

The Archaeologic Map and GIS in Ancient Topography Researches: The “Carta Archeologica d’Italia—Forma Italiae” Project

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Abstract: This paper presents the research method applied to the “Archaeological Map of Italy—Forma Italiae” project, comprising to date the *Ager Venusinus* project (completed) and the *Ager Lucerinus* project (ongoing). The idea of an Archaeological Map of Italy dates back to 1889 when by Royal decree the “Bureau for an Archeological Map of Italy” was created. Many decades later, with the advent of information technology and satellite observing systems (GPS) a “new era” of archaeological mapping began and the “*Forma Italiae*”, thanks to these technological developments, began to develop the first Territorial Information System of archaeological matter in Italy. Between 1989 and 1992, studies and experiments were carried out on automatic systems for the acquisition, calculation and management of archaeological data relating to the Carta Archeologica d’Italia (Forma Italiae). Our project sought to put together many experiences, including some from the past, as part of a ministerial initiative resulting in the establishment of a committee; furthermore, it sought to extend the discussion that for many years concerned primarily academic institutions to the sectors dealing with protection and archeological prevention. Though it has been designed for prevention and protection, it simultaneously serves as the basic instrument for understanding and enhancement of the cultural resources of the territory. In discussions about preventive archaeology and about the so-called “archaeological risk”, it is very useful to create a databank of the known archaeological heritage. For this purpose, a computerized system for data management was used, composed of a GIS platform associated with an alphanumeric archive and designed soon to become a web GIS.

Key words: Archeological map, GIS, GPS, survey.

1. Introduction

1.1 The Method of “Archaeological Map”

This paper presents the research method applied to the “Archaeological Map of Italy—Forma Italiae” project. This project is a joint effort of the University of Rome “La Sapienza”, Cartographic Laboratory of Experimental Archaeology, Unione Accademica Nazionale, CNR and Archaeological Laboratory of Cartography at the University of Foggia¹ (Fig. 1).

Here presents two projects comprising to date the *Ager Venusinus* project (completed) and the *Ager*

Lucerinus project (ongoing) (Fig. 2).

The idea of an Archaeological Map of Italy dates back to 1889 when by Royal decree the “Bureau for an Archeological Map of Italy” was created. Giuseppe Lugli’s publication in 1926 of the first volume of *Forma Italiae* represented the continuation of the initial Royal project². Many decades later, with the advent of information technology and satellite observing systems (GPS) a “new era” of archaeological mapping began and the “*Forma Italiae*”, thanks to these technological developments, began to develop the first Territorial Information System of archaeological matter in Italy.

This method was also used in the Project

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¹ Project leader: P. Sommella with me. For CNR: M. Mazzei.

² Castagnoli 1979; Sommella 2009, 47-59; Marchi et al. 2015.

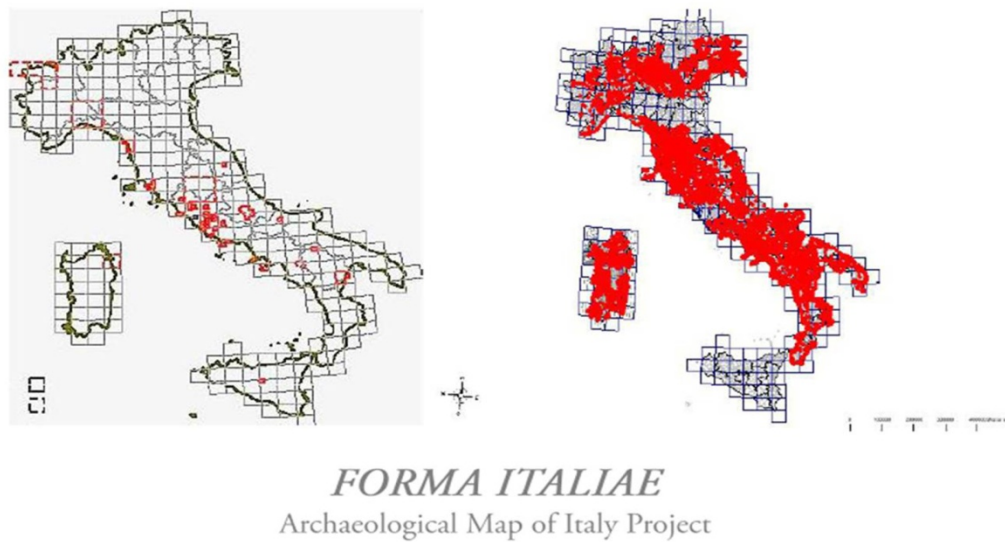


Fig. 1 Forma Italiae project (GIS).

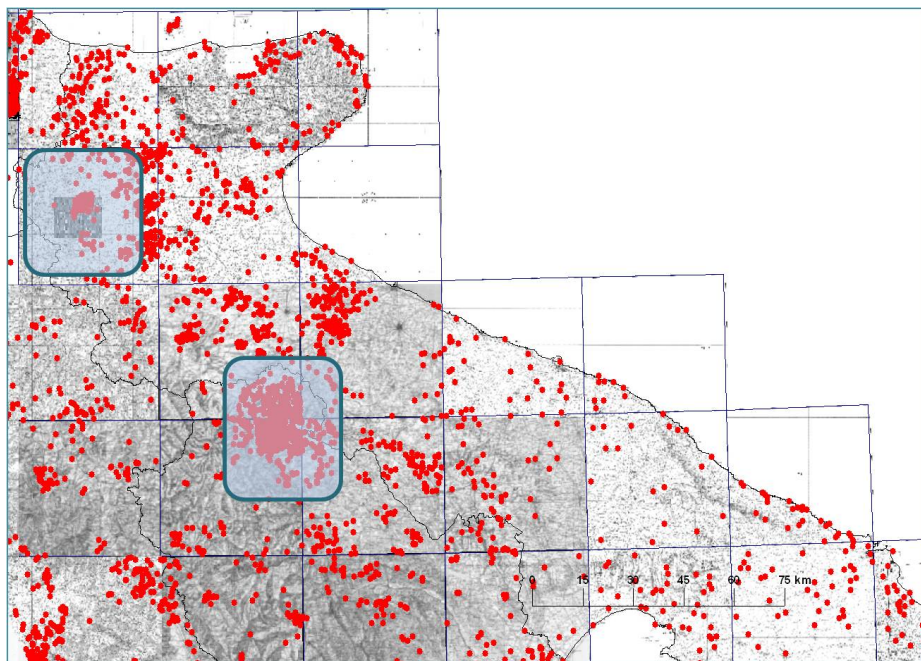


Fig. 2 Ager Venusinus and Ager Lucerinus project.

“Repertorio bibliografico per la Carta Archeologica della Provincia di Roma”³ and also in the “Project Census for an Archeological Map of Italy”⁴.

The “Project Census for an Archeological Map of Italy”, was carried out over several years (2002-2008) to create a new scientific and technical tool based on

the work done previously in relation to the “Archeological Map” of Italy.

The importance of an archeological heritage database is reinforced by the discussion on preventive archeology, and more in general on “archeological risk”, a topic currently considered of great relevance.

The “Project Census for an Archeological Map of Italy”, started in 2002 on input from the “The Ministry

³ Amendolea 2003; Marchi 2005.

⁴ Marchi 2012.

of Cultural Heritage and Activities”, in collaboration with Sapienza University of Rome, with the participation of the University of Foggia, and was carried out in several operative phases.

The project allowed for the realization of a large integrated system, for protecting the heritage and preventing damage to it. The project further, provided an essential instrument for better knowledge and greater valorization of the cultural heritage on Italian territory (Fig. 3).

The program provided a “Register”, based on the cataloguing and georeferencing of bibliographic and archive material. The census involved all of Italy, with the exception of some autonomous regions with special status and Emilia Romagna, that had its own informative system for many years. The work progressed in phases, starting with the central-southern regions and finishing with the northern regions.

The project also involved an updating for the regions subjected to census in the early phase (Basilicata and Campania) and in general a continuous updating.

The census of the archeological elements is based on published material for which a topographic localization on a map is possible. To insure the reliability all data, will be verified on site, the archeological elements were selected based on two levels of trustworthiness: georeferencing and general localization.

The project led to the census of almost 30,000 archaeological sites, chronologically ordered from Prehistory to the High Middle Ages.

The “Archaeological Map” helped us reconstruct the historical archeology of the ancient landscape from Prehistory to the High Middle Ages and promote the protection and cultural appreciation of the territory.

2. Materials

2.1 The GIS for “Forma Italiae” Project

While not being a determining factor, the great

experience of research in the Venusinus gained in twenty-year periods especially since information technology began to be integrated in most territorial documentation has facilitated everything explained above. So experimenting with the “automatic” passage of information from direct reading of the land to the operational project but without specialist interpretation was begun in topographical research as well as in the selective reading of both urban and territorial themes⁵.

This was one of the first archeological projects in Italy to use GIS, experimenting with database input and with GIS applications. Our project, which included the creation of a dedicated GIS (Carta Archeologica d’Italia: Archeological Map of Italy—*Forma Italiae*)⁶ (Fig. 4). It is important to keep in mind that having the entire project with all its analytical data in the GIS makes cartographic references and indications of scale superfluous. All archeological elements, both monumental and structural as well as scatter of material on the surface are georeferenced, their shapes and sizes perfectly represented.

Another distinguishing characteristic is that subjects can be selected from chronological phases inside geographical boundaries (regions, provinces, communes⁷, or individual locations), or by type of archaeological find (villas, necropolises, built-up areas etc.) from both the graphic (visualisation on the map) and alphanumeric points of view.

Archaeological points have been catalogued by issuing data in site reports/bibliography and site/recognition reports appropriately processed using a process based on lengthy experimentation with computerised cartographical methods and devices based on many years of data processing experience. The contents are adjusted to the stability parameters of

⁵ Sommella 2009; Azzena 2009.

⁶ Marchi, Mazzei 2012; Marchi et al. 2015.

⁷ Commune (Municipality)—the smallest administrative division in France and Italy governed by a mayor assisted by a municipal/local council.

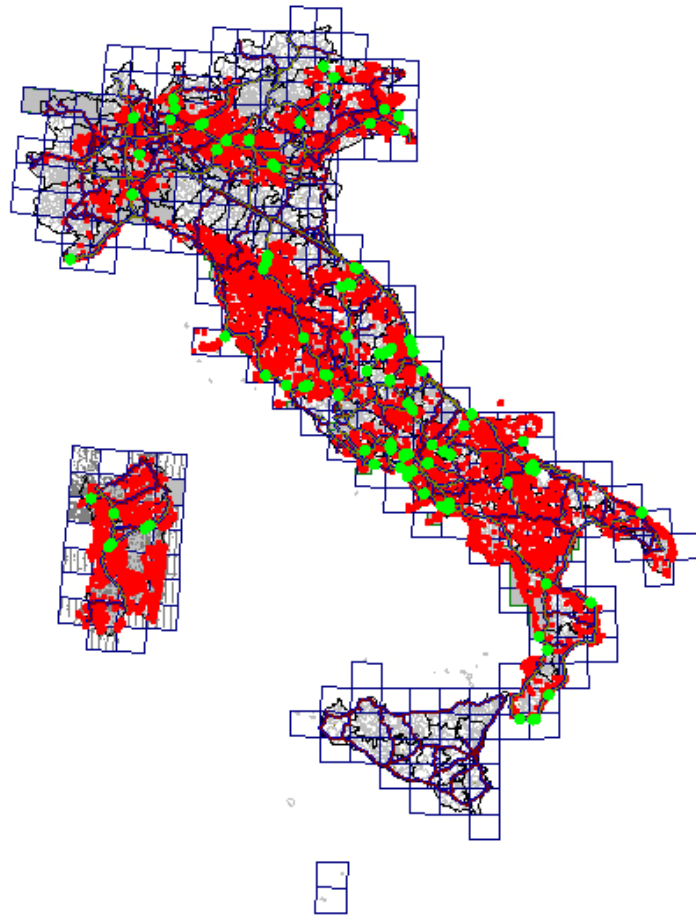


Fig. 3 The “Project Census for an Archeological Map of Italy”.

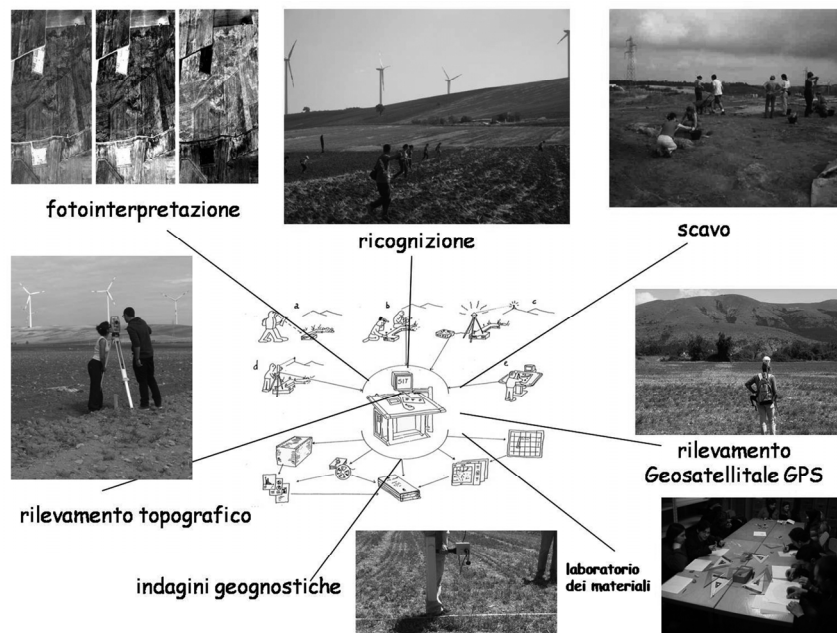


Fig. 4 The structure of GIS “Forma Italiae”.

the MiBAC⁸ Joint Committee⁹ and compatible with the ICCD¹⁰ cataloguing standards above all with regard to the identification parameters. All of the items on the report are found in dictionaries contained in the drop-down menu, and these are also processed on the basis of the ICCD directive and the lengthy experience acquired from modelling experiments¹¹ (Fig. 5).

One of the most important factors is the input of archaeological constraints as preferences¹².

The large volume of data collected (over 3,000 reports) between the end of the 1980s and the year 2000 has facilitated the refining of methods and techniques in a continuously evolving system, and data processing has been connected with experimentation on report/graphic apparatuses for both the finds and the sites where the finds were made.

Our project was also one of the first to work with GPS (global position system)¹³. Between 1989 and 1992, studies and experiments were carried out on automatic systems for the acquisition, calculation and management of archaeological data relating to the *Forma Italiae* (Fig. 6).

The digital information collected makes analysis of the distribution of archaeological finds as a function of the chronological phases possible as well as the study of the dynamics of settlement of the historic landscapes and provides indicators able to reveal hidden or unexpected characteristics found when complex territorial systems such as historic ones are analysed.

The system facilitates in-depth investigation of the distribution maps of various settlements and their relationships with other sites as well as the exploitation of the spatial analysis techniques together with other information sources so that extremely useful critical items can be caught in the territorial planning phase. This GIS project has proved useful in both scientific activity and the census needs of organisations that value and protect cultural heritage.

Moreover, it must be emphasised that the GIS presented is the result of a very lengthy process of experimentation. The examples only represent some of the potential that the system offers for researchers. All of this is only the starting point and not the purpose of the research and the aim is the historical reconstruction of the territory and its landscape.

The Ager Lucerinus Project is interesting from this point of view as it concerns a territory whose ancient landscape was varied and articulated, and the archaeological map produced is a valid instrument in protecting an area continuously threatened by the diffusion of aeolian deposits. In fact, the GIS data processed by the Archaeological Cartographic Laboratory in accordance with the Superintendency for Archaeological Heritage in Puglia was used as a support for the *Piano Paesaggistico Territoriale della Regione Puglia* (PPTR)¹⁴ (Fig. 7).

The great many applications of information systems in the archaeological-topographical sector are above all a result of them being an instrument that solves a wide range of problems with management and data analysis methods. What characterises an archaeological GIS is not so much its content, that is, the data that is managed, but its ability to interpret the data. Dedicated GIS has been made for many years that can be defined as an archaeological attempt to understand the meaning of the objects from which the data come, so an additional phase compared to what is used to recover the data using conventional GIS is necessary: a phase of interpretation. Another difference

⁸ MiBACT (*Ministero dei Beni e delle Attività Culturali e del Turismo*)—Ministry of Cultural Heritage and Tourism.

⁹ Carandini, 2008.

¹⁰ ICCD—(*Istituto Centrale per il Catalogo e la Documentazione*)—The Central Institute for Cataloguing and Documentation within the Italian Ministry of Heritage and Culture (MiBAC), defines procedures, standards and tools for the Cataloguing and Documentation of national archaeological, architectural, art history and ethno-anthropological heritage in agreement with the region.

¹¹ Azzena, Tascio 1996.

¹² Marchi, Mazzei 2012.

¹³ Azzena 1992, 747-66.

¹⁴ Puglia Regional Territorial Landscape Plan.

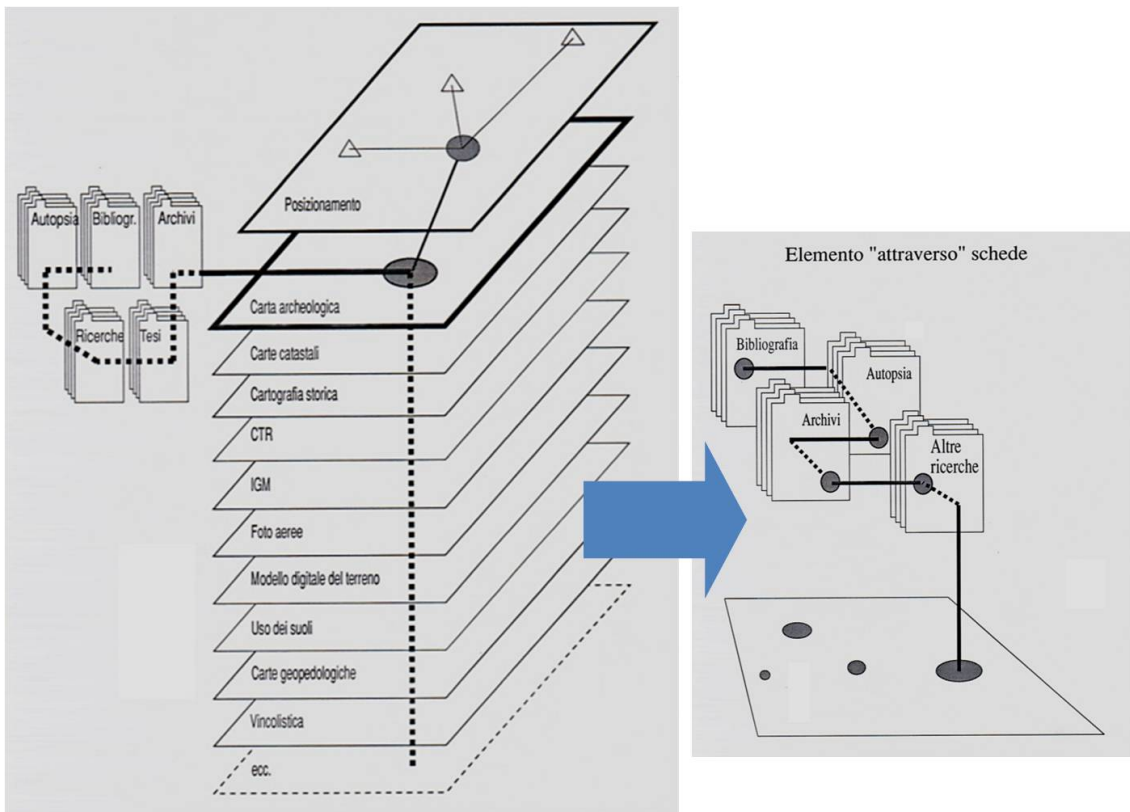


Fig. 5 The structure of GIS (from Azzena, Tascio 1996).



Fig. 6 GPS in archaeological field survey: 1988-1989.

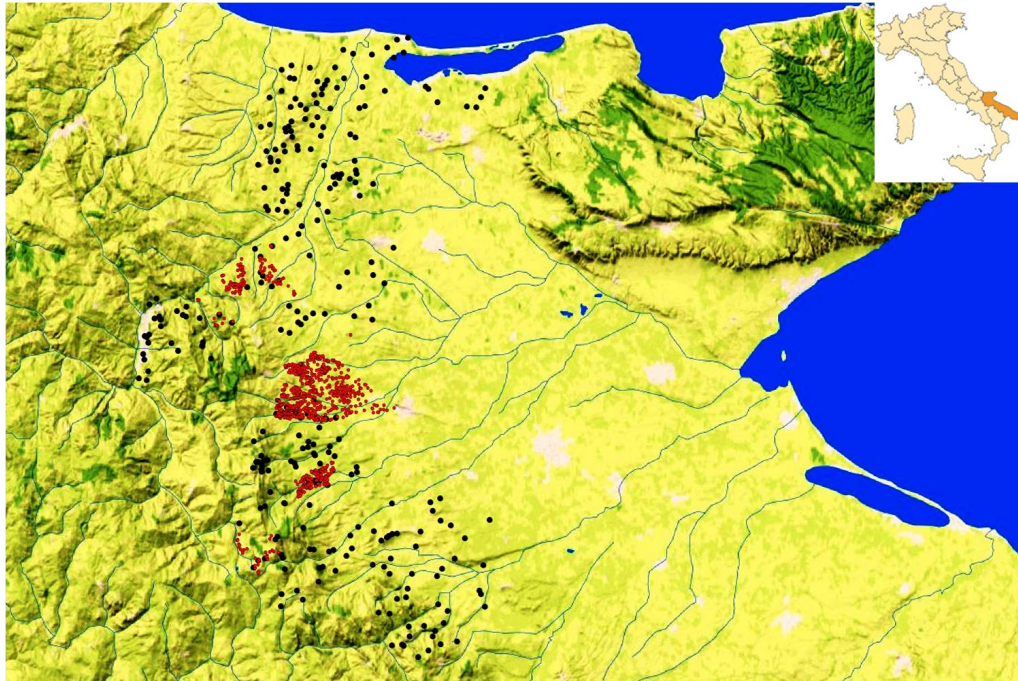


Fig. 7 The Ager Lucerinus project: DTM (Cartography Laboratory of Foggia).

compared to most conventional GIS is the use of three-dimensionality in developing models of the territory. In fact, it is clear that when an attempt is made to understand the behaviour of ancient man, one of the most important variables is the landscape with which he interacted and people still interact. Therefore, modelling the space as realistically as possible is a fundamental prerequisite in checking, using algorithms that were not developed for archaeology but when combined together appropriately, assuming that the deductions about the archaeological remains made are reliable to some degree. Therefore, the GIS used in the study presented in this paper is also often based on three-dimensional models.

Several characteristics and peculiarities of the construction and implementation of the GIS for the Archaeological Map of Italy—Forma Italiae are now examined.

In the initial phase, we used a multiple source data retrieval approach (bibliographic, archival, epigraphic, archaeological, etc.), recording much of the information reducing it to generic symbols, distinguishing only location type (precise or generic), but the scarcity of material gathered in the early stage

of the project made clear the need for a more detailed survey of the territory itself.

Orthophoto supported by the regional GIS (*Carta Tecnica Regionale*¹⁵) (Fig. 8) is the cartographical base reference (just as for the National Geoportal, in this case reference has been made to the free services available on the web site <http://www.sit.puglia.it>), while the cadastral map has always been considered as it is indispensable to the taking of protective measures although little used in the operational phase because it lacks altimetric references and is often absolutely anachronistic. As previously confirmed, the 1:25,000 scale IGM¹⁶ map is an unsurpassable base reference for the global picture and is more useful in several situations as historic cartography than direct reference on the terrain.

Aerial photographs were fundamental in identifying archaeological evidence such as crop marks in the

¹⁵ The general GIS of the region is the Regional Technical Map (*Carta Tecnica Regionale-CTR*) at the scale of 1:10,000. The source of the data is aerial photos or in some cases satellite images (layer “Use of the soil”). The mathematical elaboration of these produces the detail of these maps in urban blocks.

¹⁶ IGM (*Istituto Geografico Militare*)—the Italian military geographical institute.

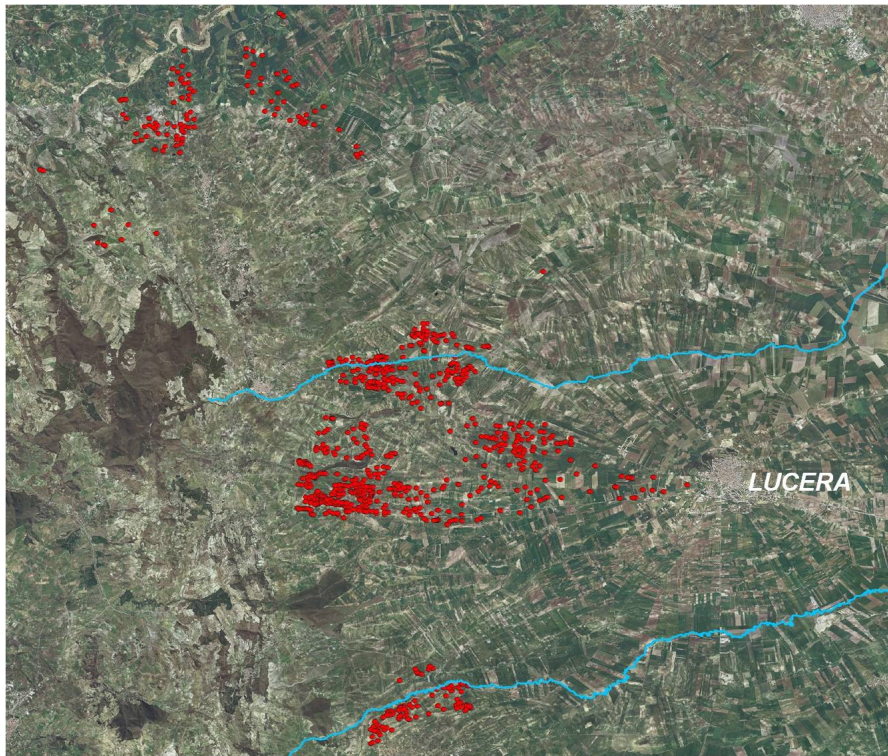


Fig. 8 The Ager Lucerinus project: Orthophoto.

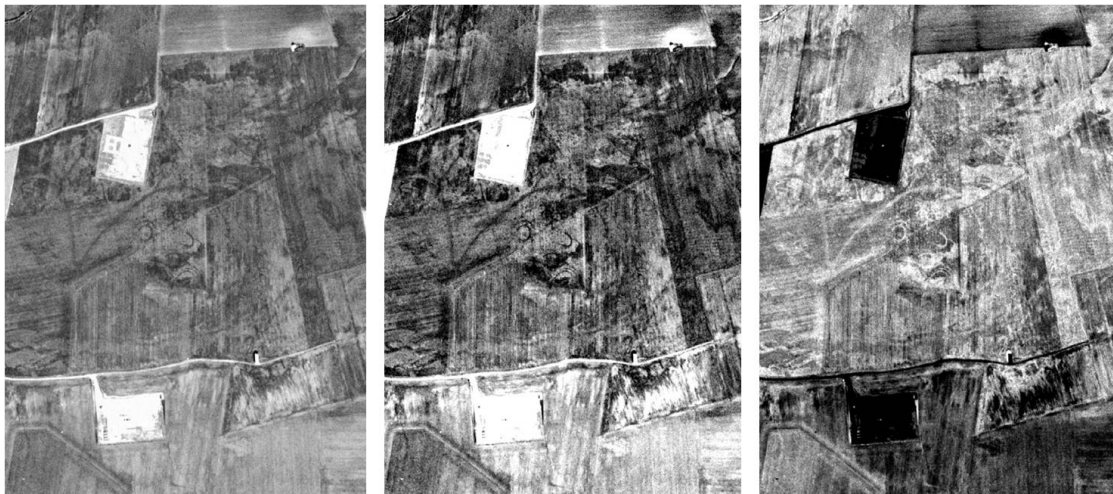


Fig. 9 The Ager Lucerinus project: Aerial photographs.

territory. The material from the RAF photographic coverage for the area (1943-47) and from IGM were unquestionably useful (Fig. 9).

The aerial coverage currently available (1954; 1988-89; 1994; 1998; 2000; 2004; 2007; 2010) was compared in order to check how legible the traces are through time. It should be noted that some of the above-mentioned series of aerial photographs,

available for reading and analysis using the GIS, are directly usable on line through the OGC (Open Geospatial Consortium), previously known as the Open GIS Consortium, an international not-for-profit organisation based on voluntary agreement which defines technical specifications for geospatial and location based services. In particular, the method used to implement the Ager Lucerinus project not only

made use of aerial photographs but also WMS, WFS, and WCS services present on the National Geoportal (www.pcn.minambiente.it). Using a procedure in the project GIS software (that is, proprietary: ESRI ArcGis, Geomedia, and *free*: QG is) through which the information layer can be coupled and projected *on fly* (only with an Internet connection) inside the project presented in this paper as a very normal information layer. In addition to clear financial and time savings, this procedure obtains updated georeferenced data with very high quality standards.

Geomagnetic or electromagnetic prospecting is also carried out in some cases in order to introduce further information on submerged presences, often contributing precious items in the reconstruction of building plans.

The reading and where possible the georeferentiation of the historic cartography are absolutely necessary for the recovery and analysis of items in the landscape above all in the historic reconstruction of infrastructures such as the road network or geomorphological evolution and changes in the landscape. Therefore, a series of historic maps was also regenerated, georeferenced, and lastly analysed in the project presented in this paper including precious historic and documental historic maps such as the Rizzi Zannoni, the “Locations” of the “Foggia sheep Customs House”, and all of the IGM cartography productions. In addition to the recognition investigations, topographical sampling is always carried out so that finds identified using GPS georeferentiation are correctly positioned (Fig. 10).

The large number of documents represented by the areas of mobile material fragments means the reliability of the data is very closely connected to how visible the terrain is which in turn depends on the type of cultivation and the degree to which the land has been worked. So when choosing the moments of maximum legibility, the maps of the visibility/legibility and use/condition of the soil need to be processed so that how reliable the data gathered

is can be defined and a solid base for reading the archaeological presence/absence can be composed, consequently creating the assumptions on which an interpretation and a qualitative standard can be based¹⁷.

The attention given to the DTM (Digital Elevation Model) processing obtained by interpolating the contour lines has facilitated hypothetical three-dimensional reconstruction of the ancient landscape and so its “virtualisation”. It also makes it easier to perceive and identify systematic forms of anthropic settlement and to formulate further research hypotheses about the presence of human life and buildings in a determined altimetric position or its slope and exposure in relation to the surrounding environment.

In particular, time has been dedicated to creating a Geodatabase in the ArcMap environment. The geodatabases not only support featureclass, rasters, and attributes, they also allow advanced GIS data behaviour and integrity rules to be implemented using types of data such as the topologies, networks, raster catalogues, terrain, specific rules for cadastral data (cadastral fabric), relationships, subtypes, and domains. The geodatabase unites “geo” (spatial data) with “database” (data repository) to create a central repository to manage and memorise the spatial data. This makes it possible to save the GIS data on a central server in order to facilitate easier management and rapid access. The construction of Geodatabase allows a very detailed implementation of the data input and so the equally detailed running of queries in the GIS constructed in this way. In other words, the more complex, the more detailed, and the more organised the attributes of any type implemented in the geodatabase are, the much more detailed, accurate, and exhaustive will the answers produced by the software be, making it possible to create the assumptions for as objective and immediate an interpretation as possible.

¹⁷ Marchi 2010.

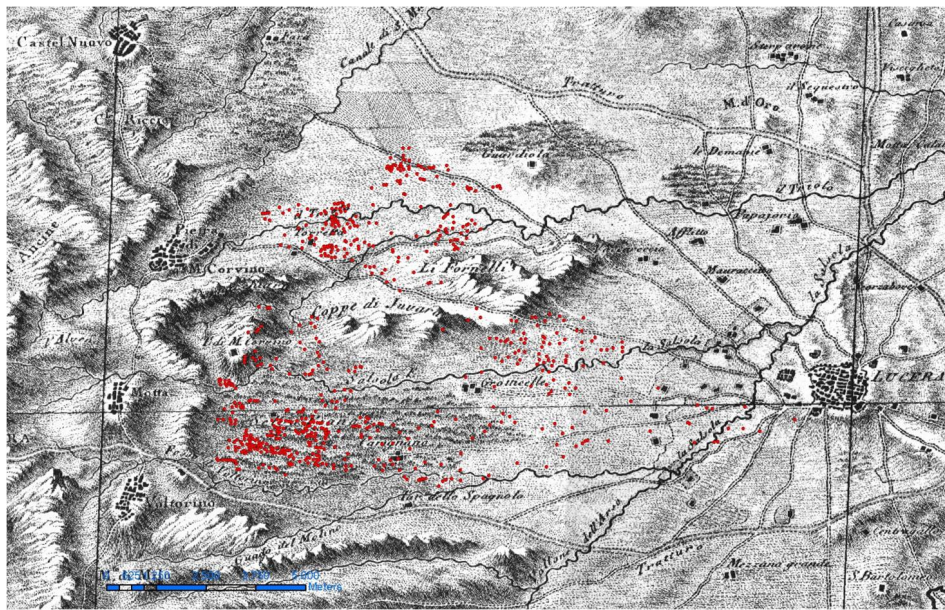


Fig. 10 Temathic map: historical maps.

For this purpose a computerized system for data management was used composed of a GIS platform, associated to an alphanumeric archive and designed to soon become a web GIS.

2.2 The Survey Methods

The archeological survey covered all the phases of territorial occupation, according to the criteria of systematic methodology. This type of survey is considered more useful than one restricted to a particular chronological period.

Our research was carried out according to the scheme established for the *Forma Italiae* using the IGM (Istituto Geografico Militare—the national mapping agency for Italy) 1:25,000 maps in the field we used the Regional Technical Map (Carta Tecnica Regionale, CTR) available in a scale of 1:10,000 or 1:5,000.

For some towns, but not all, digital aero photogrammetric maps are available. In many cases, it was possible to integrate orthophotos. In all cases, we used cadastral maps, which are fundamental for determining areas that should be protected, even though they contain no altimetric information and are sometimes outdated, for which reasons they are not easy to use in the field.

The mass of data gathered (more than 3,000 items for the Ager Venusinus project and 1,200 points for the Ager Lucerinus project) allowed us to refine techniques and methods for constructing a database. We experimented with many formats for entering data regarding both sites and materials.

The main objective determining our methodologies was that of gathering extensive, intensive and systematic data, completely covering the chosen territory (Fig. 11). The debate regarding topographic research methodologies was quite intense, the controversy pitting them against sampling survey methods. Our research results clearly demonstrated the validity of our methodology, which allowed us to obtain 90% more information regarding the starting point, in the areas where we gathered data, we were able to identify the existence of a much older settlement than what the published data indicated, with a ratio of 1 to 50 concerning published and unpublished data¹⁸.

In the initial phase, we used a multiple source data retrieval approach (bibliographic, archival, epigraphic,

¹⁸ Azzena, Tascio 1990, 207-22; Marchi, Sabbatini 1996; Tartara 1999; Quilici, Quilici Gigli 2001; Quilici, Quilici Gigli 2003, 28-31; Marchi 2005, 80-81.



Fig. 11 The survey.

archaeological, etc.), recording much of the information reducing it to generic symbols, distinguishing only location type (precise or generic), but the scarcity of material gathered in the early stage of the project made clear the need for a more detailed survey of the territory itself.

Following the “Forma Italiae project” methodology, based on an extensive and systematic survey of the whole selected district, the countryside systematically scanning the countryside on foot (the team consisting of 3-5 researchers), and returning to some areas in different seasons, though, when the ground was in different states of cultivation, in different weather and visibility conditions and at different times of the day.

Most sites were indicated by dense scatter of material on the surface. In these cases our date collection efforts per force had to take into account when the terrain had maximum visibility which depended on the type and stage of cultivation. This approach allowed us to create a map of visibility of the territory.

Since cereals predominate in the farming of the fields in the territory we were researching, the ideal

period for our investigation was from the end of the summer through the autumn when the fields had been harvested, thus offering the greatest visibility. Where grapes and olives are farmed, as where the fields are not farmed, the best periods are winter and spring. We classified the areas where we found scatter according to size and density of scatter.

It is important to note that when indicating the size of an area, we considered only the zone with the greatest concentration of material, where excavation was most likely to reveal structures.

We have had to consider theoretical and methodological implications of the classification of archaeological in regional survey archaeology, and the potential of classifications for making intra- and interregional comparisons and interpretations. The definition of a site is difficult, not in the least since everyone believes they know what it means, yet many definitions exist¹⁹.

¹⁹ S. Plog, F. Plog, W. Wait, for instance, define “sites” as discrete and potentially interpretable loci of cultural materials. For the geographer W. Wag staff, a site is “fundamentally a

We were able to define the types of settlements for sites of the Roman period (rural structures, farms, *villae*, *vici*) by combining the following types of data: size of the area, characteristics of the scatter, that is, whether construction materials (bricks and tiles, building stone, clay, etc.) or decorative elements (floors, plaster). In general, in the case of small areas, less than 100 sqm, but often also of larger ones, from 100 to 200 sqm, containing very poor building materials suggesting the presence of walls made from perishable materials, we opted to use the term “rural structure”, by which we mean, using the terminology of ancient Roman sources²⁰, *casae* or *tuguria*²¹ or *villulae*²². We used the term “farm” only for large areas where we found documentation of specific agricultural activities. We identified as “villas” areas larger than 1,000 sqm presenting multiple structures, each with a different function (residential, productive, storage), and scatter of high quality materials (marble, mosaics, etc.).

Further on our terminology, we analyzed the concepts of “topographic unit”²³, by which we meant an archaeological point. We accept the definition of an “entity clearly defined in space and culturally and chronologically interpretable”²⁴, and “off site”, a much debated term in the field of “survey”.

The initial phase of our project concerned the creation of an Archaeological map of the area which allowed us to document a constantly evolving situation. During the entire period of our project, the area was repeatedly subjected to large scale structural and infrastructural projects (for example, the Fiat factory on the Melfese plain, the Bradanica road, and windmill farms on the hillsides). Our work which

predated these projects allowed us to document the situation before it was altered, and in some cases, like that of the Fiat factory²⁵, served as the archaeological risk map.

The area of Ager Lucerinus presents an ancient complex and varied landscape, and the archaeological map created offers a valuable instrument of protection in this area constantly threatened by the spread of wind farms. In fact the data processed by the GIS Laboratory of Archaeological Cartography, according to the Archaeological Superintendence, have been used for “Piano Paesaggistico Territoriale della Regione Puglia” (Puglia’s Regional Landscape Plan)²⁶.

We were able to document situations where radical changes in the landscape had occurred due to agricultural interventions (planting of grape or olive groves which require digging deep holes and continual plowing). We were also able to contribute to actions to safeguard and protect areas of great archaeological interest.

3. Results and Discussion

3.1 The Ager Venusinus Project

The Ager Venusinus project, carried out over nearly two decades (1989-2002) coordinated by Paolo Sommella and Maria Luisa Marchi, benefited from a rich synergy of institutional and human resources. Many generations of students and scholars participated in the projects and many advanced technologies were tested (Fig. 12). Our project, for example, represents one of the first applications of both GIS (geographic information system) and GPS (global position system) in archeology. During the project we carried out an extensive and intensive survey of the ancient colony of Venusia in the Melfi district (Bottini 1982, pp. 152-160) between the Ofanto valley and the slopes of Mount Vulture (Fig. 13).

place or location where something is found. Each site is in some sense recognisable and discrete ... Site implies a fixed, formal entity”.

²⁰ Di Giuseppe 2005, 8-9.

²¹ Livio, III, 13; III, 26; XLII, 34; V, 53.8; Plinio. N. H. 16.14; Virg. Ecl. 1.69; Col. R. R. 12.15.1; Festus s.v. *tugurium*.

²² Cic. Ad Att. 8.9.3; 8.13.2; 12.27; 16.6.2; Apul., Met., 1.21.

²³ Belvedere 1994; Manacorda 2007; Quilici, Quilici Gigli 2003, 45; Carandini et al. 2007, 13-25.

²⁴ Plog, Plog, Wait 1978, 389-94.

²⁵ Azzena 2001, 77-86.

²⁶ Marchi et al. in press.

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Fig. 12 Ager venusinus project, archaeological survey: the team (1990-2000).

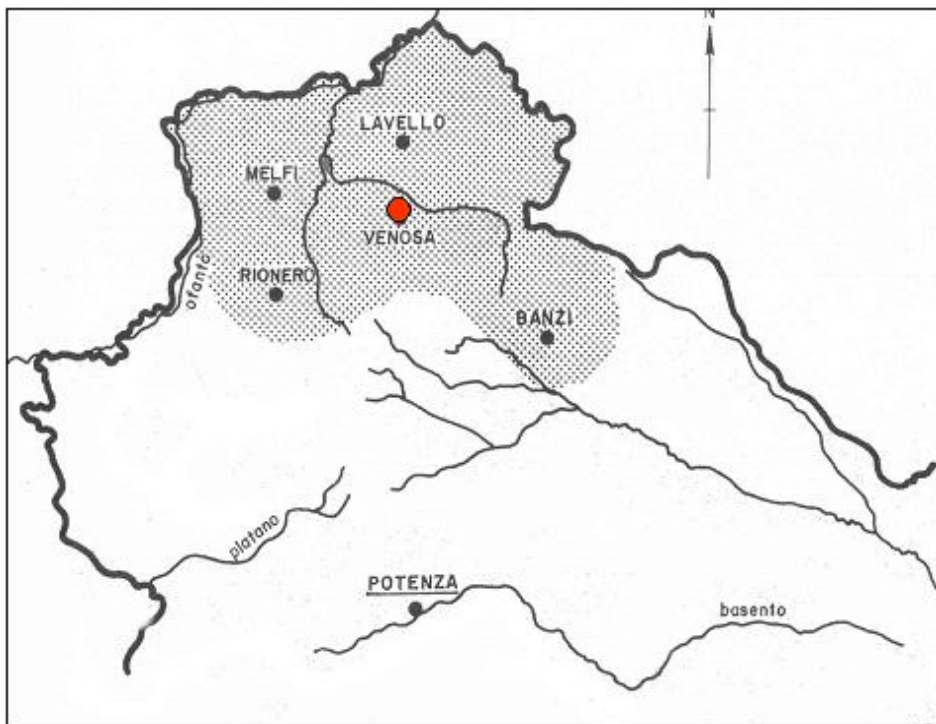


Fig. 13 The “Melfese” area.

The first volume published in the project, *Venusia*, contains an ample discussion of the techniques and methodologies employed, the survey and data analysis²⁷ (Azzena, Tascio 1996, 281-297; Azzena 2004). Other publications provide further information. Therefore, a brief summary will suffice here.

We were able to draw up a map representing an

area of seven hundred square kilometers, with more than two thousand identified archaeological sites. This map helped us reconstruct the historical archeology of the ancient landscape from Prehistory to the High Middle Ages and promote the protection and cultural appreciation of the territory. The archaeological survey covered all the phases of territorial occupation, according to the criteria of systematic methodology.

²⁷ Azzena 1992, 747-66.

This type of survey is considered more useful than one restricted to a particular chronological period.

Our research was carried out according to the scheme established for the Forma Italiae using the IGM (Istituto Geografico Militare)²⁸ maps 1:25,000 (187 I NO-Venosa; 187 I SE - Forenza; 188 IV NO - Palazzo S. Gervasio; 188 IV SO - Genzano di Lucania; 175 II SO - Lavello). In the field we used the Regional Technical Map (Carta Tecnica Regionale, CTR) available at a scale of 1:10,000 or 1:5,000. For some towns, but not all, digital aero photogrammetric maps are available. In many cases, it was possible to integrate orthophotos. In all cases, we used cadastral maps, which are fundamental for determining areas that should be protected, even though they contain no altimetric information and are sometimes outdated, for which reasons they are not easy to use in the field.

The first volume published in the project, *Venusia*²⁹, contains an ample discussion of the techniques and methodologies employed, the survey and data analysis³⁰. Other publications provide further information. Therefore, a brief summary will suffice here.

This was one of the first archeological projects in Italy to use GIS, experimenting with database input and with GIS applications. Our project included the creation of a dedicated GIS³¹. It was also one of the first to work with GPS. Between 1989 and 1992, studies and experiments were carried out on automatic systems for the acquisition, calculation and management of archaeological data relating to the Carta Archeologica d'Italia (Forma Italiae).

Our interest in using GPS (global position system), developed in the USA for military purposes, derives from the difficulty in applying traditional systems to determine the coordinates of a point, and consequently the plan of the archeological element to which it refers

that is, the difficulty in placing (or rather, georeferencing) a given point in the IGM network of coordinates. The difficulty arose from the scarcity of geodetic points in the IGM maps. GPS provided the means to overcome the difficulty, allowing us to calculate the coordinates of a point using satellite systems.

By using differential systems—we used WM102 receivers—we obtained millimetric precision. It took approximately two hours to plot each location. Initially we plotted a select number of major points with the WM102 in order to integrate the IGM network and establish the starting point for identifying the topographic stations to be included in the survey. Following this experiment, we used several different types of GPS receivers, as new more precise models became available (Trimble-Pathfinder Pro XRS). Currently we use GPS for all archeological sites.

The mass of data gathered (more than 3,000 items) allowed us to refine techniques and methods for constructing a database. We experimented with many formats for entering data regarding both sites and materials.

During the entire period of our project, the area was repeatedly subjected to large scale structural and infrastructural projects (for example, the Fiat factory on the Melfese plain, the Bradanica road, and windmill farms on the hillsides). Our work which predated these projects allowed us to document the situation before it was altered, and in some cases, like that of the Fiat factory³², served as the archaeological risk map.

We were able to document situations where radical changes in the landscape had occurred due to agricultural interventions (planting of grape or olive groves which require digging deep holes and continual plowing). We were also able to contribute to actions to safeguard and protect areas of great archaeological interest.

In this context, I would like to mention the Casalini Sottana settlement in the town of Palazzo San

²⁸ The Military Geographic Institute, the national mapping agency for Italy.

²⁹ Marchi, Sabbatini 1996.

³⁰ Azzena, Tascio 1996, 281-97; Azzena 2004.

³¹ Marchi, Mazzei 2012.

³² Azzena 2001, 77-86.

Gervasio (Pz)³³. Several years ago, there were plans to create a quarry in the area, but thanks to our survey which had revealed this rich settlement there, we were able to advise the authorities against the quarry project (Fig. 14).

This settlement occupies polylobed plateau with steep slopes, situated at the confluence of two streams covering about forty hectares. Taking into account the size and density of the site along with material found there, we were able to identify the functionality and distribution of the various housing sectors. We identified the area of the acropolis at the highest point where later, in the Middle Ages, a fortified structure arose which is still visible in an aerial photograph. Hand craft sectors characterized by kilns were also identified mainly on the basis of waste materials. The cult areas are identifiable through fragments of architectural terracotta and votive figurines. The discovery of extremely finely crafted ceramics may indicate certain areas as burial grounds.

In conclusion, thanks to the intervention of the Archaeological Superintendence to monitor the area following our report, the quarry project was not carried out. This is a fine example of how archaeological research can also contribute to conservation³⁴.

The ultimate goal of this long project is however the historic reconstruction of the area and the ancient landscape which captures the complexity of its variations, in the perspective of both natural and anthropized changes. In this perspective, the description of the settlement must perforce be global and refer to all the phases of occupation, from Prehistory to the Middle ages³⁵. Although we based our initial research on a chronological assumption that connected it to the territory of the Latin colony and that therefore defined its dates within the Roman age, as our work progressed, our field of investigation

expanded and our research took on geographic connotations.

This was one of the first archeological projects in Italy to use GIS, experimenting with database input and with GIS applications. Our project included the creation of a dedicated GIS (Carta Archeologica d’Italia: Archeological Map of Italy—Forma Italiae)³⁶. It is important to keep in mind that having the entire project with all its analytical data in the GIS makes cartographic references and indications of scale superfluous. All archeological elements, both monumental and structural as well as scatter of material on the surface are georeferenced, their shapes and sizes perfectly represented.

Our project was also one of the first to work with GPS (global position system)³⁷. Between 1989 and 1992, studies and experiments were carried out on automatic systems for the acquisition, calculation and management of archaeological data relating to the Forma Italiae.

3.2 The Ager Lucerinus Project

This paper also introduces the main research results regarding Luceria (Apulia), in the so-called Daunian district. In particular we focused on the western area, towards the Daunian subappennine, which includes the municipalities of Lucera, Pietramontecorvino, Motta Montecorvino, Volturino, Casalnuovo Monterotaro, Biccari, Roseto Valfortore (the entire Foltore valley), adding to the analysis of the Lucera territory already carried out by our team in the northeastern area³⁸ (Fig. 15).

The Ager Lucerinus project was carried out over a period of almost ten years.

The main aim of this research was to perform a complete historical reconstruction of the anthropized landscape of the Luceria colonial territory. We also included the border area between the Tavoliere and

³³ Marchi, Sabbatini 1996, 90-91; Marchi 2010, 35-39; Marchi 2014, 186.

³⁴ Bottini, De Siena, Marchi 2014.

³⁵ Marchi 2010.

³⁶ Marchi, Mazzei 2012.

³⁷ Azzena 1992, 747-76.

³⁸ Marchi 2008; Marchi, Buffo 2010; Marchi, Forte 2012; Marchi et al. 2014.

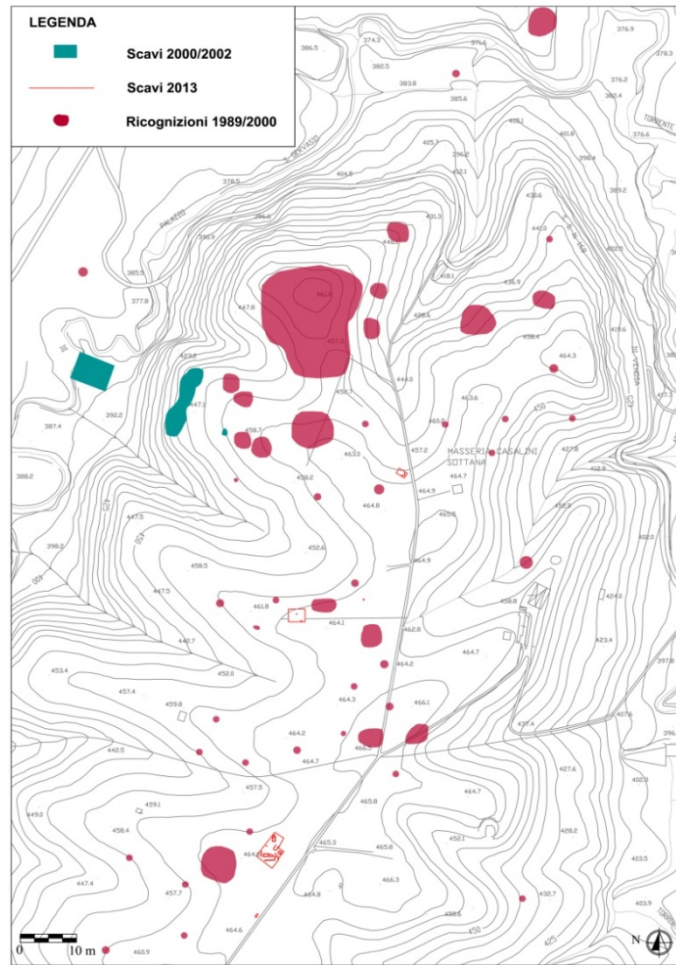


Fig. 14 Casalini Sottana settlement: archaeological map.

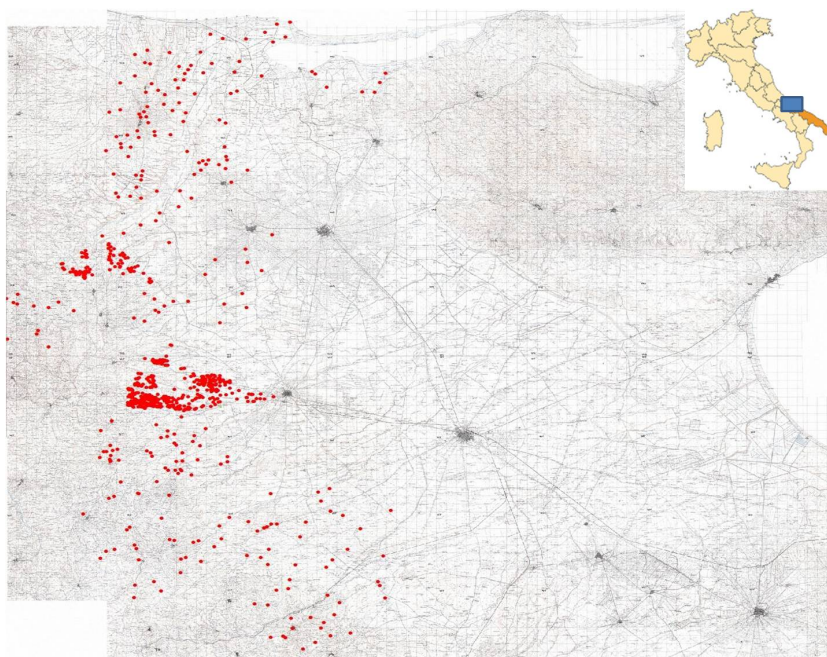


Fig. 15 The Ager Lucerinus project.

Daunian subappennine relevant in order to understand the limits between the so-called Daunian and Frentani territories, according to ancient literary sources³⁹.

New data, emerging from recent surveys, show the presence of a large population over the time-span from Prehistory to the High Middle Ages. We found 1,200 archaeological points.

These include Neolithic and Bronze ages settlements, located on vast plains. Traces of a huts village surrounded by the typical C shaped ditch, are visible on the northern sector of the investigated area.

According to ancient written sources, this area was under the so-called Daunian influence, between the 8th and 4th centuries B.C. Our new data seem to indicate a rather extensive human presence spread throughout the entire area (Fig. 16). One particularly notable settlement is that of Masseria Torretta and Selva Piana-Carignani, located at the center of a low plateau outlined by an abundant scatter of fragments, dated to the 5th-4th centuries. Aerial photography reveals traces of a rectangular building which might be interpreted such as an *oikos*.

A very interesting part of our project focused on the analysis of “Native” settlements in the period preceding the Romans’ arrival and the resulting colonization of the area.

In this perspective, one of the most important case studies is the site of Chiancone, located in the nearby Lucera (Foggia Province) (Fig. 17).

The settlement, situated on a large plateau surrounded by steep slopes, covers about two hundred hectares. Like other “Daunian” settlements of the same period, Chiancone seems to be organized in alternate groups of dwellings and burials areas clusters of ceramics fragments (i.e., bricks, tiles, “Daunian” Matt-painted, Red-figure pottery, Black-gloss ware sherds) testify to the presence of a residential building, which might be dated between the 7th and the 4th century B.C. Moreover, taking into account the

dimensions of the site and the density of material found on the ground surface, we might be able to identify and interpret the function and distribution of several dwelling sectors. For example, many antefixes (i.e., a relevant specimen with a “knight” similar to an antefix discovered in the votive deposit at Lucera), as well as a mold, may indicate the existence of a production center (e.g., an antefix with nimbus which bears similarities with the Etrusco-Campanian samples identified at Arpi, Teano and Lucera).

This area also yielded the tomb of a “warrior” dated to the 5th century B.C., on the base of the extraordinary grave goods. Among the thirty-five objects found, there were many ceramic vessels (i.e., an urn containing a dish, an olla, an Attic black-figure kylix, a so-called “Ionic-type” cup, datable to the final decades), defense weapons and skewers, placed nearby the feet of the deceased, who was buried in supine position (Marchi et al. 2015 in press).

The major change in the ancient landscape was undoubtedly produced by the Roman intervention and the foundation of Luceria. The planning of the new colony consequently entailed the reorganization of vast territory and the division of the adjacent rural area into a dense network of small properties assigned to the settlers.

These transformations may be recognized, in particular, in the area of Selva Piana, where clusters of ceramics fragments allowed us to identify small buildings of 100-200 square meters and in Fornello, where aerial photography clearly displays traces of centuriation.

The farms were later replaced by early imperial villas. Medium-sized rural settlements begin to spread and polynucleated structures, that is, structures consisting of several buildings close together, sometimes incorporating previous buildings, begin to appear. The number of settlements in the early Imperial periods grew notably but is most evident in the recurring reoccupation of pre-existent structures. The medium-large villas which began to appear mark

³⁹ Tolomeo, *Geogr.*, III, 1, 14; Pomponio Mela, 2, 4, 66; Pomponio Mela, 2, 4, 66; Strabone, VI, 3, 8.

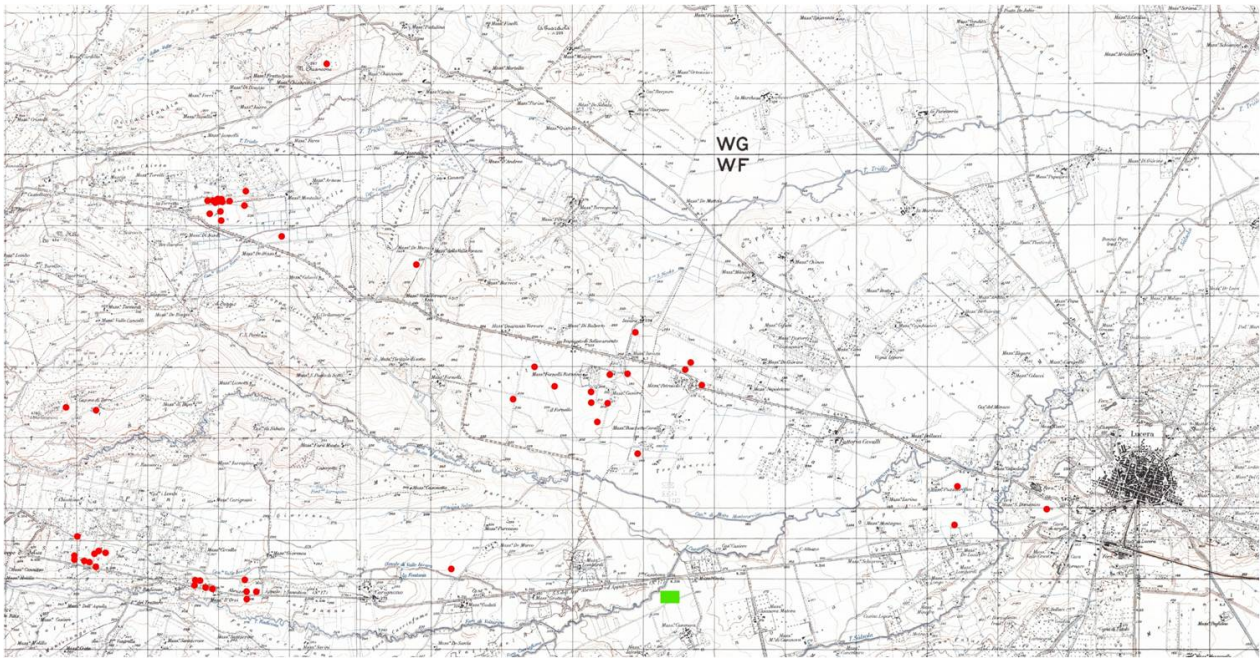


Fig. 16 The site of daunian age.

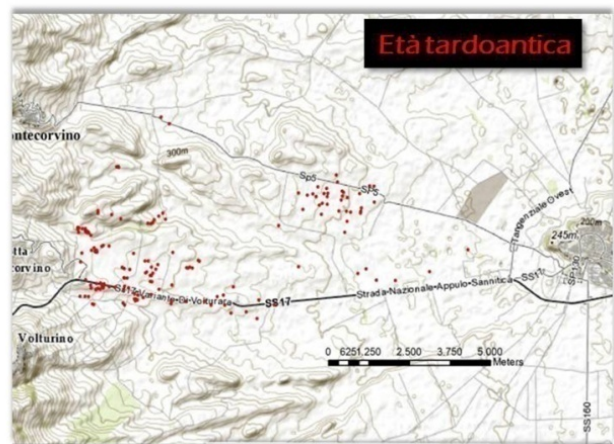
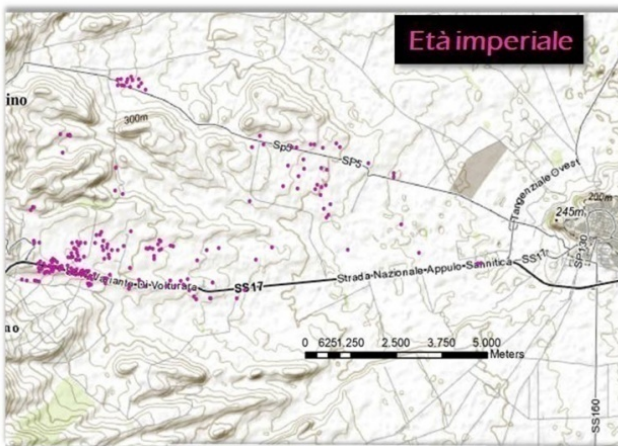
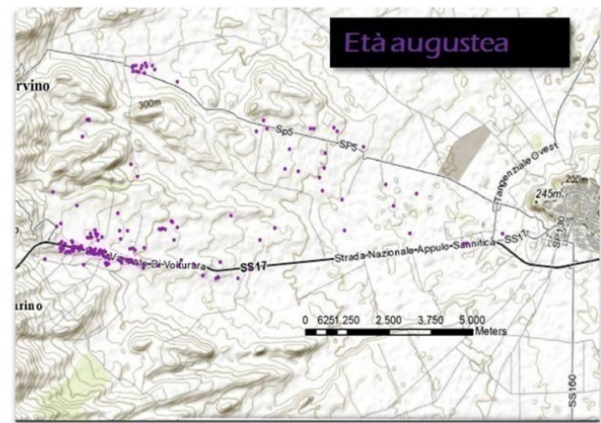
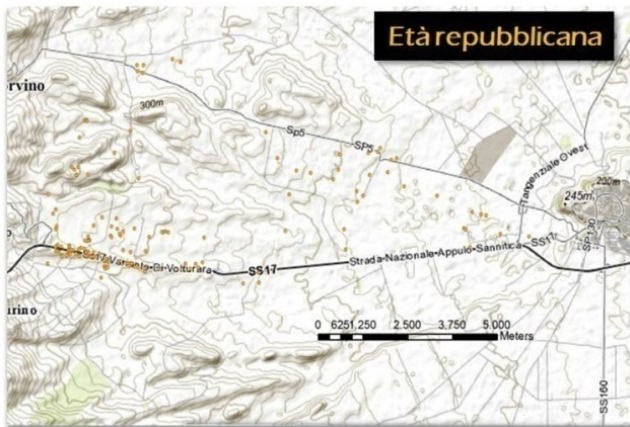


Fig. 17 The Ager Lucerinus project: age maps.

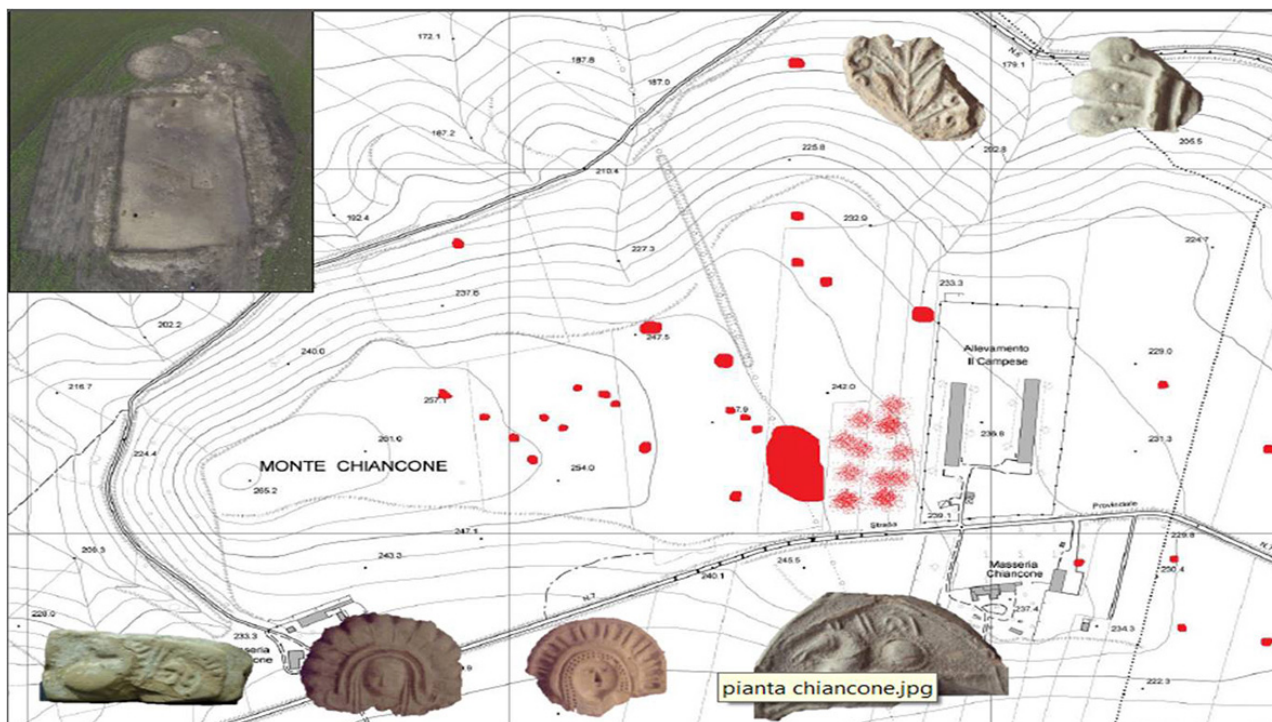


Fig. 18 The Chaincone site: Lucera (Foggia) territory.

the beginning of the process that was completed in the Mid-Imperial period with the emergence of latifundia.

The mass of data gathered (more than 3,000 items for the Ager Venusinus project and 1,200 points for the Ager Lucerinus project) allowed us to refine techniques and methods for constructing a database. We experimented with many formats for entering data regarding both sites and materials.

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