vecchione).

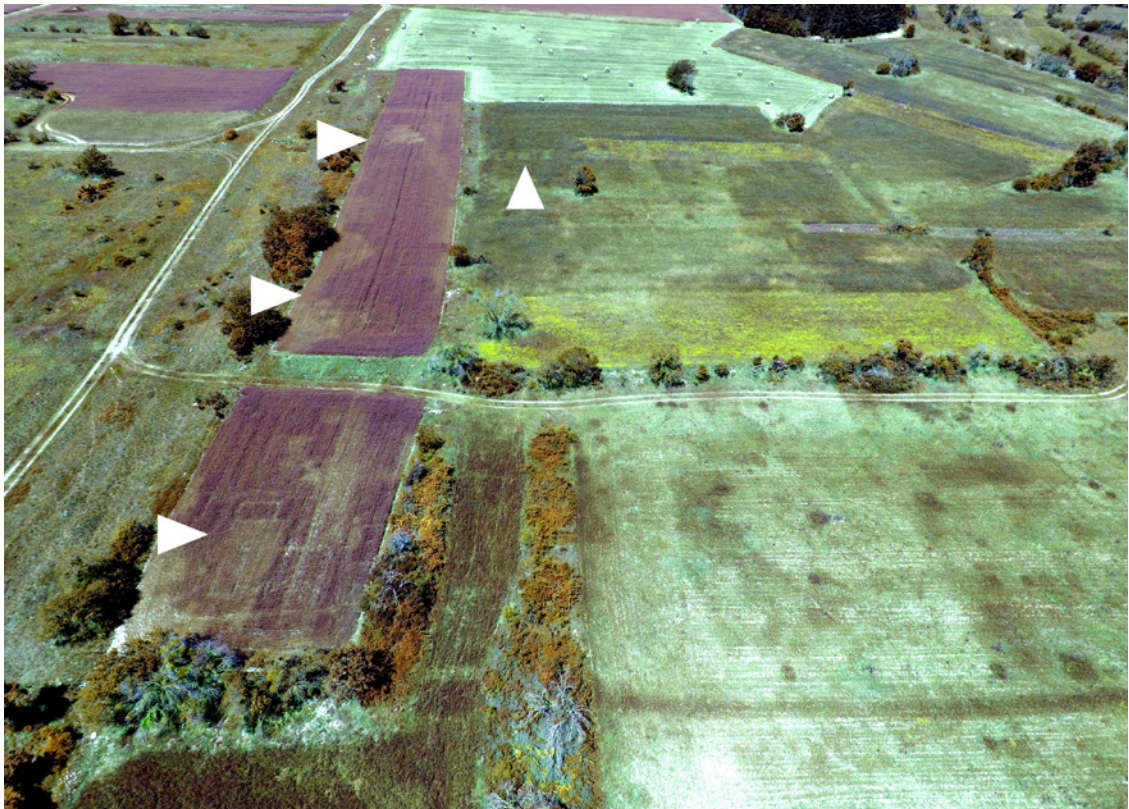


FIGURE 14. *Peltuinum*: cropmarks of minor structures and secondary roads (2017) (produced by A. Vecchione).



FIGURE 15: *Peltuinum*: post-ancient structures and the Roman theatre *cavea* (2020) (produced by A. Vecchione).

photogrammetric data acquired in the years 2019 and 2020 made it possible to place the new data in correlation with the Roman structures and contextualise them within the ancient orography on which the southern portion of the *cavea* of the theatre was built.

These two examples underline the importance of integrating photographic shots of different excavation campaigns. They also confirm the importance of reusing correctly acquired and complete archival documentation, even in those cases when data collected years later need to be combined. In fact, the heterogeneity of data collected in different years does not normally permit a complete merger of the final documents produced during the different survey campaigns. Given this situation, there is a need to draw up guidelines in order to achieve greater homogeneity with the aim of facilitating future merging operations between documents collected using different tools and methodologies.

2.3 Raw and processed data management

This large amount of digital data posed a serious problem in terms of conservation and accessibility, two of the major pillars of the FAIR manifesto for the management of scientific data which states that, according to the 2016 principles, research data should be Findable, Accessible, Interoperable and Reusable. Taking into consideration the guidelines of this international document, the data collected during the excavation campaigns were entered into a digital archive and these conditions forced the research team to think about a system to manage this large amount of data in order to improve its accessibility, sharing and updating (Vecchione *et al.* 2019). The data were uploaded to a server and managed using a simple Google Chrome browser via the 3DHop tools. 3DHop is an open-source framework for the creation of interactive Web presentations of high-resolution 3D models of up to one hundred million faces, aimed at the Cultural Heritage field. It was developed by the Visual Computing Lab of the Italian National Research Council (Potenziani *et al.* 2014; Scopigno *et al.* 2017; Apollonio *et al.* 2018).

The production of digital 3D documentation forms part of a broader digitisation process conducted through photogrammetric surveys. The digital models produced to document the trenches opened annually during the archaeological campaigns and the structures found were gradually transferred to the digital platform, assuming the function of a 3D archive and container for both new graphic and traditional documentation. The complexity of the data and their heterogeneity suggested a scheme common to both geographic information systems and CAD software should be used; i.e. with virtual containers of information overlapping at different scales. In turn, each of these virtual contents has different information layers within it. In a phase preliminary to data collection, a schedule was designed for the hierarchical organisation of the files: the first level of information is represented by a global 3D model obtained from high-altitude flights (60-70 metres above the ground) and data obtained from aerial photointerpretation (Fig. 16); the second level houses the 3D models of the individual monuments (20-30 metres above the ground) and

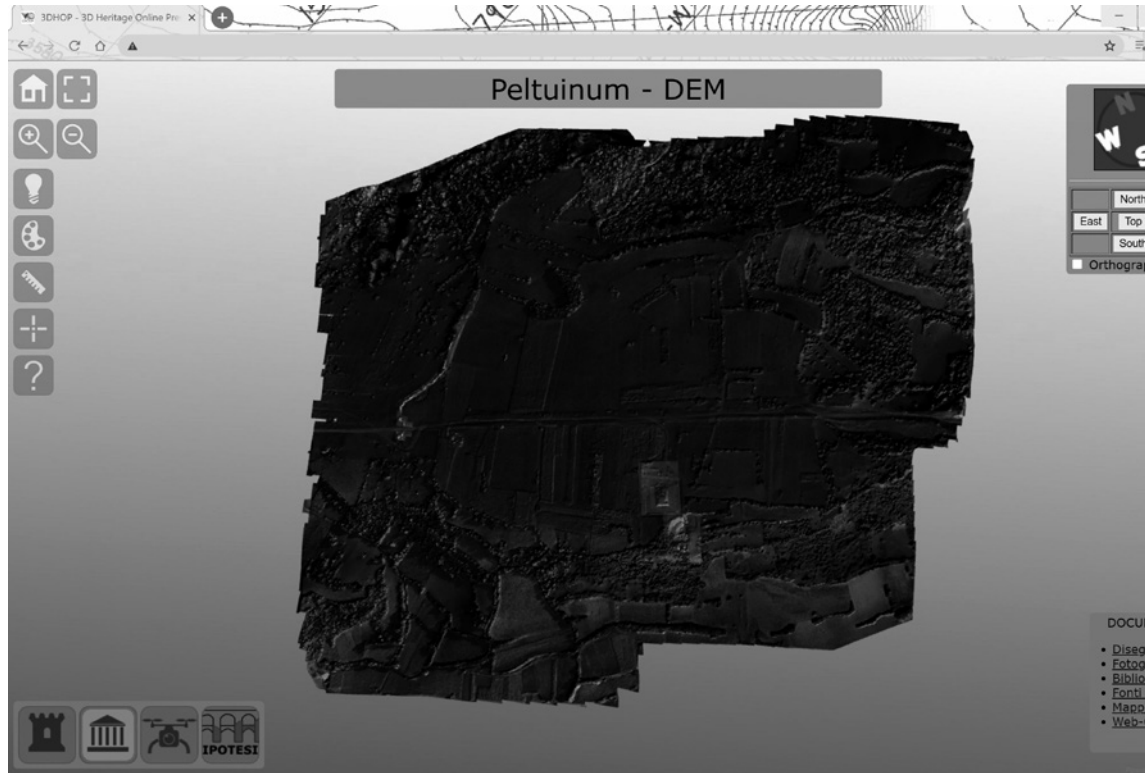


FIGURE 16: *Peltuinum* 3D access point page on 3Dhop tool, main information layer (2019) (produced by A. Vecchione and M. Callieri).

the data obtained from the analysis of the DSM and DTM; the third level presents the detailed 3D models (10-20 metres from the ground and terrestrial photogrammetry) (Fig. 17).

The 3D models were therefore used as both a volumetric hub of information and as navigable access points. The 3D model of the first level is geo-referenced on the WGS85 system while the second and third levels are oriented on the local coordinate system via the support polygon. The models have been corrected and saved in Ply format with attached texture (JPG or PNG formats). Later on, the single models were converted into multi-resolution meshes using the open-source Nexus tool and uploaded to the server for publication. They can be reached via the website URL .

Data accessibility and reuse, two of the four pillars of the FAIR Principles manifesto, are therefore adequately represented in this research context. The ability to access, update and reuse digital data resulting from photogrammetric campaigns through open-source tools means that

the digital 3D model contains geographic, volumetric and colorimetric data; it can also act as a virtual access point to the traditional archaeological documentation. Data have to be indexed and divided by area, trench and stratigraphic unit.

In structuring an information system, 3DHOP has been adapted to the needs of the various case studies and has enabled the 2D and 3D archaeological documentation to be integrated. Interaction with the website pages was intuitive, even for less experienced users, and among the most significant advantages of this program is also its adaptability to different contexts and scales, an increasingly necessary feature in the field of cultural heritage. In conclusion, 3DHOP is not only a 3D viewer but can also be used as a crucial research tool that enables bespoke interactive systems to be designed for digital archaeology datasets, which can be shared remotely within multidisciplinary research teams.

A.V.

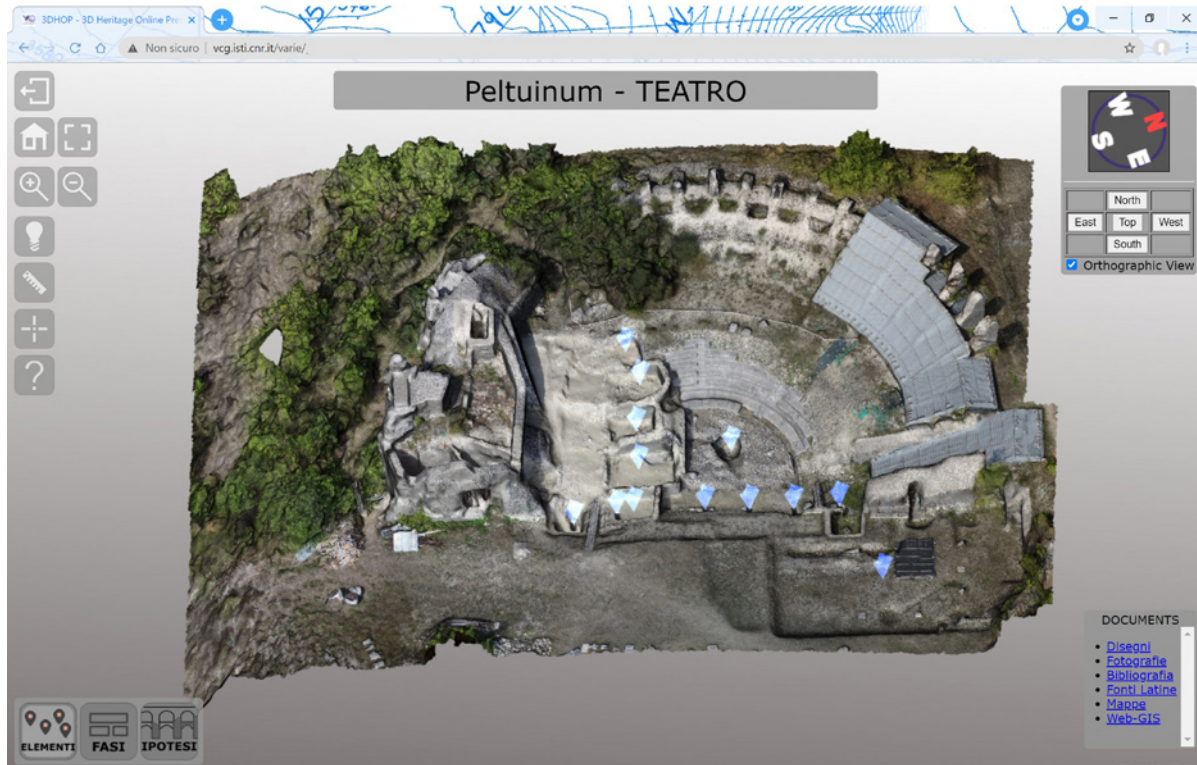


FIGURE 17: *Peltuinum* 3D access point page on 3Dhop tool, secondary information layer (2019) (produced by A. Vecchione and M. Callieri).

2.4 Conclusion

To sum up, the research activity carried out at *Peltuinum* for some years now has focused substantially on the re-evaluation and interpretation of data coming from old archive documentation as well as the contextual application of new investigative methodologies.

The possibility of documenting landscape morphology from an enhanced point of view such as the aerial perspective, and virtually modelling the archaeological structures, led to the creation of a local information system containing 3D data with several layers. This activity enabled 2D and 3D graphic support to be integrated and the results displayed. Given the consistency of the data collected, the team is now thinking of broadening the scope of the project to the surrounding area. The Navelli plain has always been characterised by a low population density and is primarily agricultural; moreover, the possibility of merging photogrammetric workflow with Lidar data would enable us to

further our knowledge of those sectors that have slowly been recovered from wooded areas. A combination of these methods would facilitate the collection of very interesting data, helping to understand the settlement dynamics of the area and with a particular focus on the Roman and post-ancient eras.

These activities (which take place in addition to the annual archaeological excavation campaigns) are providing an increasingly complete and detailed reconstruction of the ancient city and the surrounding territorial context.

D.C. & A.V.

BIBLIOGRAPHY

ACCONCIA, Valeria; D'ERCOLE, Vincenzo; LERZA, Francesca (2011). "*Peltuinum* (Prata D'Ansidonia, AQ): le indagini del 2009 nella necropoli preromana". *Quaderni di Archeologia d'Abruzzo*, 1/2009, 182-185.

- ADAMESTEANU, Dino (1963). “L’Aerofototeca”. *Archeologia: Rassegna di studi e ricerche*, no.1 vol. 5, 1-3.
- APOLLONIO, Fabrizio Ivan *et alii* (2018). “A 3D-centered information system for the documentation of a complex restoration intervention”. *Journal of Cultural Heritage*, 29, 89–99.
- BIANCHI, Fulvia (2012). “Il tempio del foro”. *RendPontAcc*, LXXXIV, 287-330.
- BUONOCORE, Marco (1998). “Peltuinum. Fonti epigrafiche”. In: BUONOCORE, Marco; FIRPO, Giulio. *Fonti latine e Greche per la storia dell’Abruzzo antico II*, 2. L’Aquila: Edizioni libreria Colacchi, 864-891.
- BUONOCORE, Marco (2007). “La tradizione letteraria ed epigrafica di Peltuinum in età romana”. In: CLEMENTI, Alessandro (ed.). *I campi aperti di Peltuinum dove tramonta il sole... Saggi sulla terra di Prata d’Ansidonia dalla protostoria all’età moderna*. L’Aquila: Edizioni libreria Colacchi, 135-178.
- BUONOCORE, Marco (2011). “Ancora nuovi documenti da Peltuinum”. *Epigraphica*, LXXIII, 324-332.
- CAMPANELLI, Adele (1996). *Peltuinum. Antica città sul tratturo*. Comunità montana di Campo Imperatore – Navelli: Carsa Edizioni.
- CANINO, Dario; MIGLIORATI, Luisa; TRIVELLONI, Ilaria (2021). “Documentazioni di pavimentazioni dall’area archeologica di Peltuinum (AQ)”. In: *Atti del XXVI colloquio AISCAM (2020)*. Rome: Edizioni Quasar, 293-303.
- D’ERCOLE, Vincenzo; MARTELLONE, Alberta (2014). “*Peltuinum* (Prata D’Ansidonia, AQ). Seconda campagna di scavo nella necropoli”. *Quaderni di Archeologia d’Abruzzo*, 3/2011, 345-350.
- LA REGINA, Adriano (1964). “Peltuinum”. *Quaderni dell’Istituto di topografia antica della Università di Roma*. Rome, vol. I, 69-72.
- LABATE, Donato *et alii* (2009). “Modena, Parco Novi Sad. Deposito archeologico pluristratificato con strutture databili dall’età del ferro all’età moderna”. In: *Atti e memorie. Deputazione di storia patria per le antiche provincie modenesi*, s. XI, vol. XXXIII. Modena: Aedes Muratoriana, 434-437.
- MIGLIORATI, Luisa (2007). “Peltuinum: un aggiornamento”. *Rivista di Topografia Antica*, 17, 107-126.
- MIGLIORATI, Luisa (2008). “Peltuinum. Un caso di “pietrificazione” di un’area di culto”. In: *Saturnia Tellus. Definizioni dello spazio consacrato in ambiente etrusco, italico, fenicio-punico, iberico e celtico. Atti del convegno internazionale Svoltosi a Roma dal 10 al 12 novembre 2004*. Rome: Consiglio Nazionale delle Ricerche, 341-356.
- MIGLIORATI, Luisa (2011-2012). “La città e il territorio”. *RendPontAcc*, LXXXIV, 351-386.
- MIGLIORATI, Luisa (2014). “Gli scavi di Peltuinum”. In: BOURDIN, Stéphane, D’ERCOLE, Vincenzo (eds.). *I Vestini e il loro territorio dalla preistoria al medioevo*. Rome: Collection de l’Ecole Francaise de Rome, 494, 249-260.
- MIGLIORATI, Luisa *et alii* (2017). “Sepolti nel teatro: il valore simbolico dei cani in sepolture comuni infantili”. *Scienze dell’antichità. Storia, archeologia, antropologia*, 23, Fasc. 3, 593-611.
- MIGLIORATI, Luisa; CANINO, Dario (2014). “Note di Topografia Vestina”. *Scienze dell’antichità. Storia, archeologia, antropologia*, 20, Fasc.1, 127-139.
- MIGLIORATI, Luisa; CANINO, Dario (2016). “Peltuinum: nuove ricerche”. *Scienze dell’antichità. Storia, archeologia, antropologia*, 22, Fasc.1, 53-64.
- MIGLIORATI, Luisa; CASAZZA Giulio; SGRULLONI Tiziana (2018). “Nuove indagini sulle fortificazioni di Peltuinum”. *Scienze dell’antichità. Storia, archeologia, antropologia*, 24, 295-308.
- NEPI, Daniele (2012). “Il teatro. Aspetti architettonici”. *RendPontAcc*, LXXXIV, 333-350.
- NEPI, Daniele (2014). “Il teatro di Peltuinum. Studio tecnico strutturale”. In: BOURDIN, Stéphane; D’ERCOLE, Vincenzo (eds.). *I Vestini e il loro territorio dalla preistoria al medioevo*. Rome: Collection de l’Ecole Francaise de Rome, 494, 261-264.

- SCOPIGNO, Roberto *et alii* (2017). “Delivering and using 3d models on the web: are we ready? distribución y uso de modelos 3d en la web: ¿estamos listos?”. *Virtual Archaeology Review*, 8, 1-9.
- SGRULLONI, Tiziana (2015). “Peltuinum (Prata d’Ansidonia AQ). Stratigrafia e materiali dell’ambiente ε”. *Quaderni di archeologia d’Abruzzo. Notiziario della Soprintendenza per i beni archeologici dell’Abruzzo*, 3/2011, 356-359.
- SOMMELLA, Paolo (1995). “Il culto di Apollo a Peltuinum città dei Vestini”. *Caesarodunum. Melanges Raymond Chevallier*, Tome XXIX, Vol. 2, 279-291.
- POTENZIANI, Marco *et alii* (2015). “3DHOP: 3D Heritage Online Presenter”. *Computers & Graphics*, vol. 52, 129-141.
- TARTARA, Patrizia (2008). “Apporti della fotografia aerea all’identificazione delle necropoli e degli insediamenti vestini”. In: TAGLIAMONTE, G. (ed.). *Ricerche di archeologia medio-adriatica I. Le necropoli: contesti e materiali*. Atti dell’Incontro di Studio (Cavallino-Lecce 2005), Galatina (LE), Congedo Editore, 163-194.
- VECCHIONE, Alessandro *et alii* (2019). A. Vecchione, A. Lureau, M. Callieri, “Gestione del dato archeologico tridimensionale via web: l’esperienza con il software 3DHop del CNR-Isti”. *Archeologia e Calcolatori*, XXX, 335-339.
- WONTERGHEM, Frank van (1999). “Il culto di Ercole e la pastorizia nell’Italia centrale”. In: Petrocelli, E. (ed.). *La civiltà della Transumanza*. Isernia: Cosmo Iannone Editore, 414-428.

The contribution of digital cartography to a *Brundisium* (Puglia, Southern Italy) ancient wall reconstruction

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ABSTRACT

Some aspects related to the definition of the *Brundisium* (Brindisi, Puglia) Roman wall will be explored in this work. Historical and contemporary cartography, as well as archaeological data and the city area digital terrain model have been compared by applying GIS technology, hence improving our urban layout understanding. Through the data collected, we will be able to suggest an ancient city wall reconstruction and figure out the possible location of the gates.

KEYWORDS: Roman urban planning, GIS technology, digital cartography, ancient fortifications, Brindisi, Puglia.

The purpose of this work is to explore some of the aspects linked to the definition of the Roman city walls of *Brundisium* (Brindisi), a Latin colony founded in 244 BC along the Adriatic coast of Southern Italy (Puglia) (Fig. 1).

The imposing walls of Brindisi have been mentioned by Roman authors, who described them as secure, impregnable and well visible from afar (Tac. *ann.* III, 1); they also mentioned their gates, walkways and towers (Caes. *civ.* I, 27-28; Cic. *Planc.* XLI, 97; Cic. *Att.* VII, 2; XIV, 13-14; Lucan. II, 607-609; App. *civ.* V, 6, 56).

Our knowledge of these defensive works' technical-constructional features and course – regarding which many uncertainties and controversial speculations still exist (Carito, 1988; Cocchiaro, Sciarra Bardaro, 1988, 13-15; Uggeri, 1988, 56) – is limited due to the very small amount of useful information available from an archaeological standpoint.

The difficulty in reconstructing the wall course is mainly due to the scarcity of structural remains, which are often hard to interpret; sections of walls have been identified in different

parts of the city, while whether they are from Roman fortifications is often uncertain².

In the northern part of the city, some of these can be definitely attributable as such: a portion of structure made in *opus quadratum*, still visible along Via P. Camassa (Cocchiaro, Sciarra Bardaro, 1988, 37 no. 70) (Fig. 2, a); and the remains of a gateway (about 200 m further east from the previous find), discovered in the 19th century but later destroyed (Cera, 2008) (Fig. 2, b).

The reconstructed course suggested by this evidence would follow the 'Collina di Ponente' hillside, with a layout that adapts to the terrain's morphology. The hill in the northern part of the city, overlooking the internal harbour (Seno di Ponente), is characterised by steep slopes towards the sea. The walls were built along the lower part of the hillside so that the natural defences of the slope could be enhanced, while

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2. In particular, see Piazzetta Alberione (Cocchiaro, Sciarra Bardaro, 1988, 13e, Fig. 4; http://www.fastionline.org/excavation/micro_view.php?fst_cd=AIAC_3526&curcol=sea_cd-AIAC_5761); in Via Montenegro (Cocchiaro, 1992); in Piazza Duomo (Marzano, 1954, 23, 25e, Fig. 18); and below the Scalinata Virgiliana (DELLA MONACA, 1674, 53; http://www.fastionline.org/excavation/micro_view.php?fst_cd=AIAC_3526&curcol=sea_cd-AIAC_5761).



FIGURE 1. The Salento peninsula (Puglia, Southern Italy) and the location of Brindisi.

the slope itself could be contained and fortified as terracing.

Given the lack of data for the rest of the defensive wall, other types of sources needed to be assessed. Historical maps, for instance, often provide relevant topographical information which helps to better grasp the past geography. We therefore compared historical and contemporary cartography by applying GIS technology; specifically, we overlaid a piece of Brindisi aerial photogrammetry on a city map made in 1739 by the Spanish marshal A. de Los Coves (Fig. 3)³; and did the same with an historical map published in 1781 by the military engineer Andrea Pigonati (Fig. 4)⁴. The resulting images showed that the Aragonese walls – built in the second half of the 15th century and strengthened in the following century under the emperor Charles V – used to surround much of the city’s historic centre but are now largely lost.

The question to ask is whether the course of these walls was the same as in the Roman Age.

3. *Plano y Mapa En que se comprende la Ciudad de Brindisi, sus Castillos de mar y tierra, Puerto piccolo y Grande con porción de los contornos de su Campanea en la Provincia de Otranto*, first published by CAGNES Pietro, SCALESE Nicola (1978). *Cronaca dei Sindaci di Brindisi 1529 – 1787*, Brindisi: Edizioni Amici della “A. De Leo”.

4. This plan, with the title *Topografia della Città e Porti di Brindisi*, forms part of the volume *Memoria del riaprimiento del porto di Brindisi*, describing the work to recondition the access to the inner harbour, entrusted to A. Pigonati by King Ferdinand IV of Naples.

Using digital cartography, we examined the distribution of archaeological data, including burial sites and necropolises, which might indirectly suggest the course of the Roman defensive wall.

We can see how this evidence, widely attested on the periphery of the modern city centre, is located just outside the line of the Aragonese defences, suggesting the Aragonese and Roman walls coincide along their west and south sides (Fig. 5). Particularly of note are the findings attested to the west along Via Cappuccini and Via Osanna (for example, see Cocchiario, Andreassi, 1998; Cocchiario, Sciarra Bardaro, 1988, 28, 32, 38 no. 7, 17, 19, 83; Cocchiario, Marangio 2006; Cocchiario 1992a; Cocchiario 2015); and to the south near Porta Lecce (Cocchiario, Sciarra Bardaro, 1988, 27, 31, 32 no. 10). In both cases, the archaeological data particularly focus on the two main roads connecting with the rest of the territory: Via Appia (Uggeri, 1983, 224-226; Cera, 2019, 143-144), coming from the west, and the so-called Via Traiana Calabria (Uggeri, 1983, 275-276; Guacci 2018), running southwards.

Further evidence of the wall’s westerly reconstruction is a moat discovered along the Via Bastioni San Giorgio (Cocchiario, 1991). Made during the Republican period in connection with the western side of the fortifications, this work suggests that the latter course is the same as the Aragonese one.

The very presence of a moat here is not surprising: in fact, this is the most exposed side of the city, neither surrounded nor defended by the sea and with no high terrain.

Such a context seems to be evoked in a passage by the historian Appian, describing the siege of Brindisi by Anthony in 48 BC. During the siege, Anthony ordered a trench to be dug and bulwark to be erected, cutting and fortifying the isthmus so that it became impossible to reach the city from the hinterland (*App. civ.*, V, 6, 56).

Archaeological data concerning the east and south-east city limits are almost absent. We are only aware of some Roman graves discovered along the slope of the eastern hill (Collina di Levante) (Cocchiario, Sciarra Bardaro, 1988, 28, 68 no. 20). The tombs’ location indicated in the Digital Terrain Model corroborates our

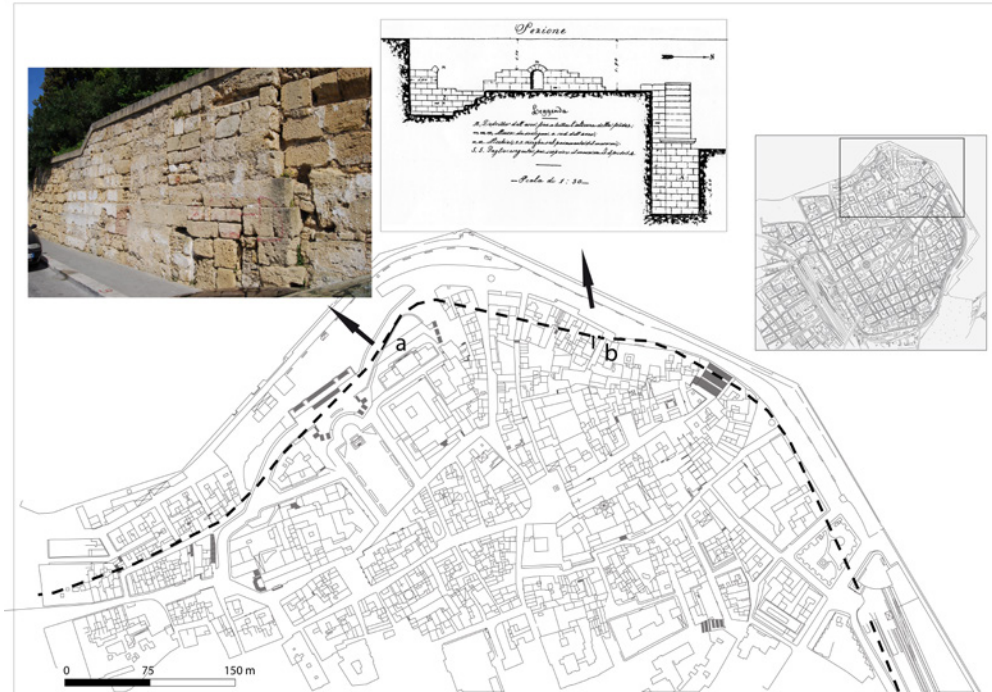


FIGURE 2. Sections of wall belonging to the Roman fortifications, identified on the north side of the city.



FIGURE 3. Overlap between the Brindisi aerial photogrammetry and the map of the city, drawn up in 1739 by the Spanish marshal A. de Los Covas (*Plano y Mapa en que se comprende la Ciudad de Brindisi, sus Castillos de mar y tierra, Puerto piccolo y Grande con porción de los contornos de su Campanea en la Provincia de Otranto*).



FIGURE 4. Overlap between the Brindisi aerial photogrammetry and the map published in 1781 by the military engineer Andrea Pigonati (*Topografia della Città e Porti di Brindisi*).

assumption that the wall's course followed the upper edge of the hill, with its steep slopes projected towards the coastline (Fig. 5-6).

The location of the city's main gateway will also be a focus of our study and contribution.

In this respect, an analysis of the *Brundisium* ancient road network offers interesting insights. Using topography, we can recognise the main *Brundisium* west-east thoroughfare in the courses followed by the Via Carmine, Via Fornari, Vico Palma, reaching Piazza Vittorio Emanuele I in front of the inner harbour (Fig. 6). Also, a stretch of Roman road surfacing brought to light in 1979 along Vico Palma (Jurlaro, 1979, 161; Cocchiario, Sciarra Bardaro, 1988, 15) confirms the antiquity of this alignment, partly recognisable also on historical cartography.

There is a coincidence between the limits of this road and the west gate in the Aragonese wall, i.e., Porta Mesagne, suggesting a possible correspondence with a Roman Age gate, through which the Via Appia entered the city (Fig. 6).

Less certain is the opening through which the Via Appia Traiana (formerly Via Minucia), coming from the north, entered the city. Some scholars agree that it re-joined Via Appia before reaching the city (Uggeri, 1983, 262; Cocchiario, Sciarra Bardaro 1988, p. 16).

Another hypothesis would be that the road enters *Brundisium* through a different gate located further north than the above-mentioned Porta Mesagne. In the suburban area, close to Ponte Grande, the Via Appia Traiana is indicated by a large necropolis featuring incineration graves, signs, inscriptions and funerary monuments (Cocchiario, Sciarra Bardaro, 1988, 24-25, 35 no. 50).

Another necropolis located behind the walls and evidenced by the archaeological findings in Via Provinciale San Vito and Via De Carpentieri seems to indirectly document the next stretch of the road running towards the city (Cocchiario, 1996; Cocchiario, 2002-2003).

This road's course, almost entering the urban area, matches the alignment of Via Castello - Via

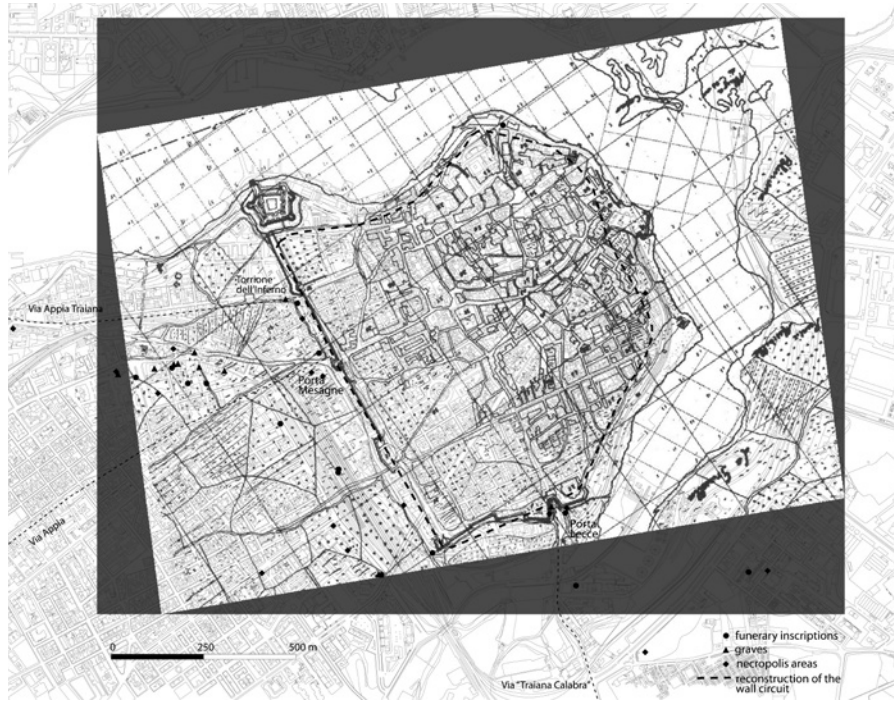


FIGURE 5. Brindisi: the distribution of Roman graves, necropolis areas and funerary inscriptions compared with the historical and modern cartography.



FIGURE 6. Brindisi: the distribution of graves, necropolis areas and funerary inscriptions compared with the digital terrain model and modern cartography. The dotted line reconstructs the urban road network and the wall circuit of the Roman period.

Santa Barbara - Via Tarantini, in which one of the main *Brundisium* south-west / north-east roads could be recognised. After considering the above, it is likely that a gate – possibly smaller in size than Porta Mesagne – existed somewhere around ‘Torriente dell’Inferno’ of the Aragonese fortifications (Fig. 6). Moreover, a street approaching the Aragonese walls and heading towards Torriente dell’Inferno also appears in the above-mentioned 18th-century maps of Brindisi (Fig. 5).

Along the southern side, an indication of a gateway somewhere around Porta Lecce adds to the analysis of the 15th-century walls. Looking at this area from a geomorphological viewpoint, we can understand why the gate would have been built right here and its value over time, as a slight natural depression in the land was ideal for creating an access point to the city.

Again, an analysis of the urban road network provides fresh insights. The find of a Roman stretch of road along Via Lauro (Palazzo, 2015) (Fig. 6) enables us to identify an ancient but preserved north-east/south-west axis in the current Via Lauro / Via Conserva, whose southern edge is located at the Aragonese gate. In addition, the hypothesis that the Roman gate was in this area is indirectly confirmed by some archaeological data; just outside Porta Lecce, numerous funerary inscriptions and Roman graves (for example *CIL*, IX, 43, 82, 107, 111, 137, 6100, *AE*, 1990 = *EDR*, 171681, 17304, 104494, 17316, 171977, 171485, 81742) – indicating here the limits of the urban area – have come to light. Finally, the find of a Maxentius milestone (309 A.D.) (*CIL*, IX, 6076 = *EDR*, 77731) seems to identify, in this area, the beginning of Via Traiana Calabria, the road that, leaving the city, ran in the direction of Otranto.

CONCLUSIONS

Starting from scanty archaeological data relating to the *Brundisium* walls, we have put forward a new reconstruction hypothesis based on a comparative analysis of archaeological evidence, historical and modern cartography, and the terrain’s geomorphological characteristics.

Archaeological remains that can be related, with certainty, to the walls have been found on the northern side of the city only. Their location clarifies the path taken by the fortifications, which ran along the lower part of the hillside; i.e., ‘Collina di Ponente’ (corresponding to the northern hill), consolidating and making the city even more difficult to attack.

Without any structural remains on the other sides, the course taken by the walls has been hypothesised by observing the location of Roman graves and funerary inscriptions, which characterise the areas outside the urban area. Using GIS technology to study their location and comparing with historical cartography, we can see that the main necropolises were located outside the Aragonese walls, clearly evident in 18th-century maps. Consequently, the latter are assumed to have largely followed the fortifications of the Roman period.

A topographic analysis also enables us to hypothesise the location of the city’s main gateway. A comparative examination of historical cartography and a digital terrain model, as well as the archaeological finds relating to the urban road network and Roman necropolis, help to identify two of these in the area around Porta Mesagne and Porta Lecce; i.e., the western and southern gates in the Aragonese walls.

BIBLIOGRAPHY

- CAGNES, Pietro; SCALESE, Nicola (1978). *Cronaca dei Sindaci di Brindisi 1529 – 1787*. Brindisi: Edizioni Amici della “A. De Leo”.
- CARITO, Giacomo (1988). “L’urbanistica di Brindisi in età repubblicana”. In: MARANGIO, Cesare (ed.). *La Puglia in età repubblicana: Atti del I Convegno di Studi sulla Puglia romana, Mesagne els dies 20, 21 i 22 marcha de 1986*. Galatina: Museo Archeologico Granafei, 173-179.
- CERA, Giovanna (2008). “Nuovi documenti d’archivio per la conoscenza della topografia urbana di Brundisium”. *Studi di Antichità*, 12, 173-186.
- CERA, Giovanna (2019). “La via Appia tra Taranto e Brindisi: ricostruzione del percorso e rapporti con il popolamento”. In:

- MARCHI, Maria Luisa (ed.). *Via Appia. Regina Viarum. Ricerche Contesti, Valorizzazione: Atti del Convegno, Melfi – Venosa, 3-4 maggio 2017*. Venosa (Pz): Osanna Edizioni, 133-152.
- COCCHIARO, Assunta (1991). “Brindisi. Via Bastioni S. Giorgio”. *Taras*, XI, 2, 283-284.
- COCCHIARO, Assunta (1992a). “Brindisi. Via Montenegro”. *Taras*, XII, 2, 276-277.
- COCCHIARO, Assunta (1992b). “Brindisi. Via Appia”. *Taras*, XII, 2, 278-279.
- COCCHIARO, Assunta (1996). “Brindisi. Via Provinciale San Vito”. *Taras*, XVI, 1, 59-60.
- COCCHIARO, Assunta (2002-2003). “Brindisi. Via De Carpentieri”. *Taras*, XXII, 1-2, 143.
- COCCHIARO, Assunta (2015). “Brindisi. Via Cappuccini 1. Via Osanna 78. Via Osanna 31”. *Taras*, n.s. II, 93-94.
- COCCHIARO, Assunta; ANDREASSI, Giuseppe (edd.) (1988). *La necropoli di via Cappuccini a Brindisi*, Fasano: Schena Editore.
- COCCHIARO, Assunta; MARANGIO, Cesare (2006). “Brindisi. Epigrafi di età romana dallo scavo di via Osanna”. *Epigraphica*, LXVIII, 337-387.
- COCCHIARO, Assunta; SCIARRA BARDARO, Benita (1988). “Per una Carta Archeologica di Brindisi”. In: COCCHIARO, Assunta; ANDREASSI, Giuseppe (edd.). *La necropoli di via Cappuccini a Brindisi*. Fasano: Schena Editore, 11-39.
- DELLA MONACA, Andrea (1674). *Memoria storica dell'antichissima e fedelissima città di Brindisi*, Lecce.
- GUACCI, Paola (2018). “La via Traiana-Calabra. Nuove proposte di ricostruzione”. *Atlante Tematico di Topografia Antica*, 28, 175-186.
- JURLARO, Rosario (1979). “Primi dati sopra l'impianto urbanistico di Brindisi romana”. *Ricerche e Studi*, 12, 153-162.
- MARZANO, Gabriele (1954). *Recenti scavi in Piazza del Duomo a Brindisi*, Bari: Cressati.
- PALAZZO, Paola (2015). “Brindisi. Via Lauro 32 (proprietà M. Cazzato)”. *FastiOnLine*, 331, 1-10 (www.fastionline.org/docs/FOLDER-it-2015-331.pdf).
- UGGERI, Giovanni (1983). *La viabilità romana nel Salento*, Fasano: Grafischena.
- UGGERI, Giovanni (1988). “Il porto di Brindisi in età repubblicana”. In MARANGIO, Cesare (ed.). *La Puglia in età repubblicana: Atti del I Convegno di Studi sulla Puglia romana, Mesagne els dies 20, 21 i 22 marcha de 1986*. Galatina: Museo Archeologico Granafei, 47-64.

Integrating historical cartography, written accounts and satellite images for the reconstruction of past landscapes: the case of Madayi (Kerala, India)

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ABSTRACT

The coastline of southern India has historically been a central node within an important commercial network that brought the West (and the Mediterranean) into contact with the Far East. After the fall of the Roman Empire, other commercial actors came into play and Arab and Jewish merchants began to travel the 'Western' routes, as attested by written sources at least starting from the 9th century AD.

In this context, archaeological surveys conducted in Madayipara (Kannur District, Kerala) have unearthed evidence of a complex network of settlements in the delta of the Kuppam River in Taliparamba which has almost disappeared today. The natural landscape has also changed over time, as the coastline slowly advanced and rivers changed their courses as well as their function. Traces of this hub or entrepôt can be found in the rich body of historical sources and cartography of the region, which suggests the presence of lively ports often associated with Jewish and Muslim communities, as well as in later maps drawn by European explorers. The historical sources, together with satellite imagery and results from archaeological surveys, can help us reconstruct a complex settlement pattern, fully embedded within the trade networks of the medieval Indian Ocean.

KEYWORDS: Historical cartography, remote sensing, Indian Ocean, remote sensing, Malabar.

Madayi is a small coastal area on the Malabar Coast (Kerala, India), which has been the target of investigations carried out by the Italian Archaeological Mission in India.² Research into the port of Madayi proved to be promising as the ceramic evidence, although scarce and originating exclusively from unsystematic surface reconnaissance, is representative of numerous types of Eastern and Western productions, distributed over a wide geographical and chronological spectrum (D. Hill, La Salvia, and Moderato 2020).

Although archaeological data are improving our knowledge about the site, we still do not know enough about its landscape and role in the historical trade networks. A multi-proxy approach is needed to place the finds in their historical and geographical framework. For this reason, different sources (material, written, cartographic and topographical) related to this site have been analysed. In this paper we will focus mainly on the overlapping literary and cartographical sources. Historical maps have long been used in archaeological research to analyse elements of the ancient landscape such as settlement patterns, communication and trade networks and even the perception of the landscape in Antiquity (Chouquer et al. 1987; Basso 2007; Cambi 2011; Gillings, Hacigüzeller, and Lock 2018). Regressive analysis can fill in the gaps due to contemporary transformations of historical landscapes; lately, the development

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of new technologies such as machine deep learning are changing the cartographic approach from qualitative to quantitative (Petrie et al. 2018; Chiang et al. 2020; Garcia-Molsosa et al. 2021).

Geographically, the Malabar Coast is located within in the sea trade routes between East and West. It is affected by the monsoons and is characterised by a recurring complex of wind and other meteorological phenomena which are significant not only because they have dictated the rate of sea travel but also the agriculture in South-East Asia (Cardini and Vanoli 2017, 13-31; Prange 2008; 2018).

The Indian Ocean is currently the focus of a great deal of attention in terms of historical and archaeological research. Numerous studies are highlighting the key role played by the Ocean/Sea in the development of millenary routes of mobility and trade from East to West. Modern scholars have gradually abandoned Eurocentric models, often focused only on Roman trade networks in the frontier areas, combining local high-resolution research with global perspectives (Heng 2019; Seland 2014; Schottenhammer 2019b, 2019c). New themes, such as Arabian trade, and new broader chronological perspectives are helping to reshape the connections between the nodes of this extraordinary network. Within this framework, the medieval period has not been yet fully investigated, in spite of a large number of literary and archaeological sources.

The study of international trade and cultural interaction during the early medieval period is only just beginning and the prevailing historiographical view continues to be that, during the middle of the first millennium, international trade ceased or declined to such an extent that it was no longer an important factor in enabling wider socio-economic developments in the area. As already mentioned, however, archaeology has begun to question the basic assumptions of these assertions. This is also due, among other things, to the fact that various textual sources, as we shall see below, indicate that Arab-Persian traders were already trading with India from at least the 7th and 8th centuries. However, this indication from written sources has not yet received the archaeological 'attention' necessary to verify its

historiographical reliability. In fact, as far as archaeology is concerned, since Carswell's studies on the Indian coast in 1976 there have been a number of surveys and reconnaissances which, in investigating trade in the Indian Ocean and in line with the general state of archaeological research in the region, have tended to focus on earlier periods (with a fixation on Indo-Roman trade and the identification of sites in India with places mentioned in classical Greek and Roman literature). In contrast, the early medieval period has so far been 'grossly' ignored (Hawkes 2014b, 2014a, 2019). The role of Rome and the Mediterranean in the Indian Ocean trade system, known from numerous written sources (Casson 1989, 1990; De Romanis 1997), on the basis of which it has always been overestimated, should, however, be repositioned within a broader (economic-commercial) horizon and, as mentioned, less centred on the Mediterranean; In fact, as Fitzpatrick well points out, taking up an 'old' intuition by Rostovtzeff, Rome was 'only' part of a mercantile trend with very ancient roots (dating back at least to the 4th millennium) and an oriental matrix that revolved around the Arabian peninsula, southern Persia, India and Ceylon (Sri Lanka). Moreover, its economy never had the capacity to stand out as a leading and/or prevailing force (not even from a military point of view) within this commercial circuit (Fitzpatrick 2011, 27-54). First for Rome, and later for Byzantium, starting at least from the 3rd century, the problem of competing with the Sassanid Empire and the consequent drastic change in trading nodes became central, progressively accentuating the importance of the Persian Gulf and Arabian peninsula to the detriment of the Red Sea (more included within Rome's political sphere of action: Fiaccadori 1992; Malekandathil 2007, 2010; Howard 2012; Cunliffe 2015). According to this perspective, the role played by the Eastern Christian Churches as a vehicle for their respective economic-commercial policies (Roman-Byzantine and Sassanid) is not secondary; rather, they seem to form part of a framework that is, by now, well defined by different spheres of influence (Fiaccadori 1992, 65-66; Tomber 2007; Howard 2012, 142-45; Seland 2012).

The Malabar coast is therefore a fundamental crossroads of inter-oceanic trade, not only because it is an intermediate station between the ‘western’ coasts and China (and/or the Far East in general) but also because of its products, the most important of which was black pepper (whose trade is reported by Roman sources from the 1st-2nd century AD). Closely connected to the movement of goods is the movement of people and ideas. Merchants moved along the routes linking the Mediterranean and the world of the Indian Ocean, sometimes only for short distances but later, especially from Late Antiquity, over long distances, supported by groups of investors and wealthy shipowners (Mohamed and Mohammad 1999; Ilias 2007).

Therefore, given its location along the Malabar coast, a very favourable position, the area existing today around the settlement of Madayi must have had a mercantile post and formed part of this intense system of commercial relations.

The site of Madayi is located near the present-day settlement of Pazhayangadi on the northern bank of the Kuppam River, north of the city of Kannur, the main administrative centre of the district in Kerala (India) that bears the same name. The Malabar coastline stretches from NW to SE in the south-western part of the Indian peninsula, alternating between headlands and bays generally situated near the delta of

rivers. These are descended from the Western Ghats, the mountains that mark the transition from the coastal region to the hinterland. The coast is characterised by relief and plains; the hillsides are, for the most part, occupied by terraces for cultivation while the extensive low wetlands are still dominated by forests or vast lagoons. The population is mainly concentrated along the coast. The current coastline is essentially due to and/or is the result of sea-level fluctuations and fluvial-marine processes and the formation of sediment of recent geological origin.

The geomorphological evolution of the coast has, historically, played an important role in the dynamics of settlement in the area. Coastal morphologies are made up of coastal ridges and sand dunes, crossed by rivers, estuaries and plains of alluvial deposits and bordered by high laterite outcrops towards the east. The evolution and stabilisation of the coastal area seem to have taken place between the middle and late Holocene, as evidenced by numerous megalithic burials found between the coastal areas and inland sand ridges (Gurukkal and Varier 1999; Shajan *et al.* 2004).

Since then, a long process of sedimentation produced by watercourses seems to have shifted the coastline considerably towards the west. Some data on the history of these geomorphological processes can be deduced from research carried out at the Pattanam site on the estuary of the Periyar River. In this area, the geomorphological sequences seem to indicate a marine transgression dating from 8,000 to 6,000 BC and a regression dating from 5,000 to 3,000 BC. The presence of a large palaeo-delta to the south of the current course of the Peryiar indicates that the course of the river moved from the NW to the SE.

The paleo-delta itself is bordered to the south by the Paravur canal, which appears to be a palaeo-channel of its ancient course, the abundance of sandy ridges and delta sediment therefore suggesting that the course of the Peryiar originally passed further south than the site of Pattanam (Shajan *et al.* 2004, 316). Such developments could have taken place in the Madayi area which, moreover, appears to be particularly suitable for human settlement. It is located at about 170-180 m above sea level, at the junction of four rivers (Taliparamba,

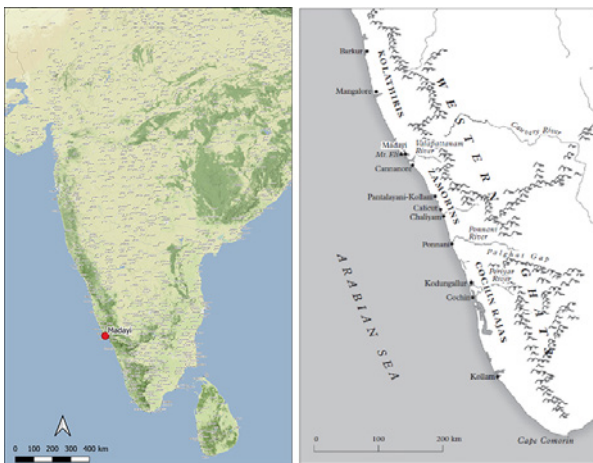


FIGURE 1. Left: Madayi's location. Right: Malabar's principal ports of trade in the 15th century (by the author based on Prange 2018).

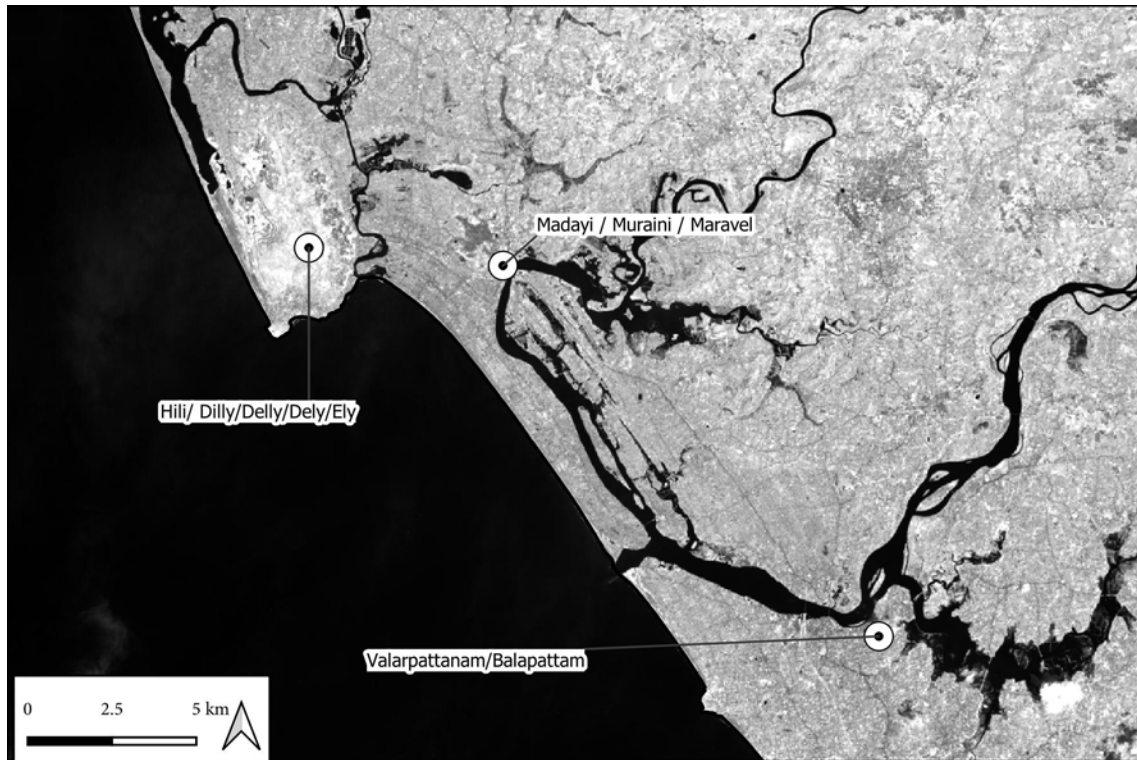


FIGURE 2. Landsat infrared of Madayi's region with historical place names.

Valapattanam, Kuppam and Perumba) and, therefore, sheltered from river flooding. It is also sheltered from oceanic winds by Mount Ezhimala.

As a preliminary step in reconstructing the historical landscape, we studied the river delta via remote sensing. From a series of satellite images (Landsat 8 B3,4,6), we can see that marine regression has formed a series of progressive sandy ridges that go from east to west and, at the same time, mark the deformation of the watercourses as they move from the laterite layers to the alluvial sands of the coastal plains (La Salvia and Moderato 2020). Several palaeo-river valleys also seem to be recognisable, the second of which, the one immediately south of the fortress, follows the contemporary road that runs along the current course of the river, passing a short distance from the present-day Madayi Mosque.

It should also be remembered that the frequent geomorphological changes along the Kerala coastline have resulted in most of the historical sites being located some distance from

the contemporary ones from which they take their name. For instance, the historical site of Pattanam/Muziris is located on the southern side of the bay while the modern town of Kodungallur is on the opposite side (Shajan et al. 2004).

The western area of the plateau, where the laterite slopes are less steep, is known as the 'Jewish Tank'. This toponym is probably related to the presence of a large rectangular cistern, cut directly into the laterite for 50×2 metres and with a maximum visible depth of at least 3.5 m; a long ramp, carved directly into the rock, is located on one of the shorter sides. Smaller circular cisterns are present throughout the surrounding area, as are the remains of walls and channels. Such a situation seems to indicate a deep and prolonged process of anthropising the landscape.

A fortified structure, known as the Madayi Fort, is in the southern part of this plateau. The fortification is trapezoidal and about 100×90 metres wide, with four square towers at the corners and a 'pincer' gate on its northern side.

All the bricks of the masonry seem to have been obtained and quarried directly from the laterite rock. The exact date of construction is still unknown but it is thought that it may be related to the reign of Kolathiris and that it was finally abandoned in 1887 (Logan 1887, 8-10).

The strategic position of the fort is evident to this day and should therefore have been even more pronounced in the past when, as mentioned, the river flowed directly into the sea instead of bending sharply to the south as it does today. At the foot of this hill is the mosque, where an epigraph on wood is still preserved, traditionally dated 1124 although there is still some debate regarding its age, given the fact that the year of the Hegira is not precisely readable (Sewell 1882, 242; Logan 1887, 424; Narayanan 2018, 344).

The aforementioned paleo-river, which passes close to the fort and the mosque, suggests the presence of a river port in the surrounding area. Traces of this past mercantile activity can be found in the rich body of historical and cartographic sources for the region, which also suggest the presence of bustling ports often associated with the presence of foreign, Jewish and Muslim trading communities.

From the list of ports compiled by Cosmas Indicopleustes for India and Malabar, one gets the impression of a region that was fully integrated into the trade networks that crossed the Indian Ocean already from Late Antiquity, although the Greco-Roman sources show, in general, a greater knowledge of the northern Indian regions. In the 11th book of Cosmas, however, eleven ports on the Indian coast are mentioned and some of these belong to the Malé/Malabar region (Banaji 2015).

Later, in the 9th century, a place called Babattan is mentioned by the Muslim geographer Ibn Khordadbeh and identified by Nainar as Baliapatam, which could be, in turn, the very Pudopatana mentioned by Cosmas (Nainar 1942, 25-26, 29; Ahmad 1989, 22): The place in question is, in fact, located on the Malabar coast, one day's journey from Schinjli and Bullin and five miles from Cannanore (modern Kannur). It is therefore one of the intermediate ports between the Persian Gulf and Ceylon, along the route that eventually led to China. This trade network was therefore active during the medieval

period. A local source, the epic poem *Mushika Vamsa*, mentions that the foundation of two sites, Muraini (Mathy) and Valabhappattana (Valarpattanam/Baliapattam) must be attributed to King Vallabha II, around the end of the 12th century AD (Kunhali 1975, 329-30).

In his study of medieval Muslim trade networks, Lambourn (2008) states that the Malabar coast had direct connections to Aden through a series of individual small ports rather than through larger regional hubs. The list of *qadis* and *khabs* mentioned follows the route from the Indian west coast to the east coast of Coromandel. The Malabar ports are therefore listed from north to south and three of these are particularly significant for our research. The first is Hili, identified with Mount Eli, which is the highest orographic point of the coast in this area and therefore fundamental for orientation in ancient navigation. In fact, it is mentioned by Al-Dimashi and Abul Fidā (Ras Hili) in the early 14th century and later by Ibn Battuta who reports, for the same site, the presence of a famous Friday mosque, a *madrassa* and a canteen. According to Lambourn (2008, 28), the site corresponds to the modern village of Madayi. Bud provides fewer details although its toponym may be a truncated derivation from Buddfattan, mentioned again by Al-Dimashqi and Ibn Battuta as being under the control of the ruler of Jurfatan. It could also be located in an area between Mount Eli and Cannanore and, therefore, perhaps identifiable with Babattan/Baliapattanam/Pudupattanam in earlier sources (Nainar 1942, 39-40).

We may also assume that many different 'Poudopatanas' were active and present along the Malabar coast at different times. However, if we consider the geographical position of this toponym in later cartography, as we will describe shortly, the term seems to fit better with the Maday area. The intensification of trade linked to the Malabar coast is, in fact, also well attested in later medieval and modern sources. As early as the 15th century, Tomé Pires lists 29 inhabited seaports. Among these we can still find Hyeri, Baliapatam/Balea Patanam, Puthupattanam/Pudopatana and Madayid/Marlarjanj mentioned. Cortesão (Cortesão 1944, 75) identifies Hyeri as a place

that existed south of Mount Dely (Mount Ely), whereas Baliapatanam is associated with a small town on the southern river of the same name, located between the same mountain and Cannanore (modern Kannur). Moreover, for the first time the toponym of Madayi is explicitly recorded in this source. Furthermore, the *Livro de Duarte Barbosa*, dating from the early Portuguese colonial period, reports the presence of a Jewish community at the foot of Mount D'Ely, in a place called Maravel. The book's editor, Dames, explains that Maravel/Maranel is most probably identifiable with Madayi.

Currently there are no longer any Jewish residents in the area. However, traces of an ancient presence is probably still reflected in a historical place name known as the 'Jewish Pond-Madaypara' on Maday Hill (Barbosa and Stanley 2010, 79-80).

Logan (1887, 235-37) also reports the presence of two fortified settlements along the Taliparamba and Valarpattanam rivers as well as trading centres (the so-called Palangadi, probably located in the

vicinity of the Madayi Mosque) and sites with strong Islamic connotations.

From a cartographic point of view, one of the first accounts is the place name Elly in the Catalan Atlas (1375), in Fra Mauro's Mappamondo, where we can find Chavo De Eli (Eli's Cape) together with the name of a settlement called Bassia/Balli. Fra Mauro's map is based on travel accounts earlier than 1453 (and for this region, mainly on Marco Polo's data), so we could state that Eli/Hili cape was still a reference point for western and eastern geographers in the 12-13th century. Mount Deli is also present in Gherard Mercator's *Asia Orientalis* (1607). The term Balepatan/Baliapatan is also mentioned in Nicolas Fer's *Les Indes Orientales* (1721), in Guillame de L'Isle's Map (1723), and refers to a place midway between Mount Dely and Cananore, while Jefferys' map (1768) shows Baliapatan together with a 'Bazaar' near a river course, located south of Mount Ely.

Consequently, the sources tend to report associated toponyms referring to Mount Ely and those related to and/or derived from the toponyms



FIGURE 3. Top left: Catala Atlas detail with the toponym Elly. Top right: Fra Mauro's Mappamondo and toponym Chavo de Eli. Bottom left: Mercator's Map with Mount Deli toponym. Bottom right: Jefferys's East Indies with Mount Dilly/Baliepatanam toponym.

Babattan/Baliapattanam/Pudupattanam, known from older sources.

Some preliminary conclusions can, however, be drawn based on this body of cartographic and topographical data. First, it is quite evident that the fact this part of the Malabar coast was continuously mentioned in late antique and medieval geographical sources is an indication of the persistence of commercial activities, at least since the early Middle Ages (if not earlier, considering that Cosmas' list may not have counted all the ports operating in the area).

The almost constant references in late medieval and early modern cartographic and geographical sources to Mount Ely/D'Ely, the only relief on an otherwise flat coastline, as a strategic point for navigation supports the idea of continuous traffic plying intense oceanic trade. These trade relations were characterised by a strong Arab-Muslim presence that left marks such as the early construction of the Madayi Mosque which was built, at the latest (if we are to trust Logan's interpretation) at least as early as the first few decades of the 12th

century (and therefore, in any case, prior to Ibn Battuta's writings).

We may suppose that the plurality of names related to the area surrounding the present settlement of Madayi derives from the fact that we are dealing with a scattered settlement, at least for the medieval-modern period. This same settlement may therefore have consisted of two separate harbours set on either bank of the two rivers, namely Balepatanam and Hili/Madayi.

The continuous presence of the toponym Hili/Elly/Eli and associated with a distinctive element of the landscape such as the promontory indicates a certain attention to this specific point on the coast, from which, according to Barbosa, the ships of the Moors and Gentiles got their supplies and then departed (Yule 1866, 2:451-53). Finally, as already mentioned, according to Ganesh (Ganesh 2009, 179-80) the term or rather the suffix -pattanam probably indicates the presence of commercial centres that operated as trading hubs all along the coast.

The sherds collected on the Madayi plateau also seem to confirm what has emerged from an



FIGURE 4. Madayi's site with the main locations: Jewish Pond, Madayi Fort and the Madayi Mosque (produced by the author).

analysis of the written sources and the preliminary analysis of the historical landscape of the area, highlighting a long period of occupation of the site, at least from Late Antiquity and throughout the Middle Ages.

Despite the absence of stratigraphic excavation and intensive reconnaissance tests of the entire Maday Hill area, it is possible to draw some conclusions based on the available data. The area around the so-called Cistern of the Jews yielded most of the TGP/TAG fragments together with numerous pieces of common ware (D. Hill, Speakman, and Glascock 2004; D. Hill 2006). The assemblages from the fort and mosque areas may have to be considered together, as many of the sherds recovered near the Islamic place of worship may have slid downwards because of the hillside eroding, ending up in secondary positions. However, most of the finds pertaining to the Mosque are of Chinese fine pottery (Longquan/Yue celadon) and other more common classes such as fragments tempered with limestone degreasers and torpedo amphorae. From a chronological point of view, therefore, the oldest fragments are those from the mosque (4th-8th) and this is not surprising given its possible privileged position as a landing place, directly connected to the Kuppam paleo-river. A second phase can be detected around the 9th century with the occupation of the area around the Cistern of the Jews, with a strong concentration of TGP/TAG. In this same phase the area of the mosque also became receptive to eastern trade routes (D. Hill, La Salvia, and Moderato 2020; La Salvia and Moderato 2020).

The whole group of fragments from the three areas, however, highlights the long occupation of the Madayi district and indicates the presence of probable river trade linked to the sea, active at least since Late Antiquity, with a first peak of activity around the 9th-10th century AD, well before the construction of the hill fort.

Considering the data available, Madayi is likely to form part of what Prange (2018, 28) calls *entrepôts* or trading ports; places specifically focusing on facilitating commercial exchanges with different cultures and institutions, characterised by the presence of access to water (anchorage, harbours), commercial infrastructures and facilities.

Further research into historical cartography and aerial and satellite images, associated with the possible coring of the coastal sediments, will be able to provide a more complete picture of the geomorphological and historical transformations undergone by the landscape in this area.

BIBLIOGRAPHY

- AHMAD, S. Maqbul (1989). *Arabic Classical Accounts of India and China*. Shimla: Indian Institute of Advanced Study in association with Rddhi-India, Calcutta.
- BANAJI, Jairus (2015). “‘Regions That Look Seaward’: Changing Fortunes, Submerged Histories, and the Slow Capitalism of the Sea”. In: DE ROMANIS, Federico; MAIURO Marco, *Across the Ocean: Nine Essays on Indo-Mediterranean Trade*, Boston: Brill, 114-26.
- BARBOSA, Duarte; STANLEY, Henry E. J. (2010). *Description of the Coasts of East Africa and Malabar: In the Beginning of the Sixteenth Century*. Cambridge; New York: Cambridge Univ. Press.
- BASSO, Patrizia (2007). “Cartografia E Ricerca Storico-Archeologica”. *Bollettino dell’Associazione Italiana di Cartografia* 129-130-13, 55-67.
- CAMBI, Franco (2011). *Manuale Di Archeologia Dei Paesaggi. Metodologie, Fonti Contesti*. Carocci.
- CARDINI, Franco; VANOLI, Alessandro (2017). *La via Della Seta: Una Storia Millenaria Tra Oriente e Occidente*. Intersezioni 489. Bologna: Il mulino.
- CASSON, L. (1989). *The Periplus Maris Erythraei: Text with Introduction, Translation, and Commentary*. Princeton University Press.
- CASSON, L. (1990). “New Light on Maritime Loans: P. Vindob G 40822”. *Zeitschrift Für Papyrologie Und Epigraphik* 84. Dr. Rudolf Habelt GmbH, Bonn (Germany): 195-206.
- CHIANG, Yao-Yi; DUAN, Weiwei; LEYK, Stefan; UHL, Johannes H.; KNOBLOCK, Craig A. (2020). *Using Historical Maps in Scientific Studies: Applications, Challenges, and Best Practices*. <http://link.springer.com/10.1007/978-3-319-66908-3>

- CHOUQUER, Gérard; CLAVEL LEVEQUE, Monique; FAVORY, François; VALLAT, Jean-Pierre (1987). *Structures Agraires En Italie Centromeridionale: Cadastres et Paysages Ruraux*. Rome.
- CORTESÃO, Armando (ed.) (1944). *The Suma Oriental of Tome Pires: An Account of the East, from the Red Sea to China, Written in Malacca and India in 1512-1515; and The Book of Francisco Rodrigues: Pilot-Major of the Armada That Discovered Banda and the Moluccas: Rutter of a Voyage in the Red Sea, Nautical Rules, Almanack, and Maps, Written and Drawn in the East before 1515*.
- CUNLIFFE, Barry W. (2015). *By Steppe, Desert, and Ocean: The Birth of Eurasia*. First edition. Oxford: Oxford University Press.
- DE ROMANIS, Federico (1997). "Rome and the Notitia of India: Relations between Rome and Southern India from 30 BC to the Flavian Period". In: DE ROMANIS F.; TCHERNIA, F. (ed.). *Crossings: Early Mediterranean Contacts with India*, 80-160.
- FIACCADORI, Gianfranco (1992). *Teofilo Indiano*. Ravenna: Mario Lapucci.
- FITZPATRICK, Matthew P. (2011). "Provincializing Rome: The Indian Ocean Trade Network and Roman Imperialism". *Journal of World History* 22 (1). University of Hawai'i Press, 27-54.
- HAWKES, Jason D. (2014a). "Chronological Sequences and the Problem of Early Medieval Settlement in India". *Puratattva, Bulletin of the Indian Archaeological Society* 44, 208-28.
- HAWKES, Jason D. (2014b). "Finding the 'Early Medieval' in South Asian Archaeology". *Asian Perspectives* 53 (1). University of Hawai'i Press, 53-96.
- HAWKES, Jason D., (2019). "The Elephant in the Room: Archaeology and the Early Medieval Period in India". In *South Asian Archaeology and Art 2014*, edited by E. Myrdal, 169-83.
- GANESH, K.N., (2009). "Lived Spaces in History: A Study in Human Geography in the Context of Sangam Texts". *Studies in History* 25 (2), 151-95. <https://doi.org/10.1177/025764301002500201>
- GARCIA-MOLSOSA, Arnau; ORENCO, Hector A.; LAWRENCE, Dan; PHILIP, Graham; HOPPER, Kristen; PETRIE, Cameron A. (2021). "Potential of Deep Learning Segmentation for the Extraction of Archaeological Features from Historical Map Series". *Archaeological Prospection*, 1-13.
- GILLINGS, Mark; HACIGÜZELLER, Piraye; LOCK, G. R. (2018). *Re-Mapping Archaeology: Critical Perspectives, Alternative Mappings*. New York, NY: Routledge.
- GURUKKAL, Rājan; VARIER, Rāghava (1999). *Cultural History of Kerala*. Thiruvananthapuram, Kerala: Dept. of Cultural Publications, Govt. of Kerala.
- HILL, David (2006). *The Materials and Technology of Glazed Ceramics from the Deh Luran Plain, Southwestern Iran: A Study in Innovation*. Oxford. England: BAR International Series.
- HILL, David; LA SALVIA, Vasco; MODERATO, Marco (2020). "La costa del Malabar (Kerala, India) fra Golfo Persico e Cina nel Medioevo: la ceramica come indicatore delle rotte commerciali". In: GIORGIO, Marcella (ed.). *Storie (di) ceramiche 6: commerci e consumi: atti della giornata di studi in ricordo di Graziella Berti, a sei anni dalla scomparsa*, All'Insegna del Giglio, 9-21.
- HILL, David; SPEAKMAN, R.J.; GLASCOCK, M. D. (2004). "Chemical and Mineralogical Characterization of Sasanian and Early Islamic Glazed Ceramics from the Deh Luran Plain, Southwestern Iran". *Archaeometry* 46 (4), 585-605. <https://doi.org/10.1111/j.1475-4754.2004.00175.x>
- HOWARD, M. C. (2012). *Transnationalism in Ancient and Medieval Societies*. London.
- ILIAS, M.H., (2007). "Mappila Muslims and the Cultural Content of Trading Arab Diaspora on the Malabar Coast". *Asian Journal of Social Science* 35 (4/5), 434-56.
- KUNHALI, V. (1975). "Advent of Islam in Kerala: Special Features". In: *Proceedings of the Indian History Congress*, 36, 326-37. <https://www.jstor.org/stable/44138858>
- LA SALVIA, Vasco; MODERATO, Marco (2020). "La Costa Del Malabar (India) Fra Tarda Antichità e Primo Medioevo". In: *VI Ciclo Di Studi Medievali*, 301-10. Lesmo: EBS Edizioni, 301-310.

- LAMBOURN, Elizabeth (2008). "India from Aden: Khutba and Muslim Urban Networks in Late Thirteenth-Century India". In: HALL, Kenneth (ed.). *Secondary Cities and Urban Networking in the Indian Ocean Realm, c. 1400-1800*. Comparative Urban Studies. Lanham: Lexington Books, 55-97.
- LOGAN, William (1887). *Malabar Manual*. Madras.
- MALEKANDATHIL, Pius (2007). "Winds of Change and Links of Continuity: A Study on the Merchant Groups of Kerala and the Channels of Their Trade. 1000-1800". *Journal of the Economic and Social History of the Orient* 50.2/3, 260-62.
- MALEKANDATHIL, Pius (2010). *Maritime India: Trade, Religion and Polity in the Indian Ocean*. Delhi: Primus Books.
- MOHAMED, K.M.; MOHAMMAD, K.M. (1999). "Arab Relations with Malabar Coast from 9th to 16th Centuries". *Proceedings of the Indian History Congress* 60, 226-34.
- NAINAR, Muhammad Husayn (1942). *Arab Geographers' Knowledge of Southern India*. University of Madras. https://www.nli.org.il/en/books/NNL_ALEPH002941122/NLI
- NARAYANAN, M. G. S. (2018). *Perumāls of Kerala: Brahmin Oligarchy and Ritual Monarchy: Political and Social Conditions of Kerala under the Cēra Perumāls of Makōtai (c. AD 800-AD 1124)*.
- PETRIE, Cameron; ORENCO, Hector; GREEN, Adam; WALKER, Joanna; GARCIA, Arnau; CONESA, Francesc; KNOX, J.; SINGH, Ravindra (2018). "Mapping Archaeology While Mapping an Empire: Using Historical Maps to Reconstruct Ancient Settlement Landscapes in Modern India and Pakistan". *Geosciences* 9 (1): 11. <https://doi.org/10.3390/geosciences9010011>
- PRANGE, Sebastian R. (2008). "Scholars and the Sea: A Historiography of the Indian Ocean". *History Compass* 6 (5): 1382-93. <https://doi.org/10.1111/j.1478-0542.2008.00538.x>
- PRANGE, Sebastian R. (2018). *Monsoon Islam: Trade and Faith on the Medieval Malabar Coast*. Cambridge: Cambridge University Press.
- SELAND, Eivind Heldaas (2012). "Trade and Christianity in the Indian Ocean during Late Antiquity". *Journal of Late Antiquity* 5 (1), 72-86.
- SEWELL, R. (1882). *Lists of the Antiquarian Remains in the Presidency of Madras*. E. Keys, at the Government Press.
- SHAJAN, K. P.; TOMBER, R.; SELVAKUMAR, V.; CHERIAN, P. J. (2004). "Locating the Ancient Port of Muziris: Fresh Findings from Pattanam". *Journal of Roman Archaeology* 17, 312-20. <https://doi.org/10.1017/S1047759400008278>
- TOMBER, Roberta (2007). "Rome and Mesopotamia - Importers into India in the First Millennium AD". *Antiquity* 81 (314): 972-88.
- YULE, Henry (1866). *Cathay and the Way Thither*. Vol. 2.

Las vías pecuarias altomedievales del Baix Montseny (Cataluña)

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RESUMEN

El artículo presenta un estudio sobre la probable adscripción altomedieval de las vías pecuarias tradicionales existentes en la primera mitad del siglo xx en el Baix Montseny (Cataluña).

PALABRAS CLAVE: SIG, arqueología, altomedieval, Baix Montseny, vía pecuaria.

Medieval drovers' roads in Baix Montseny (Catalonia)

ABSTRACT

This article presents research into the probable early medieval origin of the traditional drovers' roads documented in the first half of the 20th century in Baix Montseny (Catalonia).

KEYWORDS: GIS, archaeology, medieval, Baix Montseny, drovers' roads.

1. INTRODUCCIÓN

El artículo presenta un estudio sobre la probable adscripción al periodo altomedieval, siglos ix y x, de las vías pecuarias tradicionales del Baix Montseny (Cataluña). Entendemos como vías pecuarias tradicionales aquellos caminos de uso público y destinados a la trashumancia hasta la primera mitad del siglo xx. En el Baix Montseny transcurren tres cañadas destacables: el camino de Sant Elies, el camino de Viladrau a Hortsavinyà y el camino de la Marina. Analizaremos si estas vías pecuarias jugaron un importante papel en la articulación del territorio durante la alta edad media y si fueron utilizadas como vías de comunicación regional y no solo ganaderas. Para validar la hipó-

tesis, se han analizado los mapas resultantes de superponer los distintos yacimientos de la región junto a los trazados de las principales vías pecuarias del área.

La región del Baix Montseny es una comarca natural situada entre las provincias de Barcelona y Girona. Formada por veinte municipios y con un área aproximada de 630 km², tiene como núcleo neurálgico la población de Sant Celoni. La orografía presenta una clara dicotomía entre el llano y el monte, con un desnivel de más de 1.500 metros entre ambos. Geográficamente está compuesto esencialmente por tres unidades de relieve: el macizo del Montseny, la depresión del Vallès y el conjunto formado por el macizo del Montnegre y el Corredor. Se trata de una zona especialmente húmeda y con diversos sectores de bastante altitud, lo que motiva que se den

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unas condiciones climáticas específicas con una biodiversidad excepcional (Salvat, 2014: 19). No en vano, el macizo del Montseny está catalogado por la UNESCO como Reserva de la Biosfera.²

El área de estudio tiene una ocupación ininterrumpida desde el neolítico hasta nuestros días. Durante siglos, el poblamiento tradicional de carácter agropecuario ha modificado notablemente el paisaje para adaptarlo a sus necesidades. Todo parece indicar que la actividad ganadera de la comarca se iniciaría en el calcolítico y se consolidaría en el periodo ibérico (García 2013:287). La documentación medieval indica que la ganadería era una actividad destacada en la comarca a partir del siglo XI, tal y como ilustraría un documento del año 1088 con el pago por el paso de ganado por unas tierras de cultivo, o la instalación del mercado de Sant Celoni, motivada, en parte, por el crecimiento de la actividad ganadera (Vilaginés, 2001). A partir del siglo XVII hubo un aumento en la producción agropecuaria, lo que impulsó la creación de nuevas zonas de pasto dentro de los bosques (Pujantell, 2012:82-90). Históricamente, la mayor parte de los pastos de la región pertenecían a las diferentes masías de las zonas de montaña (Estrada 2003:41-43); estos pastos estaban unidos por caminos locales que llevaban directamente a las masías. No obstante, las principales vías pecuarias formaban parte de una trashumancia que iba de los pastos de verano, normalmente en el Pirineo, a los pastos de invierno de la depresión central, el prelitoral y la costa catalana. En este sentido, el Baix Montseny era un punto intermedio más que un destino final.

El modelo económico de la región empezó a cambiar en la década de 1920 con la llegada de la industria textil y, sobre todo, con el gran desarrollo industrial de las décadas de 1950 y de 1970. Aun así, la ganadería extensiva mantenía cierta relevancia hasta la primera mitad del siglo XX, los rebaños de ovejas pasaban el verano en las zonas altas del Montseny y en invierno bajaban a la llanura del Vallès o al macizo del Montnegre (Pujantell, 2012: 118). La industrialización de las últimas décadas ha comportado importantes cambios en el paisaje, como una intensa urbanización de la llanura y un progresivo abandono de los campos de cultivo y las zonas de pasto.

Cambios que, desde el punto de vista arqueológico, han supuesto la destrucción de muchos yacimientos en la llanura y el ocultamiento bajo el bosque de buena parte del modelo de ocupación tradicional. De toda esta actividad ganadera no ha quedado en el Baix Montseny un registro documental significativo, ni tampoco un registro arqueológico muy definido, ya que las estructuras ganaderas no varían mucho en morfología a lo largo del tiempo y han sido ampliamente reutilizadas; aunque sí que ha quedado cierta impronta en la red viaria y la toponimia local, lo que nos permite identificar partes de las antiguas vías pecuarias, áreas de pasto y zonas de descanso para la trashumancia estacional como el Pla de la Calma o Mosqueroles (Vilaginés, 2001, 39).

2. METODOLOGÍA

Para determinar el posible uso de las vías pecuarias principales en el periodo altomedieval, el primer paso ha sido realizar un estudio con la geolocalización de todas las unidades topográficas (UT)³ que aparecen en los distintos inventarios arqueológicos y arquitectónicos, así como en la documentación de los siglos IX y X sobre el área de estudio. El segundo paso ha sido restituir los trazados de las principales cañadas documentadas en un SIG. Finalmente, se han superpuesto las distintas UT a la restitución de las vías pecuarias, lo que nos permite observar las coincidencias y certificar su uso a lo largo del tiempo.

Para que este estudio sea posible se requiere crear una base de datos (BD) que contenga la información de todas las unidades topográficas de la región, pero trabajar a partir del concepto de UT conlleva ser consciente de dos consideraciones imprescindibles para evitar la creación de registros duplicados o erróneos a la hora de diseñar una BD. La primera sería que los diferentes elementos de una UT –acción, espacio, tiempo– son independientes entre sí y es su relación lo que aca-

2. Para más información: <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/europe-north-america/spain/montseny>

3. Definimos una unidad topográfica como el indicador de una acción o situación que se puede ubicar en el tiempo y el espacio, independientemente de la especificidad de la fuente de información y de su origen biótico, abiótico o antrópico (Mauri, 2006, 43).

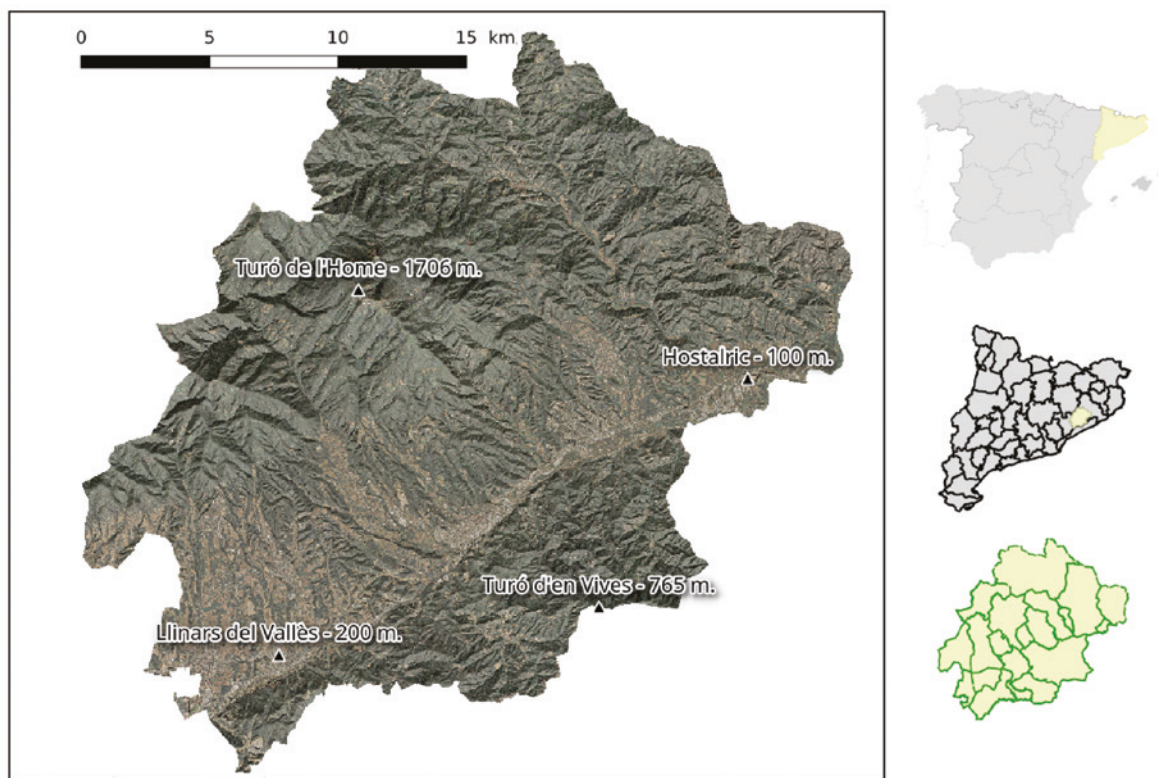


FIGURA 1. Ortofotomapa del Baix Montseny.

ba formando la UT como tal; dicho de otro modo, un mismo espacio físico puede tener diferentes acciones en diferentes tiempos y cada una de estas combinaciones puede dar lugar a una UT distinta. La segunda, hay que tener presente que diversas fuentes pueden hacer referencia a una misma unidad topográfica. Es por esto por lo que el diseño de la base de datos debe ser relacional, es decir, las tablas de almacenamiento de los datos —en nuestro caso, las acciones, los espacios físicos, la datación, las fuentes, etc.— tienen que estar separadas de las tablas que contienen las estructuras lógicas, la relación entre los elementos que dará lugar a una unidad topográfica.

La cartografía juega un papel fundamental en cualquier estudio sobre el territorio, por lo que vale la pena dedicar un espacio a comentar las fuentes utilizadas. Los mapas anteriores al siglo XVIII suelen ser mapas de toda Cataluña, muy inexactos y poco detallados, por lo que no nos son de utilidad en esta investigación. El primer mapa mínimamente útil, para nuestros intereses, está fechado en 1716 y se trata de un atlas del conde Darnius con los diferentes corregimientos

de Cataluña.⁴ En el último cuarto del siglo XIX tenemos interesantes mapas a nivel provincial donde se detallan las principales vías de comunicación de la época, como por ejemplo el *Plan de carreteras provinciales de Barcelona* editado por la Diputación de Barcelona en el 1879.⁵ Los primeros mapas detallados del Baix Montseny datan de las primeras décadas del siglo XX, y de entre ellos cabe destacar el mapa del Montseny de 1924⁶ y el mapa del Montnegre de 1930,⁷ ambos realizados por el Centre Excursionista de Catalunya. También se han utilizado los mapas creados a partir de la fotografía aérea de los llamados «vuelos americanos» de la serie A de 1945-1946 y de la serie B de 1950. Finalmente, se ha utilizado la cartografía actual, disponible a través de los servidores WMS del Institut Cartogràfic i Geo-

4. ICGC (2016). Registro: RM.250110. Disponible: <http://cartotecadigital.icgc.cat>

5. ICGC (2010). Registro: RM.2270. Disponible: <http://cartotecadigital.icgc.cat>

6. ICGC (2010). Registro: BDM24. Disponible: <http://cartotecadigital.icgc.cat>

7. ICGC (2008). Registro: BDM126. Disponible: <http://cartotecadigital.icgc.cat>

lògic de Catalunya (ICGC),⁸ para añadir a nuestro SIG varios mapas ortofotográficos y topográficos. Las fuentes cartográficas recientes nos ofrecen un nivel de detalle realmente excelente, pero con el evidente problema de que no son representativas de un pasado tan remoto como el altomedieval.

Sobre la documentación utilizada, vemos que las primeras menciones que hacen referencia al Baix Montseny son del siglo IX, coincidiendo con el dominio carolingio. La documentación de los siglos IX y X no es muy abundante y, en líneas generales, es de carácter administrativo y legal. Se trata principalmente de donaciones, consagraciones, testamentos y compraventas; documentos muy útiles a la hora de definir afrontaciones, articular el paisaje humano y, en menor medida, el paisaje biótico. Una de las complicaciones es la gran cantidad de antropónimos, utilizados en la identificación de propiedades, que aparece en la documentación altomedieval; esto implica que, en la mayoría de los casos, cambian en cada generación y no dejan un rastro fosilizado en la toponimia que nos pueda dar una localización más allá de su existencia en un municipio u otro. Además, como es habitual en la documentación del periodo, las localizaciones nunca se presentan exactas, aunque combinando las distintas fuentes documentales y cartográficas hemos podido geolocalizar, en un espacio relativamente preciso, parte de los topónimos y microtopónimos que aparecen en la documentación. Una de las fuentes documentales más importantes para el estudio ha sido el cartulario del monasterio de Sant Cugat, consultado a partir de la transcripción de Rius Serra (1945-1947) y el índice toponímico de Roca Garriga (1981), especialmente relevante dado que el cenobio de Sant Cugat se convirtió en un gran señor de las tierras del Baix Montseny durante los siglos X y XI dentro de un proceso general de donaciones de tierras a la Iglesia por parte de los campesinos. Otra fuente destacada es el diplomatario de la catedral de Barcelona, pues la mayor parte del territorio del Baix Montseny formaba parte de dicho obispado; la lectura y vaciado de esta fuente se ha hecho

8. Para más información: <https://www.icgc.cat/Administracio-i-empresa/Serveis/Geoinformacio-en-linia-Geoserveis>

a partir de la compilación de Fàbrega Grau (1995), que utiliza la datación de Mn. Josep Bauccells. Finalmente, cabe destacar la obra *Catalunya Carolingia*, de la que se han utilizado los volúmenes originales de Abadal (1986), referentes a los diplomas reales, y el quinto volumen, dedicado al condado de Girona (Sobrequés *et alii*, 2003).

Otro tipo de fuente utilizada ha sido la de los inventarios arqueológicos y arquitectónicos, de los que destacamos los volúmenes de *Catalunya Romànica* (Vigué, 1984-1998) y los *Inventarios del Patrimonio Cultural Inmueble Arqueológico y Arquitectónico de Cataluña*.⁹ La utilización de los Inventarios del Patrimonio está plenamente justificada por la gran cantidad de información útil que contienen sus fichas, desde una descripción básica del yacimiento o edificio, hasta información sobre las distintas intervenciones arqueológicas, tipologías, vegetación del área, programas de protección, etc. Aun así, ambos inventarios tienen importantes carencias debido a la infrecuente actualización de la información, lo que comporta que no todas las fichas empleen el mismo sistema de coordenadas, que haya campos importantes vacíos o que existan algunas incongruencias entre distintas fichas. A pesar del intento de completar estos vacíos, hay casos en los que no ha sido posible hacerlo y se han descartado algunas fichas que se han considerado poco fiables. Como criterio general, hemos descartado aquellas fichas en las que la datación o la información se basan tan solamente en noticias orales imposibles de verificar y, también, aquellos yacimientos donde los únicos hallazgos consisten en unas pocas evidencias materiales aisladas.

El resultado obtenido de todo el proceso de vaciado documental y de los distintos inventarios arqueológicos y arquitectónicos ha sido una base de datos con más de 475 unidades topográficas de la región del Baix Montseny que, pese a dedicar especial interés al periodo altomedieval, abarcan los diversos periodos históricos hasta la edad contemporánea.

La segunda gran tarea ha sido la utilización de un SIG para crear los trazados de las vías pe-

9. Ambos consultables telemáticamente a través de: <https://egipci.cultura.gencat.cat>

cuarias tradicionales. La precisión de los mapas publicados, adecuada para una visualización general a nivel provincial, no ha sido suficiente para trabajar con el nivel de detalle requerido en este estudio, por lo que ha sido necesario hacer una restitución de los caminos a partir de otros trabajos publicados. Los trazados restituidos son el resultado de las aportaciones de varios autores como Duch *et alii* (2004), Garcia (2013) y sobre todo del trabajo de Miralles, Queralt y Sala (2002). La restitución se ha hecho a partir de un mapa topográfico a escala 1:5000 siguiendo las descripciones facilitadas (Miralles *et al.* 2002) y comparando los caminos con los otros trabajos publicados. Siempre que ha sido factible, el trazado ha recorrido los caminos rurales más coincidentes con los trazados originales, pero al acercarse a la zona de la depresión central, un sector con una intensa urbanización reciente, vemos que las vías de comunicación tradicionales han sido completamente alteradas. En estos casos en los que no hay un evidente recorrido, hemos escogido la ruta más directa y, preferiblemente, no coincidente con las vías de comunicación más modernas.

También hemos restituido el trazado de las principales vías de comunicación del periodo medieval dentro del área de estudio. La más destacada es la antigua Vía Augusta, que en época medieval es conocida como *strata Francisca*, y cruzaría nuestra área por la Depresión Prelitoral Catalana. El otro camino principal se situaría en el extremo este del Baix Montseny, y recorrería el valle de la Riera de Arbúcies, conectando las poblaciones de Vic con Blanes (García, 2013: 249). La tercera vía destacable se encontraría muy cerca del límite oeste del límite actual del Baix Montseny, y recorrería el valle del río Congost, uniendo Barcelona con Vic. La documentación medieval hace mención a estos caminos (Mundó, 2001: 43-45), aunque la primera representación de estos data de la segunda década del siglo XVIII.¹⁰ La red de caminos regionales la formarían los distintos ramales verticales de la *strata Francisca* que unirían esta vía con las distintas poblaciones, así como los caminos interiores que unirían los núcleos de población entre sí. Si bien

la comparación de las cañadas y las vías de comunicación regionales es un tema muy interesante, el alcance del mismo escapa al ámbito del estudio presentado en este artículo.

Una vez completada la restitución de los trazados de los caminos y la base de datos, el siguiente paso ha sido integrar en el SIG las distintas fuentes cartográficas, los caminos y la información de la base de datos. De este modo se ha podido analizar la superposición de las UT de los distintos periodos históricos, desde el neolítico hasta la alta edad media, con las vías pecuarias tradicionales.

3. LAS VÍAS PECUARIAS MEDIEVALES DEL BAIX MONTSENY

En el Baix Montseny podemos distinguir diversas vías ganaderas (véase Figura 2) que surgen de un tronco común que recorre el sector occidental de la llanura de Vic. La primera vía pecuaria la forman los distintos caminos de la Calma. El tramo principal, conocido como camino de Sant Elies, se inicia en el Molí Estatllat (Viladrau), pasa por el Pla de la Calma y los municipios de Sant Pere de Vilamajor, Sant Antoni de Vilamajor, cruza la strata Francisca y sigue bajando hasta llegar a las zonas de pasto del Vallès y el Maresme. También cabe destacar cinco caminos secundarios como la cañada de Samalús, que en su tramo final se cruzaría con el camino regional del Congost, la cañada de Vallfornès, la de Cànoves, la de la Torrassa del Moro y la de Sant Pere de Vilamajor. Es interesante señalar cómo los trazados de los caminos de la Torrassa y de Vilamajor discurren en varios tramos por el límite municipal entre Cànovas y Sant Pere de Vilamajor, y entre Cardedeu y Sant Antoni de Vilamajor.

La segunda cañada es el camino de Viladrau a Hortsavinyà. Esta cañada también parte del Molí Estatllat y avanza hasta Viladrau para después bajar por el macizo del Montseny, cruzando distintas poblaciones en dirección a Sant Celoni. Una vez en el llano, cruza la strata Francisca y avanza por el macizo del Montnegre hasta llegar a Hortsavinyà (Tordera). Hay que destacar diversos ramales, como el camino de Can Batalla, el camino de Can Rovira a Can Ginestar y el ca-

10. ICGC (2016). Registro: RM.250110. Disponible: <http://cartotecadigital.icgc.cat>

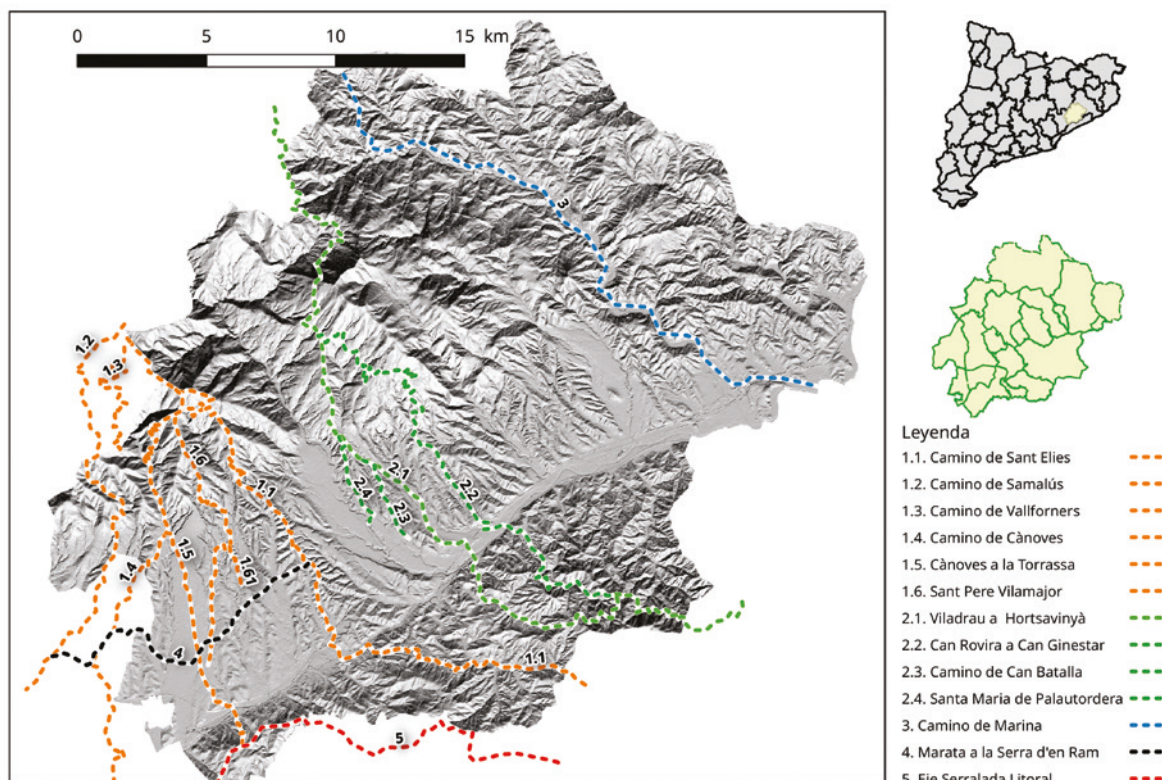


FIGURA 2. Vías pecuarias tradicionales del Baix Montseny.

mino de Santa Maria de Palautordera, que también circula cerca del límite municipal.

La tercera vía pecuaria es el camino de la Marina. Esta vía sale de Viladrau en dirección a Arbúcies y avanza por Hostalric hacia el municipio de Tordera. El camino está identificado en la documentación medieval y moderna como parte del camino que unía Vic con Blanes, y por lo tanto es un indicador de que al menos esta vía pecuaria tuvo en el pasado una función más generalista.

Finalmente, hay que destacar dos ejes transversales. El primero es el camino que va de la Marata a la sierra de Ram; esta vía cruza todos los caminos de la Calma así como los municipios de Cànoves, Cardedeu y Sant Antoni de Vilamajor. La segunda vía recorre en parte la cordillera Litoral y tenía un destacado papel en la distribución de los rebaños del Pirineo por el Maresme y el Barcelonès (Miralles, 2002, 90). Este camino entra en nuestra comarca desde el macizo del Corredor por Llinars del Vallès y sale de ella poco después para continuar su recorrido hacia el Maresme. Se puede observar cómo estos dos

caminos transcurren, en su paso por el Baix Montseny, en paralelo a la strata Francisca.

La superposición de las unidades topográficas junto al camino de Sant Elies (véase Figuras 3, 4, 5 y 6) nos permite observar cómo este camino pasa cerca de tres monumentos megalíticos: la Estela de la Calma (Montseny, E.5),¹¹ la Pedra Arca (Vilalba Sasserra, E.34) y la Pedra Gentil (E.29). La existencia de estos megalitos indica que probablemente nos encontramos ante uno de los caminos más antiguos del Baix Montseny. Esta relación entre caminos trashumantes y megalitos también se da, entre otros casos, en el camino de las Maioles en la Anoia (Clop, 1995) o en Almadén de la Plata en Sevilla (Murrieta, 2011). El camino también circula próximo al yacimiento romano y altomedieval de Sant Genís de Tapioles (Vallgorguina, E.31). De la época altomedieval también encontramos el asentamiento de Can Parera de Canyes (E.280) y la iglesia

11. El código E.X es la nomenclatura interna de nuestra base de datos. La E. hace referencia al espacio que ocupan una o varias unidades topográficas.

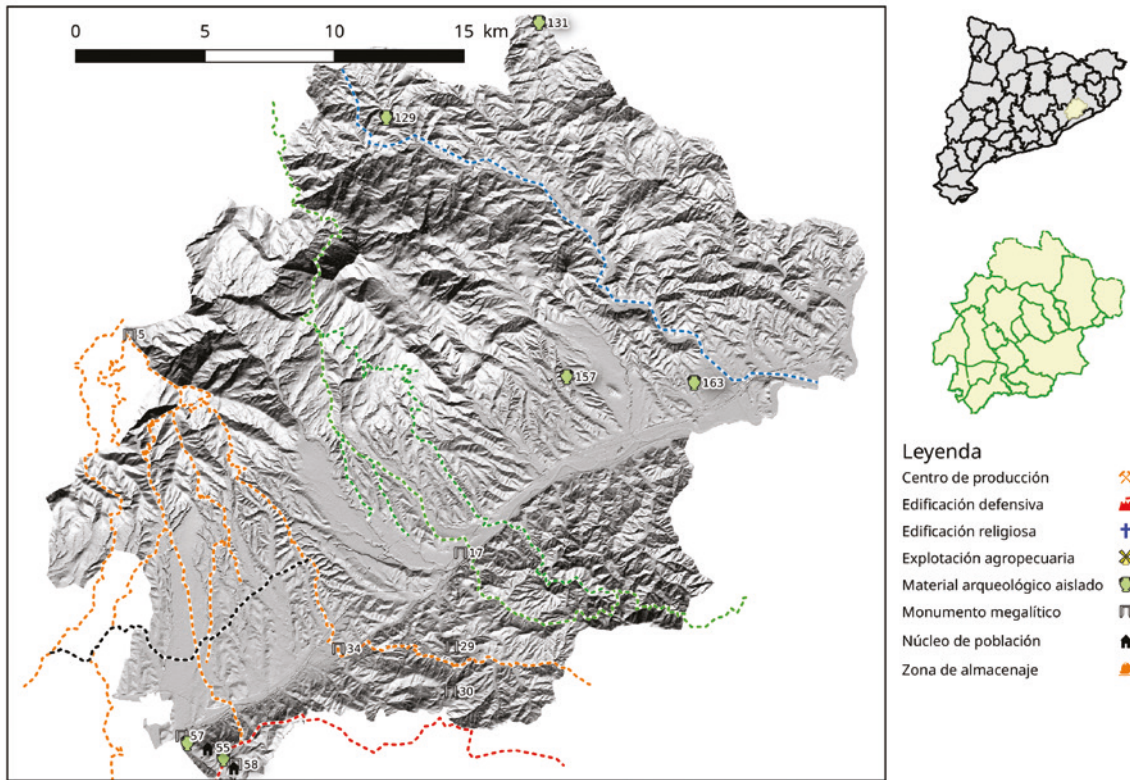


FIGURA 3. Vías pecuarias superpuestas con las unidades topográficas del calcolítico.

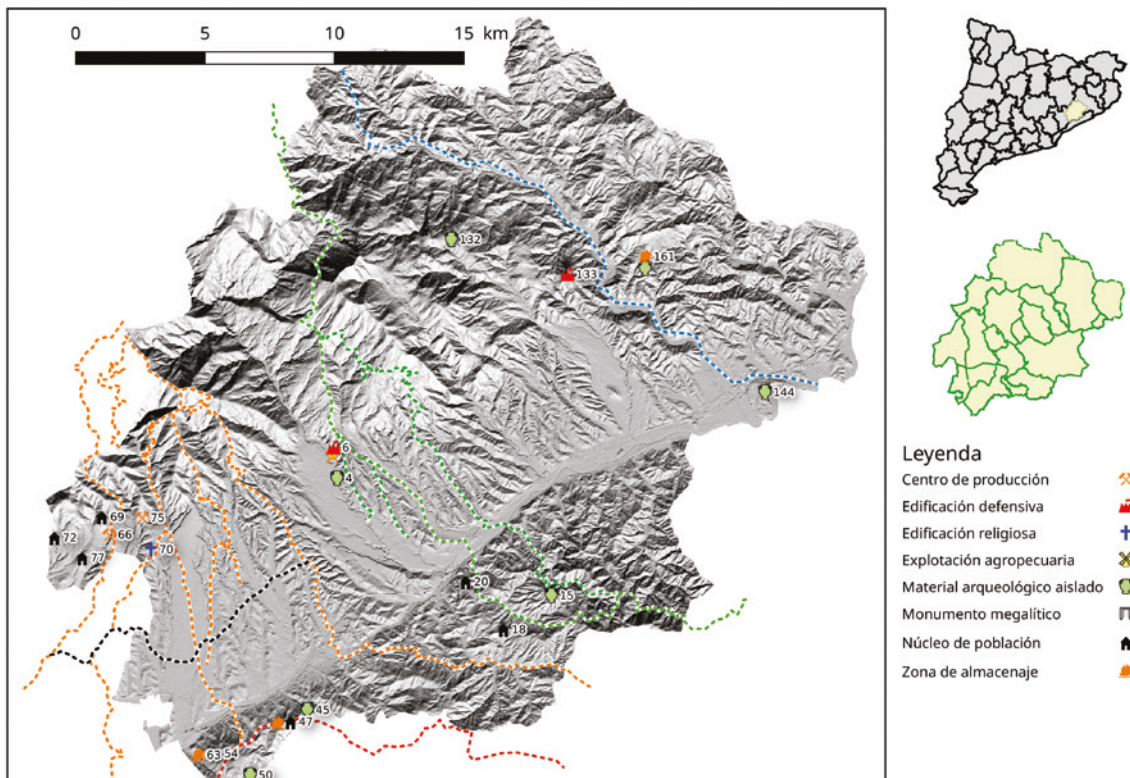


FIGURA 4. Vías pecuarias superpuestas con las unidades topográficas del período ibérico pleno.

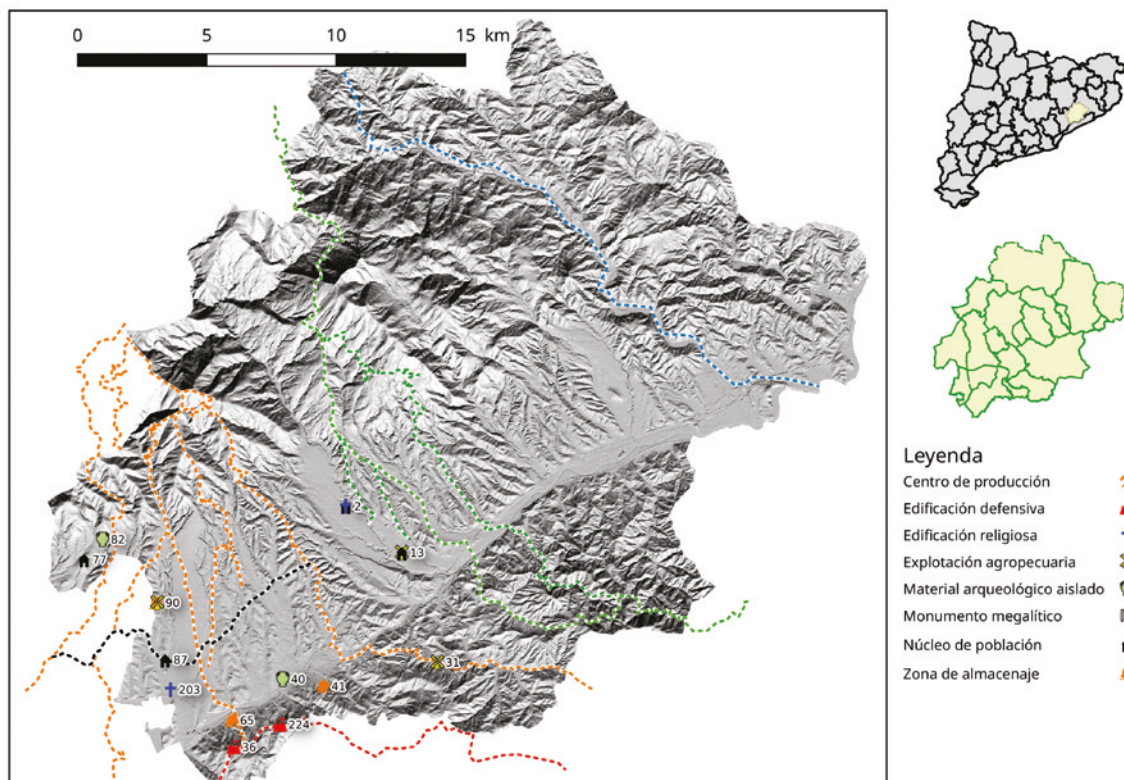


FIGURA 5. Vías pecuarias superpuestas con las unidades topográficas del período romano bajoimperial.

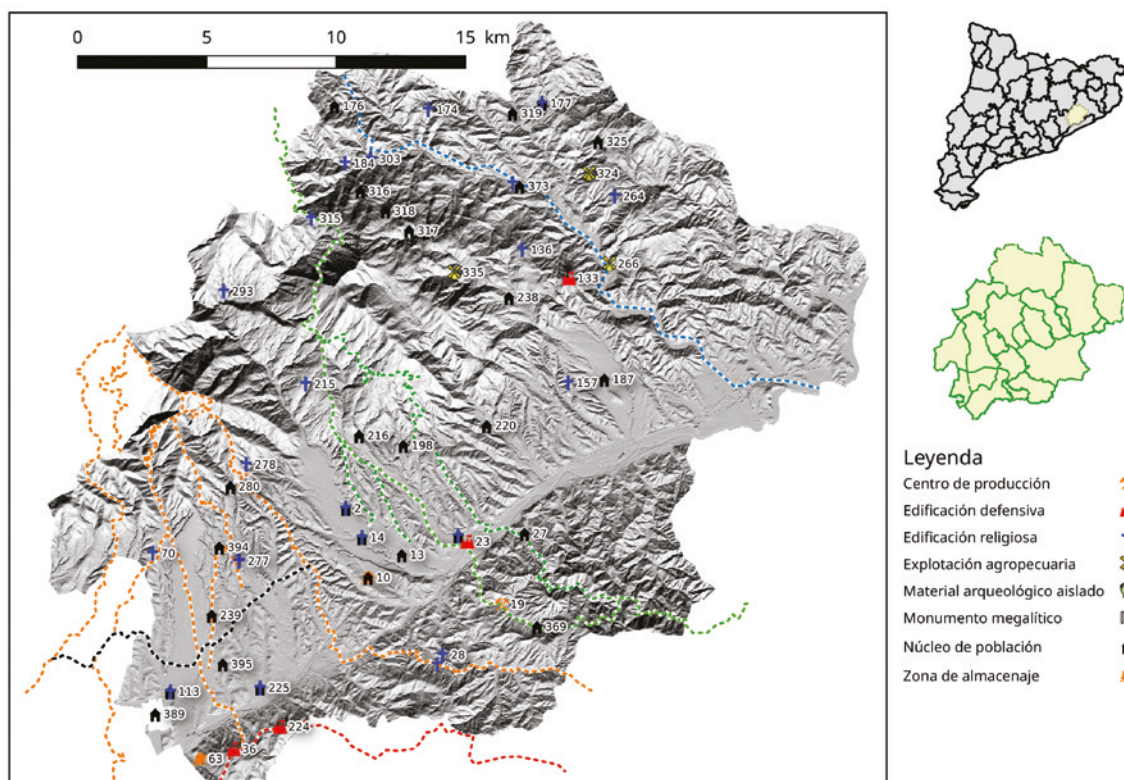


FIGURA 6. Vías pecuarias superpuestas con las unidades topográficas del período altomedieval (siglo X).

prerrománica de Sant Joan de Cavallar (E.278), ambos situados en Sant Pere de Vilamajor.

El resto de los caminos de la Calma también presentan en su recorrido varias unidades topográficas de las diferentes épocas analizadas, a excepción del camino de Vallfornès. En el camino de Samalús destacamos el sector delimitado entre Samalús y Puig Castell, donde hay varios yacimientos de época ibérica, romana y altomedieval. El camino de Cànoves circula cerca del yacimiento ibérico del Forn de Pega (E.75) y la necrópolis altomedieval de la Ferreria (Cànoves y Samalús, E.70). El camino de la Torrassa del Moro pasa por el asentamiento ibérico y romano de Can Suari (E.65), así como la Torrassa del Moro (E.36), un edificio defensivo de época romana y altomedieval. El camino de Sant Pere de Vilamajor circula cerca de varios asentamientos altomedievales como el Palacio Comtal de Vilamajor (E. 394 y E.277), Sant Jaume de Rifà (E.239) o Sant Julià de Fou (Sant Antoni de Vilamajor, E.395).

El camino de Viladrau a Hortsavinyà discurre próximo a Pedra Mirona (E.17), un megalito del calcolítico. De las unidades topográficas del periodo ibérico hay que destacar los sectores de Sant Celoni (E.20) y del castillo de Montclús (E.6). El camino también pasa cerca de diversos sitios altomedievales como Sant Marçal (Montseny, E.315), Sant Esteve de la Costa (Fogars de Montclús, E.215) o Sant Celoni (E.23). De los ramales destacamos el de Can Batalla, que cruza cerca del yacimiento romano y altomedieval de Can Jan Romans (E.13). El camino de Santa Maria de Palautordera pasa por los yacimientos de Montclús (E.6, E.4) y la necrópolis bajoimperial y altomedieval de Sant Esteve (E.2). Finalmente, el camino de Can Rovira a Can Ginestar avanza próximo a los núcleos altomedievales de Campins (E.198) y Vilardell (E.27).

El trazado del camino de la Marina avanza cerca del asentamiento de Can Pons –datado del ibérico final–, del asentamiento ibérico y medieval del castillo de Montsoriu (E.133) y de la Torre de la Mora (Sant Feliu de Buixalleu), una edificación militar utilizada durante el periodo romano y en el siglo VIII d. C. Otras unidades topográficas altomedievales que cruzan el camino son las iglesias de Sant Cristòfol (E.176), de Sant Nari (E.303) y Sant Quirze (E.173) en Arbúcies, así

como el asentamiento de Ca n'Horta (E.266) en Sant Feliu de Buixalleu.

El eje transversal de la Marata a la sierra de Ram discurre cerca de la Marata (Les Franqueses del Vallès), un *palatio* mencionado en la documentación del siglo IX y X (Dalmau, 1990, 310). El camino de la Marata también pasa por el yacimiento romano de Ca l'Alzina (Cardedeu, E.87). Ya para acabar este apartado, destacamos que, aun en su corto recorrido por la región de estudio, el camino de la cordillera Litoral circula cercano a varios yacimientos de distintas épocas de los que destacamos la Torrassa del Moro (E.36) y el sector de Castellvell del Far (E.224 y E.47).

4. CONCLUSIONES

Los resultados obtenidos indican que las vías pecuarias del Baix Montseny presentan una larga continuidad en el tiempo y fueron usadas en el periodo altomedieval y anteriores, ya que discurren a lo largo de su recorrido cerca de algunos asentamientos del periodo neolítico, antiguo o altomedieval. Es llamativo el caso del camino de Sant Elies, con tres monumentos megalíticos a lo largo de su recorrido y múltiples yacimientos de otros periodos. También son destacables por su posible antigüedad el camino de Samalús, el de Cànoves o de la cordillera Litoral, que pasan por zonas con una concentración de yacimientos ibéricos. El resto de los ramales secundarios, a excepción del camino de Vallfornès, también cruzan por una o más unidades topográficas datadas del periodo altomedieval.

Otra característica a destacar es que estos caminos parecen unir puntos clave de la comarca dentro del periodo altomedieval. El camino de la Torrassa del Moro une esta edificación defensiva con las de poblaciones de Cardedeu y Cànoves. El camino de Can Rovira a Can Ginestar une los núcleos de Campins, Sant Celoni y Vilardell. El camino de la Marina cruza un punto clave como es el castillo de Montsoriu. El camino de la Marata a la sierra de en Ram une las diferentes poblaciones medievales de la llanura sin tener que desplazarse por la *strata Francisca*. Es también ilustrativo el modo en que algunas de las vías pecuarias, como la de Palautordera, la de la Torrassa y la de Vilamajor,

presentan tramos coincidentes en parte con los límites municipales actuales. Que los distintos caminos pasen cerca de puntos clave del territorio del periodo altomedieval es un buen indicador del carácter cambiante y adaptativo de la trashumancia. Los resultados indican que en el periodo altomedieval estas vías habrían tenido un carácter más general. Es decir, estos caminos no se habrían creado bajo una finalidad ganadera, sino que sería la evolución en la población, el paisaje y en la red viaria los que habrían ido adaptando y consolidando estos caminos para su uso ganadero.

Podemos concluir que las tres vías pecuarias principales del Baix Montseny –el camino de la Calma, el de Viladrau a Hortsavinyà y el de la Marina– tuvieron, en época altomedieval, un papel destacado en la articulación vertical del territorio entre la montaña y la llanura. Además, también parece muy probable que los caminos analizados hubieran actuado no solo como caminos destinados al uso ganadero, sino también como vías de comunicación de carácter general.

BIBLIOGRAFÍA

- Inventari... (1984-1993). *Inventari del Patrimoni arqueològic de Catalunya*. Barcelona: Generalitat de Catalunya. Servei d'Arqueologia.
- Inventari... (1985-1999). *Inventari del Patrimoni arquitectònic de Catalunya*. Barcelona: Generalitat de Catalunya. Departament de Cultura.
- ABADAL, Ramon. (1986). *Catalunya Carolíngia, II. Els diplomes carolingis a Catalunya*. Barcelona: Institut d'Estudis Catalans.
- CLOP, Xavier; FAURA, Josep (1995). *El sepulcre megalític de les Maioles*. Direcció General del Patrimoni Cultural.
- DALMAU, Rafael (1990). *Els castells catalans*. Barcelona: Rafael Dalmau.
- DUCH, J.; TORREGROSA, A.; CAMPILLO, X.; ROMAGOSA, F. (2004). *Inventari de camins del parc natural del Montseny*. Memòria. Bellaterra: Universitat Autònoma de Barcelona.
- ESTRADA, Ferran; ROIGÉ, Xavier (2003). «De l'ahir a l'avui: continuïtats i canvis en els masos del Montseny». *Ponències Anuari del Centre d'Estudis de Granollers 2003*, 27-66. Granollers: Centre d'Estudis de Granollers.
- FÀBREGA GRAU, Àngel (1995). *Diplomatari de la Catedral de Barcelona: documents dels anys 844-1260. Volum 1, Documents dels anys 844-1000*. Barcelona: Arxiu Capitular de la Catedral de Barcelona.
- FERRER FERNÁNDEZ, Marc (2019). *Arqueologia del paisatge altmedieval al Baix Montseny, segles vi-x. Una demostració pràctica dels sistemes d'informació geogràfica*. Directora: Marta Sancho Planas. Universitat de Barcelona.
- GARCIA MOLSOSA, ARNAU (2013). *Arqueologia del paisatge cultural del massís del Montseny: dinàmica territorial de la prehistòria a l'edat mitjana*. Director: Josep Maria Pallet. Institut Català d'Arqueologia Clàssica.
- MAURI MARTÍ, Alfred (2006). *Configuració del paisatge medieval: el comtat de Barcelona fins al segle XI*. Director: José Ignacio Padilla Lapuente. Barcelona: Universitat de Barcelona.
- MIRALLES, F.; QUERALT, A.; SALA, P. (2002). «Els camins ramaders del Vallès Oriental». *Ponències. Anuari del Centre d'Estudis de Granollers 2002*, 49-93. Granollers: Centre d'Estudis de Granollers.
- MUNDÓ, ANSCARI (2001). *De quan hispans, gots, jueus, àrabs i francs circulaven per Catalunya*. Barcelona: Universitat Autònoma de Barcelona.
- MURRIETA, Patricia; WHEATLEY, David; GARCÍA SANJUÁN, Leonardo (2011). «Movilidad y vías de paso en los paisajes prehistóricos: megalitos y vías pecuarias en Almadén de la Plata». *Tecnologías de información geográfica y análisis arqueológico del territorio. Actas del V Simposio Internacional de Arqueología de Mérida*, 411-423. Mérida: CSIC.
- PUJANTELL, Josep Antoni (2012). *Les manifestacions del canvi global en àrees de muntanya mediterrània. Un cas d'estudi al Baix Montseny*. Director: Martí Boada i Juncà. Universitat Autònoma de Barcelona.
- RIUS SERRA, Josep (1945-1947). *Cartulario de Sant Cugat del Vallès*. Barcelona: C.S.I.C. Secció de estudios medievales de Barcelona.
- ROCA GARRIGA, Pere (1981). *Índex toponímic del cartulari de Sant Cugat del Vallès*. Sabadell: Museu d'Història de Sabadell.

- SALVAT SALADRIGAS, A.; PIÉ VALLS, G. (2014). «Pla de conservació del Parc Natural. Reserva de la Biosfera del Montseny: diagnòsi de la flora i els hàbitats». *VIII monografies del Montseny*, 16-31. Diputació de Barcelona.
- SOBREQUÉS VIDAL, S.; ORDEIG MATA, R.; RIERA VIADER, S.; ROVIRA SOLÀ, M. (2003). *Catalunya Carolíngia, V. Els comtats de Girona, Besalú, Empúries i Peralada*. Barcelona: Institut d'Estudis Catalans.
- VILAGINÉS SEGURA, Jaume (2001). *El paisatge, la societat i l'alimentació al Vallès Oriental (segles X-XII)*. Barcelona: Publicacions de l'Abadia de Montserrat.
- VIGUÉ, Jordi; PLADEVALL, Antoni (1984-1998). *Catalunya romànica*, 5 y 18. Barcelona: Enciclopèdia Catalana.

A methodological approach to settlement location factors. The case of monastic communities in the medieval Penedès (Catalonia)

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ABSTRACT

Settlement location factors could be analysed from an historical perspective using Geographical Information Systems. However, their application is subject to some drawbacks, such as the lack of detailed information about past landscapes and the need for global, interdisciplinary knowledge of the territory under study. Building on the case of monastic communities in the medieval Penedès, this paper illustrates the methodology used both in the data treatment and in the settlement spatial analysis.

KEYWORDS: Landscapes, settlement, monastic communities, location factors, Penedès, medieval.

1. INTRODUCTION

Geographical Information Systems (GIS) have become an essential tool in the field of landscape studies. Although there is no well-established research tradition in Spain and Catalonia compared to other countries,³ several historians and archaeologists have successfully applied GIS in the study of the medieval period in Catalonia (Soler, 2002; Mauri, 2006; Negre, 2013; Bosch, 2017; Costa, 2019; Fernández, 2019).

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3. Without seeking to be exhaustive, some theoretical and practical works on GIS and history should be mentioned, such as those by D. J. Bodenhamer, J. Corrigan and T.M. Harris (2010), H. Chapman (2006), I. N. Gregory (2003), A. K. Knowles (2008) and D. Wheatley (1993, 1995).

These previous experiences have been essential to define the main objective of this paper: evaluating the suitability of some medieval settlement locations using Geographical Information Systems (GIS). To achieve this, B. K. Roberts’s theoretical proposal has been used as an analytical guideline.

In *The Making of the English Village*, Roberts proposes a diagram with the intrinsic and extrinsic qualities of a site to be occupied (Roberts, 1987, 105). While the former are desirable characteristics of a specific site of settlement, the latter refer to qualities of its environment. Subsequently, archaeologist J. Bolòs (2004, 155) suggested an adaptation of this diagram to the Catalan context, which our present spatial analysis has adopted, albeit with some changes (Fig. 1).

The following text will detail the analytical methodology used to evaluate the suitability of some medieval settlements. The major drawback encountered has been a lack of historical data. Following the recommendations of Open Science (European Commission, 2018; Abadan; Anglada, 2020), this paper outlines the steps followed and the decisions taken throughout the research process.

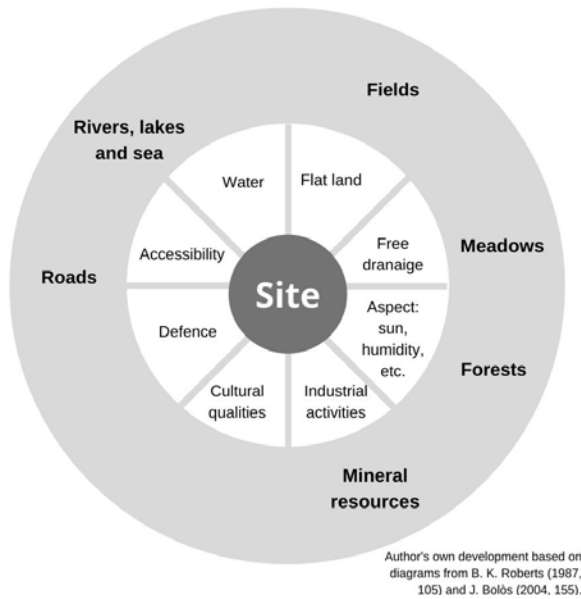


FIGURE 1. Diagram of the extrinsic and intrinsic qualities of a site.

2. THE OBJECT OF STUDY: MONASTIC COMMUNITIES IN THE PENEDÈS REGION

In order to facilitate the analysis, a particular type of settlement has been selected from a specific period of time and geographical area. Archaeological, bibliographical and documentary sources attest to the existence of twenty-three monastic communities between the 10th and 13th centuries in the Penedès region (Fig. 2).⁴ This flat territory constitutes an area of transit, as it's located between the Mediterranean Sea and the Catalan pre-coastal range of hills, and also between Barcelona and Tarragona, two cities of great importance in the north-east of the Iberian Peninsula during Ancient History and the Middle Ages.

The Penedès appears documented for the first time in 917 as *Penitense*. The region formed part of Al-Andalus until the 10th century, when the Count of Barcelona occupied it. From the 10th to the 13th century, the nobility created a network of castles and churches and the Count of Barcelona sent a deputy, called the *vicarius*, to control the region. Finally, in the 14th century,

4. Among these, the exact location of Sant Salvador de Pinells is still unknown.

the Penedès was recognised as a *vegueria*, one of the new administrative territories into which Catalonia was divided (Arnabat, 2007; 2014).

2.1 The medieval monastic communities documented

In recent years, various research projects have been drawing attention to Catalan monastic communities and revisiting them from a contemporary standpoint. As for the Penedès region, the main bibliographic references are the works of E. Zaragoza (1997) and J. Vigué and A. Pladevall (1992) as well as some websites created by amateur historians. The use of documentary sources, both original and edited, has been crucial to confirm and complete this information. In addition, reports of archaeological campaigns carried out in some monasteries, such as in Granja d'Ancosa (Bolòs; Mallart, 1986) and in Santa Maria de Santa Oliva (Teixell, 2001; Garcia; Teixell, 2009), also provide useful information.

The first references of monastic communities in the Penedès region date back to the 10th century. These are referred to as *cellae* and were dependent on the abbey of Sant Cugat del Vallès, near Barcelona. There are no existing records documenting their organisation or size. The *cella* of Santa Maria and Sant Joan de Monistrol d'Anoia is the most ancient amongst them, documented in 986 (Abadal, 1950, 194). It seems that most *cellae* did not survive for longer than 100 years, with the exception of Santa Maria de Santa Oliva, which lasted beyond the medieval period (Rius, 1945, fol. 382, 1020).

In the 11th century, the Penedès nobility and the Count of Barcelona promoted the creation of four Benedictine priories subordinated to foreign abbeys. A great amount of information about these communities is available and all of them lasted beyond the medieval age. Sant Pere de Riudebitlles, founded in 1011 by the lords of Mediona Guifré and Guisla and linked to Santa Maria and Sant Martino on the island of Gallinara in Italy, is a clear example of such priories (Feliu; Salrach, 1999, 100).

The 12th century was characterised by the arrival of new orders, such as the Cistercians, Templars and Knights Hospitaller. These orders created five new communities, some of them

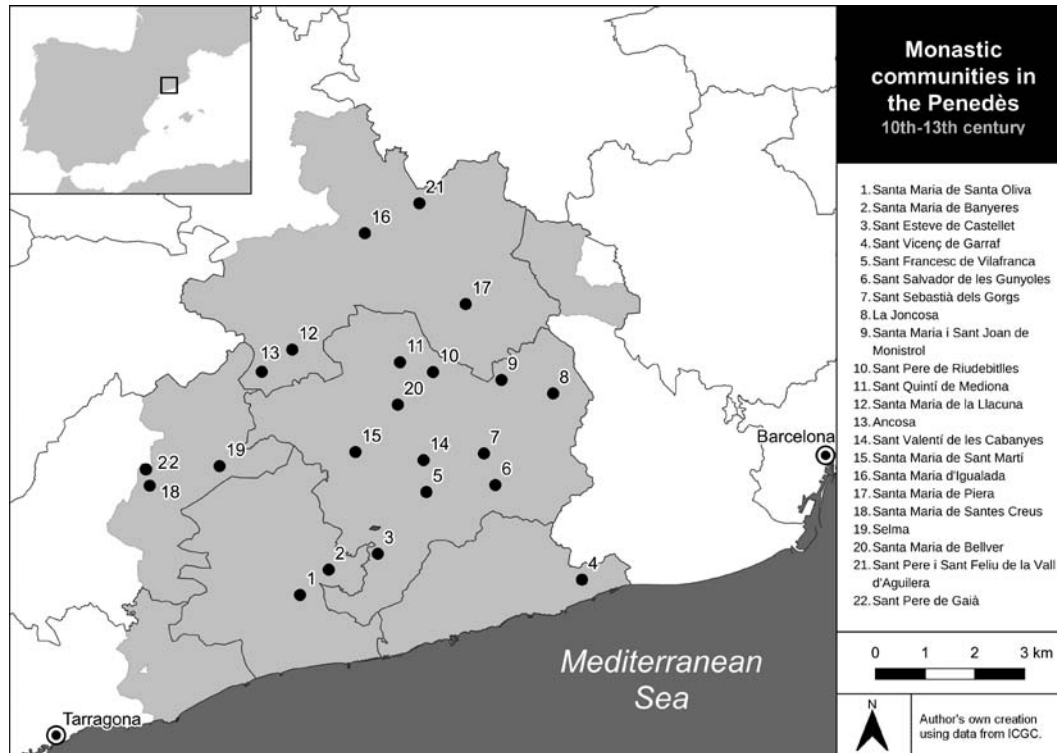


FIGURE 2. Monastic Communities of the Penedès during the 10th-13th century.

developing as delegations of important monasteries, as is the case of Granja d’Ancosa (Bolòs; Mallart, 1986). Santes Creus, located at the border of the Penedès region, stands out as one of the most important Cistercian abbeys in Catalonia.

Finally, historical records corroborate the emergence of two phenomena in the 13th century. Firstly, mendicant orders arrived and founded the first urban convent in Vilafranca del Penedès, the most important city of the region at that time (Miret, 2002). Secondly, historical references attest to the existence of *donati* communities, groups of people that gave their life to the Lord, in different churches. Pastoral visits made by the Bishop of Barcelona, Ponç de Gualba (1303-1334), reported three cases of *donati* but information about them is minimal (Martí et al., 1984).

3. METHOD OF ANALYSIS

According to Roberts’s diagram, several analyses were carried out to assess the extrinsic and intrinsic qualities of the locations of monastic

communities. Unfortunately, not all these qualities could be analysed due to a lack of historical information. For example, there are no reliable data about forest areas in the Penedès between the 10th and 13th centuries, so the importance of this location factor has been excluded from the analysis.

L. García Sanjuán’s work (2005) and M. Fernandez’s doctoral thesis (2019) focusing on the region of Baix Montseny have become essential guides to plan this research. Most of the methods detailed in this paper have been adapted from these studies, albeit making the necessary changes.

3.1 Delimitation of extrinsic qualities: Site Catchment Area and friction costs

The first step has been to calculate the Site Catchment Area (SCA) for each community; i.e. the priority territory to obtain different resources. Consequently, the analysis of suggested extrinsic qualities has been restricted to these areas.

The Site Catchment Area (SCA) of a certain territory results from the sum of the radius equivalent to the maximum possible distance to be walked in 60 minutes from a settlement (Fig. 3). The free software QGIS offers an *r.walk* tool that enables this calculation, as Fernandez has widely demonstrated (2019, 57). To do so, a two-raster dataset is required: one with elevation data (DEM) and another with movement costs. These datasets provide information to calculate the walking speed according to the slope and type of terrain.

For the dataset with the elevation data, a Digital Elevation Model (DEM) from the Cartographical and Geological Institute of Catalonia (ICGC) with high resolution (2x2 metres) has been used. However, the dataset with movement or friction costs was built by the researcher as there are no historical models for this (Fig. 4). These costs are affected by several geographical elements, such as forests or rivers, that can hinder or facilitate movement. Due to a lack of historical evidence regarding their exact location in the medieval period, present data must be used.

To establish movement costs resulting from hydrography, cartographical information from the Catalan Water Agency (ACA) has been used with some modifications. Several studies have revealed that, between the 10th and 13th centuries, the Medieval Climatic Anomaly (MCA) affected the north-east of the Iberian Peninsula, leading to a drier climate with low frequency and more extreme episodes of rain (Belmonte et al., 2012; Benito et al., 2019). With some differences, these conditions are similar to the existing ones. Certainly, watercourses often change their route and flow but using present hydrographic data has been considered the best available approach in the absence of any alternative. To establish the proportional friction costs, watercourses have been classified using the works of A. Munné and N. Prat (2002) as well as some historical information (Palau, 1988; Sabaté, 1992; Bolòs; Hurtado, 2018; Díaz-Ros, 2018).

Apart from these data, movement costs related to soil use (forests, fields and meadows) have also been considered. Some studies adopt 20th-century soil use as a method to obtain such

data (Fernández, 2019) but this option was rejected for the Penedès. This region has undergone a large number of agricultural changes in the last 300 years (Valls, 1997; Arnabat; Vidal, 2008, 255-270), making this option unreliable. Estimating an agricultural area with low movement costs around each settlement was also rejected. Although this could have been a good solution, it required a detailed study of the medieval Penedès settlement system, which was not available. Instead, low friction costs resulting from the medieval road network have been taken into consideration thanks to the work of M. Vives (2007) and other secondary studies (Bolòs, 2004; Mallart, 2008; Bolòs; Hurtado, 2018).

3.2 Agricultural potential of the Site Catchment Area

Roberts (1987) proposed the proximity of arable fields, forests and pasture as extrinsic qualities of a site. In their spatial analyses, L. García Sanjuan (2005), J. Negre (2013) and M. Fernández (2019) have considered the agricultural potential of land located next to settlements. The classification of slopes is commonly assumed as an accurate method to calculate such potential because of its historical conditioning. Drawing on the slope classification model suggested by Fernández (2019, 68), a slope map of the Penedès area has been created using the same DEM dataset as for the Settlement Catchment Areas. However, due to the strong anthropic modification undergone by the soil over the past few centuries, this information must be considered merely as an approximation of the medieval landscape.

The United States Department of Agriculture (USDA) soil taxonomy draws on several factors to determine their agroecological potential, such as drainage, slope, depth and texture (López-Acevedo et al., 1994). Present-day soil analyses usually borrow heavily from this taxonomy and the Catalan Institute of Cartography and Geology has drawn on it to create its agrological cartography (ICGC, 2010-2019). However, the latter did not include the Penedès area. For this reason, our analysis has used the Catalonia Soils Map based on the Soil Taxonomy System

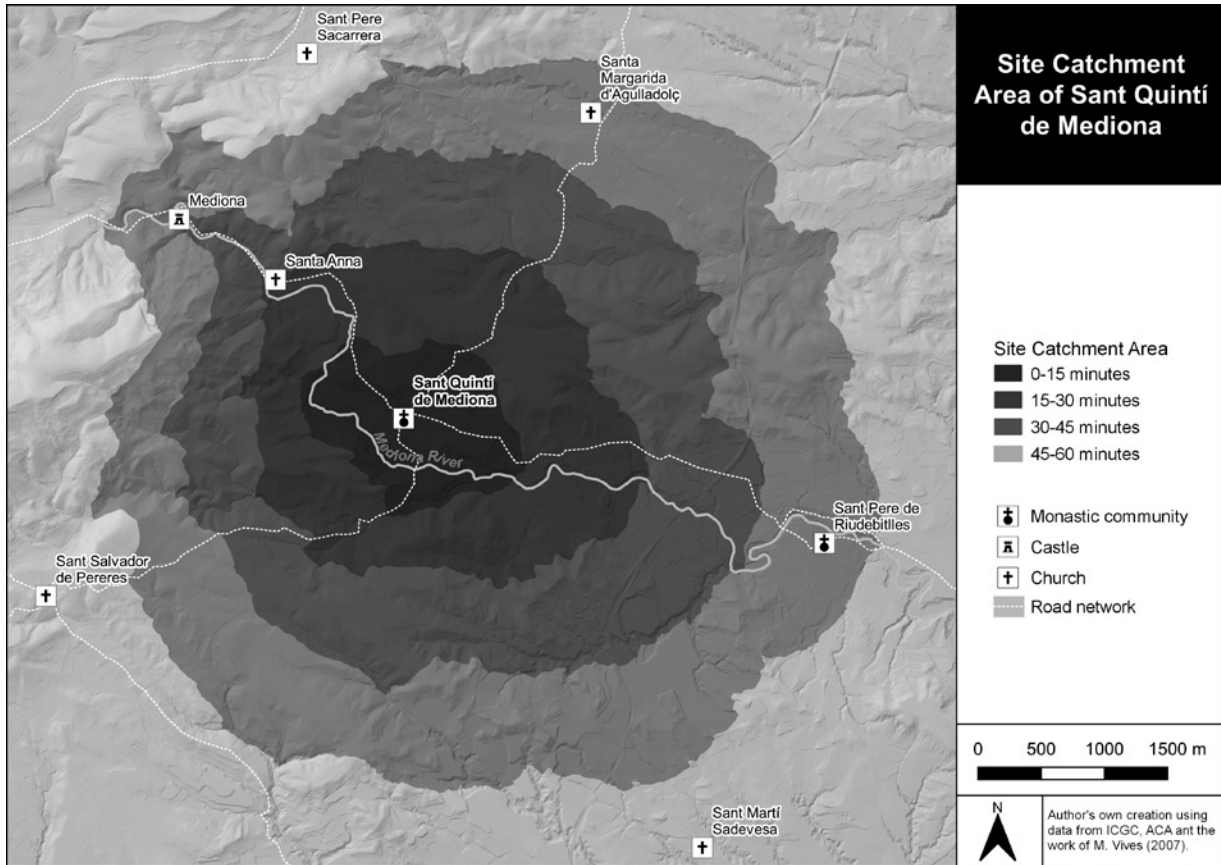


FIGURE 3. Site Catchment Area of Sant Quintí de Mediona.

Name	Characteristics	Width	Walking speed
Permanent	Fast-flowing, permanent rivers at present.	Hydraulic Public Domain according to ACA	3 km/hour
Potentially permanent	Fast-flowing rivers with variable flow which were used by medieval watermills.	Hydraulic Public Domain according to ACA	3 km/hour
Seasonal flow	Streams with seasonal flow and drainage surface similar to potentially permanent streams, with medieval watermills next to them.	2 metres	3.6 km/hour
Temporary	Present streams with little and seasonal flow.	2 metres	4 km/hour
Road network	Comprising international, interregional and local roads.	2 metres	4.5 km/hour
Non-classified terrains	Comprising fields and forest.	-	4 km/hour

FIGURE 4. Classification of friction costs included in the raster map. (Author's own creation based on information from A. Munné and N. Prats (2002) and the Catalan Water Agency (ACA).

(ICGC, 2019). Despite being less detailed, it offers some approximation of important soil qualities, such as depth and texture.

By cross-referencing two geographical datasets, namely for soils and slopes,⁵ a map with three general categories of terrain has been obtained: soils with generally good conditions [A], soils with some disadvantages [B] and generally unsuitable soils [C] (Fig. 5 and 6). This classification has been used to assess the agricultural potential of land next to settlements.

3.1 Accessibility

In order to study the access of communities to certain terrains, two different analyses have been carried out. The first consists of calculating the distance from a specific settlement to the nearest main medieval road using, once again, the *r.walk* tool. In this case, the friction cost dataset was adapted to restrict possible movements to the road network (walking speed for *non-classified soils* has been reduced to nearly 0 km/h, see Fig. 4). In doing so, the travel time from a specific settlement to its nearest main communication route was calculated using only medieval paths, drawing on the work of Vives (2007).

This estimation has been completed with the prominence coefficient, which determines the elevation of the settlement in relation to its surrounding terrain. It has been calculated by dividing the settlement's altitude by the maximum altitude in the SCA. If the result is near 1, this indicates the settlement's elevation is considerable; if it's around 0.5, the elevation is intermediate; and if it's near 0, this indicates a low elevation (García Sanjuán, 2005, 142).

Proximity between monastic communities and market towns has been dismissed as an extrinsic quality related to accessibility. M. Soler (2016) dated most of the Penedès marketplaces existing in the 13th and the 14th centuries, except the cases of La Granada, Vilafranca del Penedès and Martorell. Their origin seems to be later than the foundation of most monastic communities, so

they should not be considered as a location factor. However, simple examination of a map with the communities and markets indicates this relationship may have sometimes been in the opposite direction: some monasteries may have encouraged the creation of towns and marketplaces related to them.

3.4 Water supply

Water supply is a basic requirement to ensure the survival of a settlement. Water could be collected via springs, wells, canals or watercourses. Due to a lack of academic research dating springs or wells, it's difficult to determine their antiquity. Documentary sources can provide us with some information but only in certain instances, as is the case of Santa Maria de Piera (Rius, 1945, fol. 382) and Sant Vicenç del Garraf (Pladevall; Vigué, 1992, 64). An analysis of piezometric levels could be a good option to infer the possibility of sinking wells but the Catalan Water Agency does not provide enough detailed information to carry this out.

Consequently, only water available in large quantities so it can be exploited by mills or irrigation systems has been studied. For this purpose, the travel time from each monastic settlement to the nearest main watercourse has been calculated using, again, the *r.walk* tool with movements restricted to the road network (in the same way as in the accessibility analysis, see section 3.3). This analysis has only considered permanent, potentially permanent and seasonally flowing rivers, according to the classification carried out with friction costs maps (Fig. 4).

3.5 Defensive qualities

There are different options to analyse the defensive qualities of a settlement. Firstly, the prominence coefficient (see section 3.3) indicates a site's accessibility, which could be linked to its vulnerability. Moreover, this coefficient has been complemented with an analysis of settlement visibility carried out using QGIS Visibility Analysis plug-in (*r.viewpoint* and *r.viewshed*). This tool offers an approximation of the territory

5. This could take more than 24 hours with QGIS software, so it's recommended to use ArcGIS if possible.

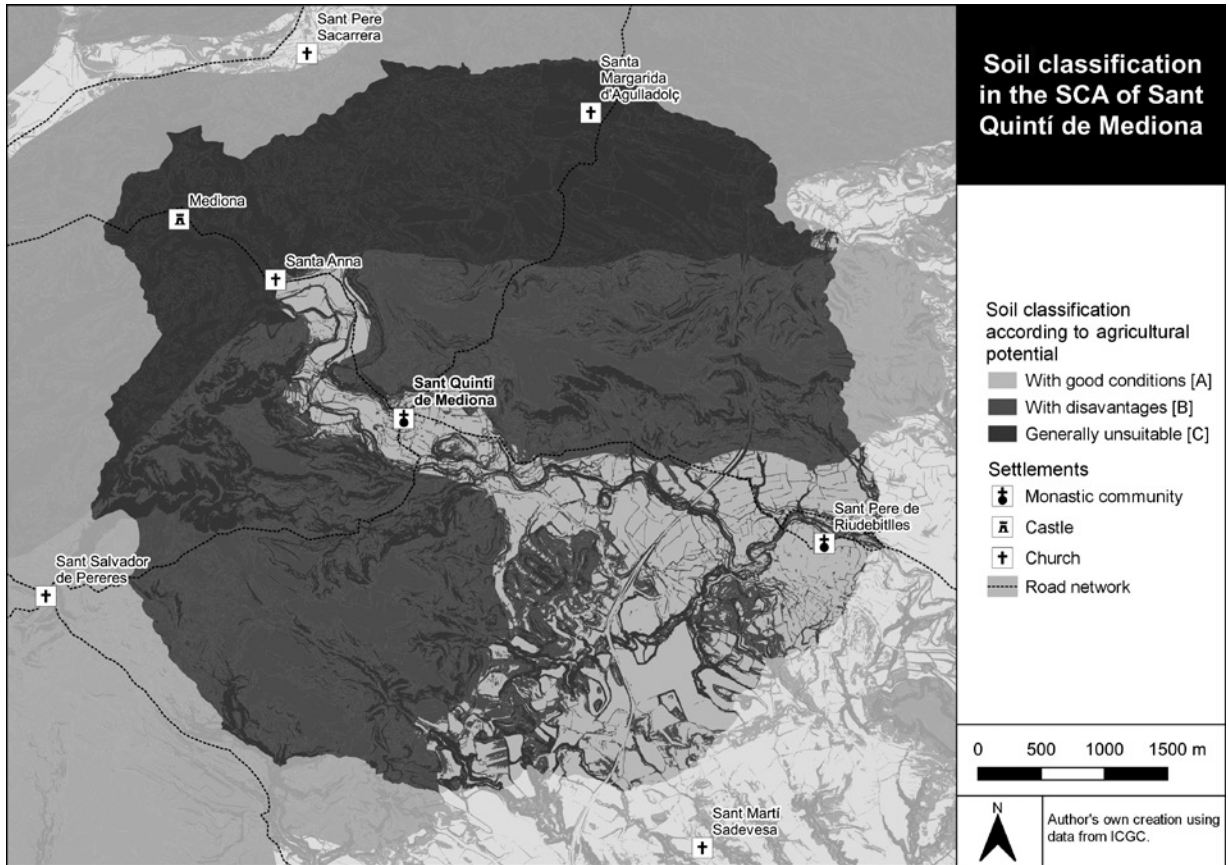


FIGURE 5. Soil classification in the SCA of Sant Quintí de Mediona.

Classification based on the Soil Taxonomy System

	Deep soils with good drainage and medium textures	Soils with good drainage and medium textures but with variable depth	Superficial soils with good drainage and medium or thick textures
0-7° Suitable for crops	A	B	-
7-15° Suitable for crops using terraces	B	B	C
15-20° Suitable for occasionally crops	B	B	C
20-60° Suitable for livestock or forest	-	C	C
>60° Unsuitable for vegetation	-	C	C

FIGURE 6. Soil classification for the Penedès area (Author's own creation based on information from Leandro López-Acevedo (1994) and the Cartographical and Geological Institute of Catalonia (ICGC, 2010-2019; 2019).

that can be seen from a certain location, taking into consideration the altitude of its terrain. The result should be interpreted cautiously as some factors have not been considered, such as the presence of a forest or frequent fog.

Finally, another way to assess the defensive qualities of a location is by observing the distance between a specific settlement and its nearest castle. A significant number of studies provide information about castles and towers in the medieval Penedès (Pladevall; Vigué, 1992; Batet, 1996; Bosch, 2017). In these studies, fortresses have been divided into two categories: castles with dependent territory (*terme*) and other buildings (castles, towers) subordinate to them. Once more, the *r.walk* tool restricted to the medieval road network (see section 3.3) has been used.

3.6 Aspect: insolation and humidity

Catalan farms (*masies*) are usually located on south-facing slopes to make the most of the sunlight (Bolòs, 2004, 154). Sun is also necessary to ensure crop growth. This quality has been evaluated by the QGIS *r.sun* tool, which calculates the hours of solar irradiation on each part of the territory on a specific day of the year using elevation data (DEM) and an aspect map (previously developed with the QGIS tool *Aspect*). In this analysis, the calculation has been limited to 21 March, during the spring equinox, since on this day the sunniest places receive exactly 12 hours of sun. This facilitates the estimation of insolation for each site.

3.7 Culturally perceived qualities

Roberts (1987, 124) considers several subjective appreciations conditioned by cultural, religious and superstitious beliefs as cultural qualities. Bolòs (2004, 154) proposes settlement continuity as one of these qualities. The existence of remains of occupation could be seen as a proof of a location's suitability to be occupied but also as evidence that it's impossible to live at the site. However, in a pre-industrial society these considerations would probably be of less importance than the reuse of construction

materials. A study of the "history of mentalities" could help in determining these factors.

In the case of the Penedès monastic communities, archaeological and documentary sources provide enough information to observe the existence of prior constructions in most of the settlements studied. For this reason, the analysis has been simplified by locating on a map those sites with prior constructions and those without.

4. CONCLUSIONS

The results of the different spatial analyses explained above will be used to classify monastic communities in the medieval Penedès according to their location. For now, the experience described above reveals some considerations, mainly related to the methodological approach.

In the first place, global knowledge of the territory analysed and of its main historical and geographical characteristics is necessary. For example, what may seem a simple operation (such as calculating travel time between a settlement and the nearest thoroughfare) requires vast knowledge of the complete medieval road network. This has to be complemented with an interdisciplinary view, since there is a large number of location factors which require being familiar with different scientific disciplines. The methodology used to analyse the Penedès monastic communities has included concepts from edaphology, biology, hydrology and climatology, for example, and advice from colleagues from these disciplines has been essential.

Secondly, two ideas must be considered regarding the use of data for spatial analysis. To start with, the use of current geographical information is the only possible option under present conditions as historical sources are often unable to provide the highly detailed information needed by GIS. Using present data offers us an approximation of certain past realities, which have to be contextualised. Fortunately, studies are gradually improving our knowledge of past landscapes and this could make spatial analyses more precise in the future. Moreover, new data produced by research must be shared with the

scientific community via reliable digital deposits. This will save time for future studies and enhance the quality of the results. The work presented above would not have been possible without some information provided by public institutions.

We are still waiting to be able to present the definitive results of this analysis. However, the methodology detailed in this paper is expected to enable a classification of monastic communities according to their location factors. In doing so, it would be possible to determine which ones exercised most influence and whether some settlements share a location strategy. In certain cases, these strategies can become clear by observing a map, such as the relationship between some monasteries with drovers' routes (Sant Salvador de les Gunyoles) or important rivers (Sant Quintí de Mediona and Sant Pere de Riudebitlles). However, there are other instances where such links are not always evident, especially when the strategy takes more than one spatial factor into account. The combination of this information with historical data would make it possible to examine the success of these strategies and the influence they exercised on the development of the monastic communities.

Moreover, it's expected that the methodology presented here can also be applied to other types of settlements, such as castles or villages. Previously, however, it would be necessary to appraise its effectiveness with regard to the outcome and also to assess a possible overuse of GIS tools for some analyses.⁶ In the near future, we hope to present a classification of monastic communities of the medieval Penedès according to their location factors in conjunction with new methodological considerations.

BIBLIOGRAPHY

ABADAL, Ernest; ANGLADA, Lluís (2020). "Ciencia abierta: cómo han evolucionado la denominación y el concepto". *Anales de Documentación*, 23, 1-11.

6. This refers to the ineffectiveness of using computer programs for certain analyses when they are not strictly needed. For example, if a map clearly shows the relationship between mills and rivers, it's not necessary to calculate the distance between them.

- ABADAL, Ramon (1950). *Catalunya Carolíngia: Els diplomes carolíngis a Catalunya*. Barcelona: Institut d'Estudis Catalans.
- ARNABAT, Ramon (2007). "El Penedès, una justificació històrica". In: INSTITUT D'ESTUDIS PENEDESENCS. *Monogràfic Vegueria Penedès*. Vilafranca del Penedès, 83-100.
- ARNABAT, Ramon (2014). "Què és el Penedès?". *Recull de Treballs*, 15, 229-245.
- ARNABAT, Ramon; VIDAL, Jordi (2008). *Història de Vilafranca del Penedès*. Vilafranca del Penedès: Ajuntament de Vilafranca del Penedès.
- BATET, Carolina (1996). *Castells termenats i estratègies d'expansió comtal*. Vilafranca del Penedès: Institut d'Estudis Penedesencs.
- BELMONTE, Ànchel; CACHO, Isabel; CANALS, Miquel; CORELLA, Juan Pablo; FRIGOLA, Jaime; GONZÁLEZ-SAMPÉRIZ, Penélope; GRIMALT, Joan O.; HERRERA, Gemma; MORENO, Ana; JIMÉNEZ-ESPEJO, Francisco; MARTRAT, Belen; MARTÍN-PUERTAS, Celia; MARTÍNEZ-RUIZ, Francisca; MORELLÓN, Mario; NIETO-MORENO, Vanesa; PÉREZ, Ana; RODRIGO-GÁMIZ, Marta SANCHO, Carlos; VALERO-GARCÉS, Blas L.; VEGAS-VILARRÚBIA, Teresa (2012). "The Medieval Climate Anomaly in the Iberian Peninsula reconstructed from marine and lake records". *Quaternary Science Reviews*, 43, 16-32.
- BENITO, Gerardo; CORELLA, Juan Pablo; MONTOYA, Encarnacion; RULL, Valentí; VALERO-GARCÉS, Blas; VEGAS-VILARRÚBIA, Teresa; WILHELM, Bruno (2019). "A millennium-long perspective of flood-related seasonal sediment yield in Mediterranean watersheds". *Global and Planetary Change*, 177, 127-149.
- BODENHAMER, David J.; CORRIGAN, John; HARRIS, Trevor M. [ed.] (2010). *The Spatial Humanities: GIS and the future of humanities scholarship*. Bloomington: Indiana University Press.
- BOLÒS, Jordi (2004). *Els orígens medievals del paisatge català*. Barcelona: Institut d'Estudis Catalans.

- BOLÒS, Jordi; MALLART, Lurdes (1986). *La Granja cistercenca d'Ancosa (La Llacuna, Anoia): estudi dels edificis i dels materials trobats durant les excavacions (1981-1983)*. Barcelona: Generalitat de Catalunya. Departament de Cultura.
- BOLÒS, Jordi, HURTADO, Víctor (2018). *Atles del comtat de Barcelona (801-993)*. Barcelona: Rafael Dalmau Editor.
- BOSCH, Josep Maria (2017). L'escenari del feudalisme a la frontera del comtat de Barcelona. Anàlisi territorial dels assentaments, l'espai obert i els camins del terme castral d'Olèrdola. Doctoral thesis [unpublished]. Universitat de Barcelona.
- CHAPMAN, Henry (2006). *Landscape Archaeology and GIS*. Stroud: The History Press.
- COSTA, Xavier (2019). Paisatges monàstics. El monacat alt-medieval als comtats catalans (segles IX-X). Doctoral thesis [unpublished]. Universitat de Barcelona.
- DÍAZ-ROS, Marçal (2018). Proposta complementària per al projecte: El Camí del Riu. Master Final Project [unpublished]. Universitat de Barcelona.
- EUROPEAN COMMISSION (2018). *Commission Recommendation of 25.4.2018 on access to and preservation of scientific information*. Brussels.
- FELIU, Gaspar; SALRACH, Josep Maria [ed] (1999). *Els pergamins de l'Arxiu Comtal de Barcelona de Ramon Borrell a Ramon Berenguer I*. Barcelona: Fundació Noguera.
- FERNÁNDEZ, Marc (2019). Arqueologia del paisatge altmedieval al Baix Montseny, segles VI-X. Una demostració pràctica dels sistemes d'informació geogràfica. Doctoral thesis [unpublished]. Universitat de Barcelona
- GARCÍA SANJUÁN, Leonardo (2005). *Introducción al Reconocimiento y Análisis Arqueológico del Territorio*. Barcelona: Ariel.
- GARCIA, Míriam; TEIXELL, Imma; (2009). *Memòria de la intervenció arqueològica al priorat de Santa Maria de Santa Oliva. Santa Oliva (Baix Penedès)*. Ajuntament de Santa Oliva.
- GREGORY, Ian N. (2003). *A place in history: A guide to using GIS in historical research*. Oxford: Oxbow Books.
- INSTITUT CARTOGRÀFIC I GEOLÒGIC DE CATALUNYA (2010-2019). *Mapa de sòls de Catalunya 1:25.000*. Barcelona: Institut Cartogràfic i Geològic de Catalunya i Departament d'Agricultura, Pesca, Ramaderia i Alimentació de la Generalitat de Catalunya.
- INSTITUT CARTOGRÀFIC I GEOLÒGIC DE CATALUNYA (2019). *Mapa de sòls de Catalunya 1:250.000*. Barcelona: Institut Cartogràfic i Geològic de Catalunya i Departament d'Agricultura, Pesca, Ramaderia i Alimentació de la Generalitat de Catalunya.
- KNOWLES, Anne K. [ed.] (2008). *Placing history: How maps, spatial data, and GIS are changing historical scholarship*. Redlands: ESRI Press.
- LÓPEZ-ACEVEDO, Marta; PORTA, Jaime; ROQUERO DE LABURU, Carlos (1994). *Edafologia para la agricultura y el medio ambiente*. Mundi-Prensa.
- MALLART, Lurdes (2008). "El camí ral a la Llacuna". *De Penedès*, 18,43-57.
- MARTÍ, Josep Maria; MIQUEL, Fèlix; NIQUI, Leandro (1984). *Processos de l'Arxiu Diocesà de Barcelona*. Barcelona: Departament de Cultura de la Generalitat de Catalunya.
- MAURI, Alfred (2006). La configuració del paisatge medieval: el comtat de Barcelona fins al segle XI. Doctoral thesis [unpublished]. Universitat de Barcelona.
- MIRET, Montserrat (2002). "El convent de Sant Francesc de Vilafranca del Penedès". In: PLADEVALL, Antoni [ed.]. *L'art gòtic a Catalunya*. Vol. 1. Barcelona: Enciclopèdia Catalana, 183-185.
- MUNNÉ, Antoni; PRAT, Narcís (2002). *Regionalització del sistema fluvial a les Conques Internes de Catalunya. Aplicació de la Directiva Marc en Política d'Aigües de la Unió Europea*. Barcelona: Generalitat de Catalunya. Agència Catalana de l'Aigua.
- NEGRE, Joan (2013). De Dertosa a Țurtușa. L'extrem oriental d'al-Ṭagr al-A'la en el context del procés d'islamització d'al-Andalus. Doctoral thesis [unpublished]. Universitat Autònoma de Barcelona.
- PALAU, Salvador (1988). "Inventari de molins fariners al riu Foix". *Miscel·lània Penedesenca*, 12, 259-286.

- PLADEVALL, Antoni [ed] (1992). *Penedès. Anoià*. In: VIGUÉ, Jordi; PLADEVALL, Antoni (dir.) *Catalunya Romànica*. Vol. XIX. Barcelona: Enciclopèdia Catalana.
- RIUS, José, [ed] (1945). *Cartulario de 'Sant Cugat' del Vallés*. Barcelona: Consejo Superior de Investigaciones Científicas. Sección de Estudios Medievales de Barcelona.
- ROBERTS, Brian K. (1987). *The making of the English village*. Harlow: Longman.
- SABATÉ, Flocel (1992). "Estructura socio-econòmica de l'Anoià (segles X-XIII)". *Acta Historica et Archaeologica Mediaevalia*, 13, 175-238.
- SOLER, Maria (2002). "Feudalisme i nucleació poblacional. Processos de concentració de l'hàbitat al comtat de Barcelona entre els segles X i XIII". *Acta Historica et Archaeologica Mediaevalia*, 23-24, 69-101.
- SOLER, Maria (2016). "Fires i mercats a Vilafranca i al Penedès Medieval". In: ARNABAT, Ramon; SANCHO, Daniel; SOLER, Maria; VIDAL, Jordi. *Fires i mercats a Vilafranca i al Penedès*. Vilafranca del Penedès: Institut d'Estudis Penedesencs.
- TEIXELL, Imma (2001). *Memòria de l'estudi històrico-arqueològic de la rectoria de l'església de Santa Maria de Santa Oliva (Santa Oliva, Baix Penedès)*. Ajuntament de Santa Oliva.
- VALLS, Francesc (1997). *Contractació a rabassa morta i conjuntura vitícola a Catalunya*. Barcelona: Col·legi de Notaris de Barcelona.
- VIVES, Miquel (2007). *Evolució històrica de la xarxa viària entre el Llobregat i el Foix*. Doctoral thesis (unpublished). Universitat de Barcelona.
- WHEATLEY, David (1993). "Going over old ground: GIS, archaeological theory and the act of perception". In: ANDRESEN, Jens; MADSEN, Torsten; SCOLLAR, Irwin [ed.]. *Computing the past: Computer Applications and quantitative methods in archaeology, CAA'92*. Aarhus: Aarhus University Press, 133-138.
- WHEATLEY, David (1995). "Cumulative viewshed analysis: a GIS-based method for investigating intervisibility, and its archaeological application". In: LOCK, Gary R.; STANCIC, Zoran [ed.]. *Archaeology and geographical information: A European Perspective*. London: Routledge, 171-185.
- ZARAGOZA, Ernest (1997). *Catàleg dels monestirs catalans*. Barcelona: Publicacions de l'Abadia de Montserrat.

Conclusions

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Maps are an important output of research, both on a micro-regional and on a large scale. This belief underlies one of the commitments undertaken by the TIR-FOR project: to provide high quality data in constructing a map of the Roman world, updating the content and enabling a comprehensive thematic and diachronic view. Consequently, to ensure a thorough scientific approach, we believe the authors of TIR-FOR should be the very archaeologists who are working in the territory, as suggested by the Symposium's title.

The presentation of the digital platform for the map of the Roman world by the Catalan team emphasised that it is an open, interactive digital map and gazetteer, designed to provide access to a large amount of information, beyond its own, through links to other applications and websites. But it is also equipped with an advanced search facility that allows thematic and chronological maps to be created on demand. This project may have been reformulated but it retains the spirit of collaboration between countries that has characterised TIR-FOR since it began a hundred years ago. Now, however, this project has been renewed, based on teamwork with everyone using the same digital tool. Such a transnational approach brings up essential issues, both cultural and evolutionary, which need to be taken into account.

One fundamental contribution made by the digital TIR-FOR project has been the unification of criteria. The fact that everyone uses the same digital platform to enter data from all the provinces in the Roman world forces the various national teams to classify their data according to common

criteria. Researchers have to adjust their archaeological information to an established, common interpretation, namely the criteria of the TIR-FOR application. Researchers are also asked to consider how the system could be improved. In adapting the platform's criteria to the particular situation of each region, they need to be adjusted to reflect the cultural multiplicity and long evolution of the Roman world. The result, however, is incredibly valuable because all the data entered are standardised, both on the map and in the gazetteer. This makes the map extraordinarily reliable. The thematic and chronological maps produced by the digital TIR-FOR provide an evolutionary view of the Roman world with unprecedented accuracy. This is precisely one of the project's research strengths. Moreover, all the data are available for use in any other research. Thanks to these common criteria, we have created a new and universally applicable research tool.

The Italian team has provided us with an historical assessment of map drawing in Antiquity, as well as interesting reflections regarding these maps, such as which reality was being represented, which concepts were applied, at what scale and with what errors. In contrast to the maps of Antiquity, the team highlights the fact that greater precision is needed when producing digital maps, explaining the requirements entailed and the problems of precisely transitioning from the paper to the digital TIR.

The Romanian team's new digital TIR is a clear example of cartographic research. Based on the paper publications, the team's aim has been

to bring the project into the digital era, with the new methodology this entails. After completing the digital TIR map of Dacia, they concluded they had achieved a new view of the borders and therefore of the history of Roman occupation in the province. They now intend to publish the volume on paper. They also plan to start the FOR of the legionary camp of Potaisa, an important site they've been excavating for 50 years and for which there is a wealth of data, which the FOR will enable them to map.

In Barbaricum also has its place within the TIR as we have detailed information on this area from various classical authors as well as archaeology, data which can be mapped. With the computerisation of the TIR-FOR, in order to integrate the Barbaricum data they have had to be adapted to the systems established for the Roman world, but without losing the specific characteristics of the sites, cultural areas and chronological evolution *per se*. Roman imports had essentially been mapped but recent archaeological work has unearthed important discoveries regarding Barbarian relations with the Romans, such as battlefields, votive deposits and buildings constructed under Roman influence. All this is being reflected on the map to provide a new view of the mechanisms and routes taken by the influx of Roman imports into Barbaricum, as well as helping us to refine our knowledge of how such peripheral cultures evolved.

The Tunisian team is working on the TIR for Tunisia in parallel with the archaeological map. This is producing a map that is much more faithful to the actual Roman situation than the French topographical charts from the 19th century. The new TIR includes the advances made by archaeology, with improved reliability. It therefore provides much more insight into how the region was structured in Roman times.

As the Greek contributors rightly point out, “the amount of information contained in the TIR indexes allows any researcher of the Roman world to easily access the data needed for his or her own study”, while digitisation “has converted the TIR project from a static into a dynamic one”. As we have already mentioned, the new online TIR enables views of the Roman world that are more faithful to reality, as well as being able to interact with the data to give rise to

new research. The Greek authors provide two wonderful examples from Epirus and Aitolia-Akarnania, where the settlement structure and exploitation of the territory changed radically with the Roman conquest, an evolution that is clearly reflected in the maps.

We were unfortunately not able to hear Andreas Külzer at the Symposium but, for the Proceedings, he sent a superb description of the *Tabula Imperii Byzantini* (TIB) project by the Austrian Academy of Sciences in Vienna, mapping the Byzantine sites, a task that has proved to be of paramount importance for both their study and preservation. The project has generated the TIB Map Application (<https://data1.geo.univie.ac.at/projects/tibapp>), a prototype map viewer that is still a work in progress, which functions quite similarly to the TIR-FOR application.

A map of the Adriatic Sea was also presented, produced using the AdriAtlas application (www.adriaticummare.org) and coordinated by Francis Tassaux from the Ausonius Institute of the Bordeaux Montaigne University. This is the first ever cartographic overview of the ancient Adriatic and it's extraordinary. Once again, this experience is of great interest because of its similarities to the TIR-FOR project, both in terms of purpose and technical presentation.

Continuing westwards, the Roman thoroughfares of Aquitaine also represent a magnificent cartographic contribution by Clement Coutelier and François Didierjean from the Ausonius Institute of Bordeaux Montaigne University. Prioritising accuracy, exhaustive data collection, reliability and ease of consultation, the project is in line with current trends in crowdsourcing or citizen science. Thoroughfares are a key element for any map as they represent how the territory is structured, but they also provide insight into people's movements. The application of new technologies to digital maps of Roman roads is producing innovative results and providing researchers with essential study tools thanks to these new approaches. Remaining with Roman roads, we must also praise the ambitious project *Viator_e*, by Pau de Soto from the Catalan Institute of Classical Archaeology, which attempts to analyse and explain the territory in economic and communication terms by mapping

the network of Roman roads in the western part of the Roman Empire.

The application of spatial analysis, modelling, 3D elevations and other cartographic resources have enabled specific studies, such as the work on population movements carried out by Jesús Ignacio Jiménez and Alicia Ruiz for the provinces of *Hispaniae*, the military settlements of north-eastern *Hispania Citerior* and the population densities of the Lower Guadalquivir. Travelling through Cappadocia, Jacopo Turchetto proposes the application of new technologies to archaeological mapping in order to extract different views and achieve a deeper understanding of the territory and how the ancients shaped the countryside. 3D reconstructions are highly expressive, improving our understanding of the dynamics of the landscape, least cost path and visibility analyses, as well as providing a useful video to raise awareness of the research.

The study of satellite imagery is aided by the analysis of ancient cartography, as in the example of Madayi (Kerala, India). This is a wonderful project studying the Roman world's trade with Asia, which could also be mapped within the TIR project under the Barbaricum concept, incorporated within the project for some time now.

We have seen case studies on cities such as *Munigua*, *Peltuinum*, *Pivernum* and *Brundisium*, and the impressive multidisciplinary studies on the *ager* of *Barcino*, the result of many decades of work, as is also the case with *Potaisa*, helping us to better understand its history. There is such detailed information on *Potaisa* that the FOR fields and even the FOR sub-files could be completed. The same can be said for the case of the Calore River valley, in the territory of the Roman city of *Telesia*. That's the secret of archaeology: important results can only be achieved after many decades of perseverance and continual work.

Analysing the ancient settlement of the Lower Guadalquivir we have also seen that, with the spatial analyses proposed, apparently similar conclusions are reached as those achieved with a succession of chronological maps. But there is one fundamental difference: these new analyses include actual figures, representing a huge advance.

Everyone agreed that maps are important; that they are not only a tool for research but an approach to history, an investigation *per se*.¹ They are a bird's-eye view that provides an analysis of the territory we want to explore. And even if we have diachronic and thematic maps, as is the case, our view of the contents of the whole territory isn't fixed but evolving and nuanced, with all its structure, movements, zones of economic exploitation, areas of control, areas of urbanisation and centuriation, symbolic areas and a long etcetera. There can be no doubt that general maps are essential in order to understand a place; they are necessary to understand a region but are also necessary to understand the global nature of a dominium such as the Roman Empire. And the *Tabula Imperii Romani* and *Forma Orbis Romani* are necessary for their precision, reliability, integrity and especially for their standardisation of data and unity of criteria.

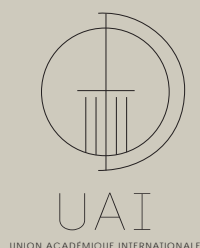
Hence our invitation to all researchers to collaborate with the TIR-FOR project, to link data from their different projects and to complete the corresponding sheets on the TIR-FOR platform.

1. Between 2016 and 2018, the production of the TIR for Catalonia and the construction of the digital platform received aid from Spain's "Secretary of State for Research, Development and Innovation" as R&D Project HAR2015-69655-P. Aid was denied in the 2019-2021 application period because the Project was classified as "instrumental" and "mechanical" and not as research.

The TIR-FOR International Commission decided to hold this first TIR-FOR Symposium with the firm belief that it could be a useful platform to raise awareness of the latest advances made by a project whose roots date back over a century, at the same time as providing the opportunity for researchers working in related areas to share their experiences, methodologies and findings.

The International Commission has been commissioned by the International Union of Academies to manage the unification, digitisation and updating of these two, initially parallel, projects on the cartographic topography of the Roman world: the *Tabula Imperii Romani* and the *Forma Orbis Romani*. Two projects which, in the 20th century, published numerous volumes on paper that cover a considerable proportion of the Roman Empire.

In fact, the decision to organise a Symposium, which the International Commission hopes will be held regularly, results from this desire to raise awareness of the digital TIR-FOR project's scientific potential. The subject chosen for this first Symposium, *From Territory Studies to Digital Cartography*, is clearly along these lines, with the aim of encouraging reflection and debate regarding the inextricable interaction between research into archaeological sites, territory and archaeological topography and digital cartography.



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