

Recovering LOST LANDSCAPES

Edited by

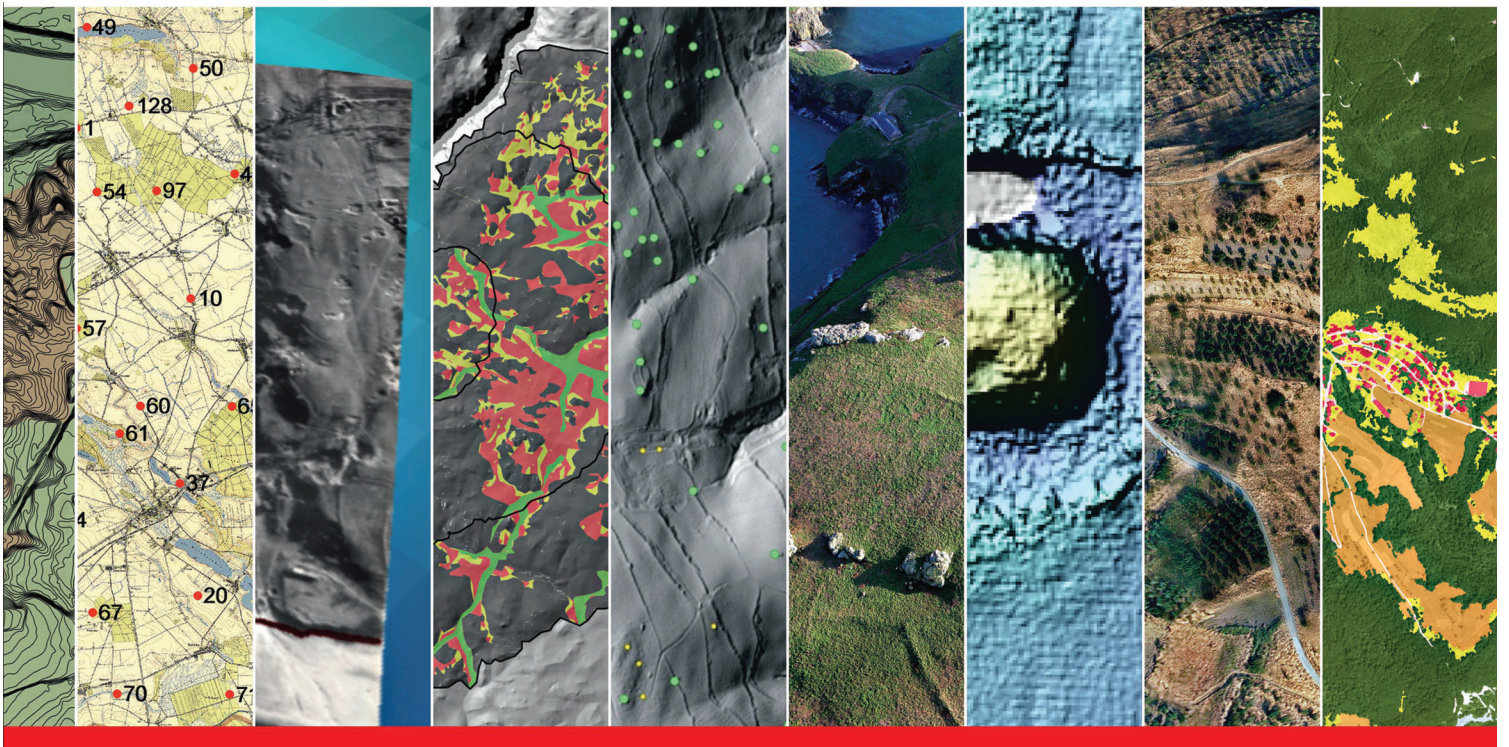
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Belgrade 2015

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Ancient landscapes of north-western Iberia: historical aerial photographs and the interpretation of Iron Age and Roman territories

Abstract: *This paper presents the use of historical aerial photographs in research of past landscapes in the north-western Iberian Peninsula, through several examples taken from a larger regional study, all connected with the diachronic study of social and territorial changes during the Iron Age and Roman period (5th century BC to 3rd century AD). Technical procedures are explained, but also the different solutions adopted and the consequences of the use of the historical aerial photographs. An important point of this paper is to demonstrate the great value of such imagery in an age when the use of other sources, such as Airborne Laser Scanning (ALS or LiDAR) data or modern aerial orthoimages, might be seen as all that is needed.*

LANDSCAPE ARCHAEOLOGY AND THE USE OF HISTORICAL AERIAL PHOTOGRAPHS

This paper presents the use of historical aerial photographs in our research of past landscapes of north-western Iberia. We will focus on the different uses of historical aerial photographs for documentation of ancient landscapes, for analysis and for interpretation, recognising also that their use for the management of cultural landscapes and dissemination of research results has an important place in our work (Ruiz del Árbol et al. 2005). As we will show, historical aerial photographs are essential to our study, even if other contemporary images and resources (such as ALS/LiDAR or aerial orthoimages) are also used in our work.

Archaeological research has relied on aerial photographs as a fundamental tool for the study of historical processes through the analysis and interpretation of landscape landmarks. Such studies have a long tradition and several approaches and theoretical perspectives can be distinguished (some useful works of synthesis are: Orejas 1991; Clavel-Leveque et al. 1994; Gillings et al. 1999; Bewley, Rączkowski 2002; Bourgeois, Meganck 2005; Barber 2011). Our work has developed within this context, and we have already published several papers showing our procedures and results (such as Sánchez-Palencia, Orejas 1991; Sánchez-Palencia 2000, 2014). Our point of departure is the idea that archaeological documentation must be understood in a broad sense. The archaeological record is not reduced to the material vestiges of culture but it involves all the products of human action in space and time: that is to say the whole landscape. From this perspective, the landscape, conceptualized as a cultural creation, is a key element in our research, because through it the processes of social change are visible in their complexity and integration (Orejas et al. 2002).

Landscape archaeology is conceived in our work as meaning the investigation of social formations and the processes of change within space and over time from an inter-disciplinary perspective. This requires the use of different methods and techniques within a multi-scaled approach to move beyond the environment as a vague framework for archaeological sites, and leading to an archaeological reading of landscape in all its complexity. And historical aerial photographs are one of the essential tools to record the dynamism of historical processes, a dynamism that is embedded in the landscape.

Historical aerial photographs have been a key instrument in all the stages of our research and also, an important tool to develop our proposals on the valorization and management of the archaeological heritage.

In this paper we present the use of these photographs in our research work, thorough selected examples of the main projects of our group “Social Structure and Territory – Landscape Archaeology” (GI EST-AP), developed for the last 30 years. In these projects we have used photo-documentation, photo-interpretation and photogrammetry for the study, understanding and interpretation of cultural landscapes.

However, and as a consequence of the long duration of our project, the use of historical aerial photographs has changed in our research over time. Historical photographs were, firstly, the main instrument employed in the remote sensing analysis, primarily through stereoscopy. As time went on, digital stereoscopy has been incorporated. Today, the use of historical aerial photograph can only be understood if integrated with other geospatial analysis instruments and digital technologies, such as the topographical analysis with ALS and the use of GIS.

In any case, as we intend to show the use of historical aerial photos is integrated in a very well programmed research with precise archaeological and historical objectives. The geospatial documentation or GIS systems constitute a useful tool, but these are technical tools that must be subordinate to the goal of Archaeology, that is understanding the historical processes and the recording of change. In fact, in the study of ancient Iron Age and Roman landscapes we are interested not only in specific activities developed over the territory (such as mining or agriculture), or sites or settlement patterns, but also in considering them in the framework of profound changes in our study areas during the past. Our interests are the transformations of the north-western territories between the Iron Age and the Roman conquest: new power relations, new economic interests and new organizational and territorial frameworks for the local societies (Orejas, Sánchez-Palencia 2002; Sastre, Sánchez-Palencia 2013; Ruiz del Árbol et al. 2014).

There is today, from our point of view, a proliferation of studies in which aerial photographs are used in a simplistic way, under the pretext of recording the landscape (not to mention the overuse of the term “archaeology of landscape”). Aerial photographs are in a vast majority of cases used as a mere illustration without any analytical capacity (the extreme example of this “abuse” is the un-critical use of Google Earth™ as illustration). The causes for this are to be found partly in the easiness of access to geospatial digital data and user friendliness of visualization services and map downloads, that has produced a notable increase in the use of aerial photographs in archaeological analysis during the last few years; also, on the empiricist approach that dominates the landscape in GIS-based Archaeology (Criado 2015). The consequence is that many studies developed from a pretended “landscape archaeology” and do not go beyond site analysis. Thus, the historical aerial photographs are used only to formally analyse a site, without paying attention to the multidimensionality of the landscape as a whole, understood as a complex reality. Often, these works are presented as innovative studies and even published in high standard (peer-reviewed) archaeological journals. This is the case (to cite but one example) of several papers related to the use of ALS to study gold mining in north-western Iberia (such as Fernández et al. 2015; Fonte et al. 2014) that even neglect the value of historical photographs in the research process. These papers in fact do not approach conceptual or historical problems. Although they do provide a technical and innovative methodology (ALS), this is not a contribution to the formal study of mining structures: the study is not included within a broader comprehensive analysis, oriented with historical criteria and with recourse to different sources. In fact the two papers cited present as “novel” mining workings previously detected and studied in depth through the photogrammetric analysis of several historical flights (Fernández-Posse, Sánchez-Palencia 1988; Sánchez-Palencia, Orejas 1993; Sánchez-Palencia et al. 2009).

To sum up, the use of historical photographs in archaeological analysis goes far beyond accompanying the study of a site with a picture for illustrative purposes, reducing it to a decorative role. Stereoscopic vision is a key component in working with aerial photographs that was recognised at the very origins of this discipline, but which nevertheless seems to have been neglected in many recent archaeological studies. The work of J. C. Sánchez and I. Fumadó (2006) is a good example of how the real capabilities of aerial photographs are underexploited. Their point of departure is a simplistic vision in which soil-marks and crop-marks seem to be the sole observable elements through aerial photograph. The authors create an index to evaluate the potential use of aerial photographs in which only the cultivated and less mountainous areas appear as suitable for their archaeological use. However, the real potential of photogrammetric analysis goes far beyond, and it is not limited to what can be seen with the naked eye on the photograph; it is only revealed by the stereoscopic vision of the formal elements that appear in the landscape. Therefore, only through the photogrammetric analysis of multi-temporal historical photographs can we access the great historical potential of these archives, and thus

contribute to the construction of interpretations to understand past landscapes.

THE HISTORICAL AND SPATIAL CONTEXT OF OUR RESEARCH

The several case studies we present below have been chosen from the different regional studies undertaken by our Research group in relation to the study of ancient landscapes of the western Iberian Peninsula (Figure 1). Chronologically, our work focuses mainly on the Iron Age and Roman periods (5th century BC – 3rd century AD).

During the 1980s the team started working in the Spanish provinces of Leon, Ourense and Asturias, especially in the La Cabrera Mountains (the River Cabrera and River Eria area); Las Médulas and its region; the north-western Duero valley; and in the upper and middle basin of the River Sil. There is very complete information for this area already published (Orejas 1996; Sánchez-Palencia 2000). From 1997 we have worked in Las Cavenes de El Cabaco (Salamanca) and other gold deposits in the Roman province of Lusitania. This area has provided very interesting details on the development of gold mining and Roman provincial organization (Ruiz del Arbol 2005; Ruiz del Arbol et al. 2014, Sánchez-Palencia 2014). Also, from 2005 we have worked in the area of Pino del Oro, in Zamora, and in the Lower Miño and Lower Tajo valleys (Sanchez-Palencia 2014, Sánchez-Palencia et al. 2013, Currás 2014). More recently other projects, such as the Via Nova Project, or the study and valorization of Sanabria (Zamora) (Currás et al. 2014) and Os Biocos (Ourense), have also made intensive use of historical aerial photographs.

All our study areas have in common that they are important regions for the study of ancient gold mining. It is out of the scope of this paper to stress the importance that the gold-bearing areas of the north-western Iberian Peninsula had to the Roman Empire, beyond stating that throughout the 1st and 2nd centuries AD secondary or alluvium gold deposits and primary or rock deposits were discovered and extracted here (Domergue 1990 and 2008; Orejas and Sánchez-Palencia 2002). The areas studied by our team are representative of this process.

SPATIAL ANALYSIS: OBTAINING, ORGANIZATION, ANALYSIS AND PRESENTATION OF DATA

Here the uses of historical aerial photographs in our regional studies and in the whole north-western Iberia are presented, outlining the technical procedures, the different solutions and consequences of the use of these historical documents. Our aim is to illustrate the analytical process undertaken for the archaeological characterization of the territory and is potential for the interpretation of the landscape.

There are several systematic historical flights available for north-western Iberia. For the Spanish territories, the main flights are the so-called “vuelo americano” (“American flight”), A series of USAF, from 1945–1946 (1:45.000); the “vuelo americano”, B series, taken during 1956 (1:33.000); and the “vuelo interministerial” (literally: “inter-ministerial flight”) from 1977–1983 (1:18.000).

Finally there is also the “vuelo nacional” (“national flight”) from 1980–1985 (1:30.000). These flights are partially accessible online (<http://mapas.xunta.es/> & <http://fototeca.cnig.es/>), although it is not possible to download a stereo-pair that makes photogrammetric use possible (the purchasing of stereo-pairs must be done by contacting the relevant agency).

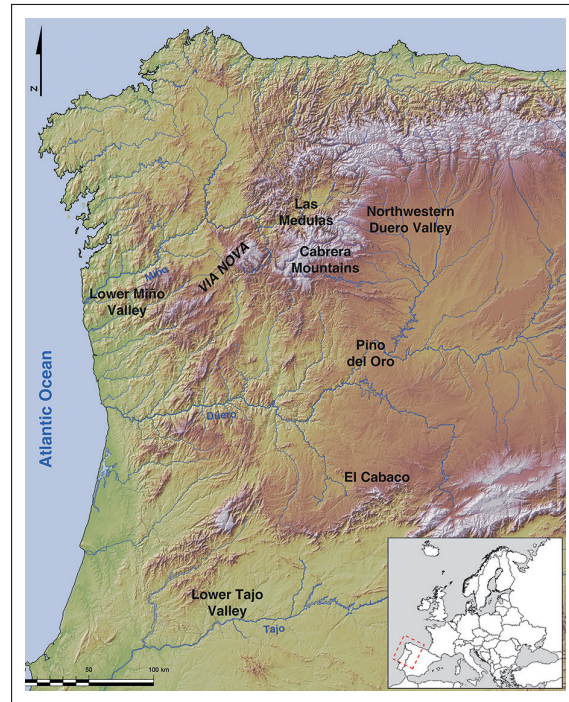


Figure 1. *The northwestern Iberian Peninsula showing the main areas of our research. Elaborated by EST-AP, CSIC.*



Figure 2. Photo-interpretation of the mining exploitations and Roman fort of Valdemedina (Truchas, León). Legend: 1: mining exploitations; 2: network of Roman water canals for the supply of water to the mining exploitations; 3: water reservoirs; 4: modern main road; 5: modern secondary road (cfr. Fernández et al. 2015, figure 10, where the isolated use of ALS makes it impossible to detect many of these structures). Elaborated by EST-AP, CSIC.

For Portugal, and with a systematic character, there is, firstly, a RAF flight from 1947 (1:30.000) and secondly, the “American flight” taken in 1958 (1:33.000). There is also an interesting flight from the “Sociedade Portuguesa de Levantamentos Aéreos” (Portuguese Society for Aerial Surveys) taken from 1937, which is unfortunately not systematic in area coverage and nor does it have a constant scale.

As we are going to show in each study-case historical aerial photographs are an essential tool in several and complementary ways. The first works of our team in the 1980s illustrate very well the use of the historical aerial photographs in our fieldwork and analysis. The work at the Cabrera Mountains exemplifies how we have used photo-interpretation for the documentation and analysis of settlement morphology and the identification and recording of several structures (Figure 2). However, the “American flight” has also been used in the newer projects, such as the study of the Lower Miño Valley. Its main advantage is that the 1950s marks the greatest extension of cultivated and forested land: the landscape of these years – not abandoned, but fully under traditional agricultural use, not yet transformed – is ideal to the detection of ancient structures, such as mining exploitation.

Field survey (aerial survey)

The stereoscopic analysis of historical and modern aerial photographs offers the possibility of a general recognition of the territory, and thus providing a global perspective while allowing the identification of sites. The aerial photograph analysis is done with the use of a mirror stereoscope (a portable one is used in the field). A digital stereoscope has also been used for the photogrammetric survey of some specific sites.

The “American flight” of the 1950s has been generally used to make a systematic and intensive survey. Its scale (about 1:30.000) provides a general overview of the geomorphology of the studied region and allows (by

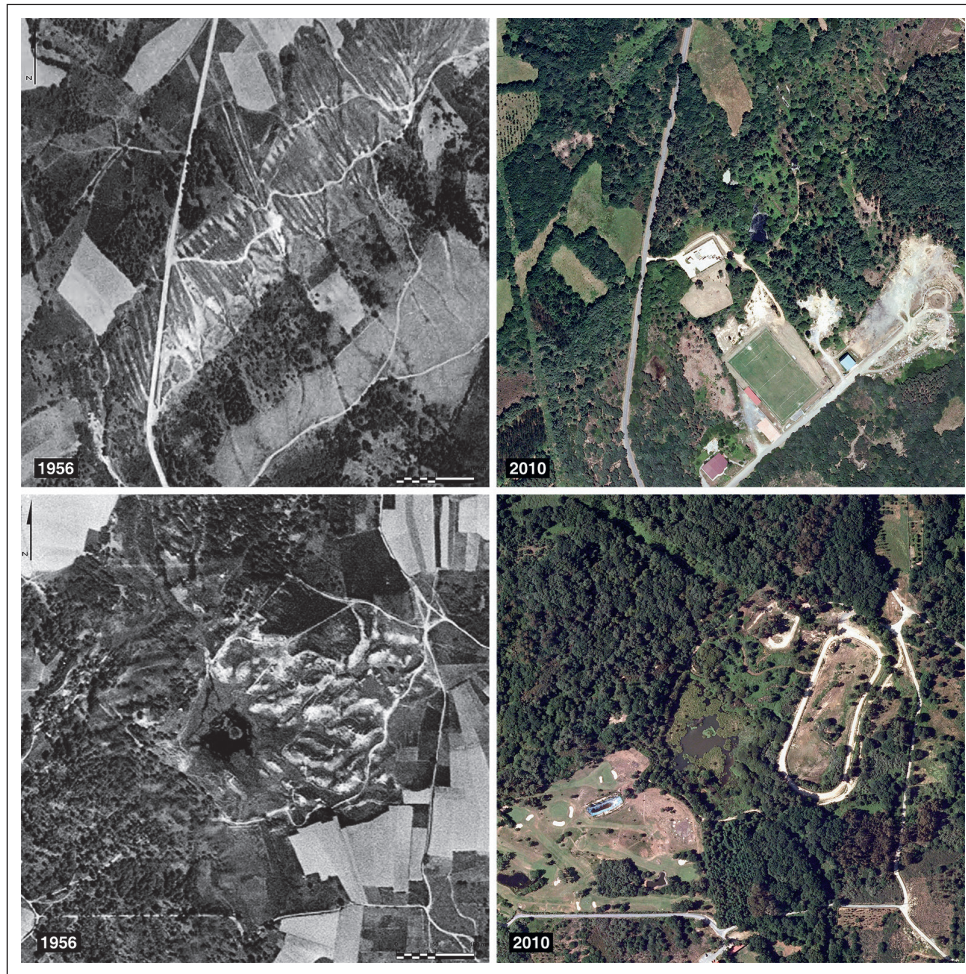


Figure 3. Transformation of the Roman mining exploitation of Os Medos (Pobra do Brollón, Lugo) and Puzo do Lago (Maside, Ourense) between the 1950s and the 2010. © Elaborated by EST-AP, CSIC from the USAF “American flight” (series B, 1956) and the IGN PNOA flight (2010).

using selected enlargements) identification of the different human actions on the landscape. Depending on the regions, along with the “American flight” we have used other available imagery, mainly from the 1980s. Also, in the last few years the possibility of using ALS-derived digital terrain models has offered the possibility to analyse the morphology of the territory as complementary resource to the historical aerial photographs.

The planning of fieldwork normally involves the selection of places to visit. The surface recognition of the archaeological sites is preceded by detailed photo-interpretation that facilitates the identification and characterization of each of the formal elements on the ground.

Field walking is extremely difficult in most of the studied areas of north-western Iberia. Most of the rural areas are in a situation of total abandonment, and in many cases archaeological sites are impossible to access because of thick vegetation. The morphological traits of ancient features and landmarks are often poorly defined due to the extension of the forest and the vegetation. Other alteration, even more serious, is the result of modern developments. In these cases the “American flight” is an essential element to record the surviving morphological elements of the ancient landscape and even to detect traces that have disappeared today. This potential is clearly exemplified by Figure 3 in which the transformation of the Roman mining exploitations of Os Medos (Lugo) and Puzo do Lago (Ourense) between the 1950s and the present is shown. Another example is the case of the study of the Via Nova (via XVIII of the Antonine Itinerary) in A Limia (Figure 4), only recognizable on the historical photographs due the significant changes in this region.

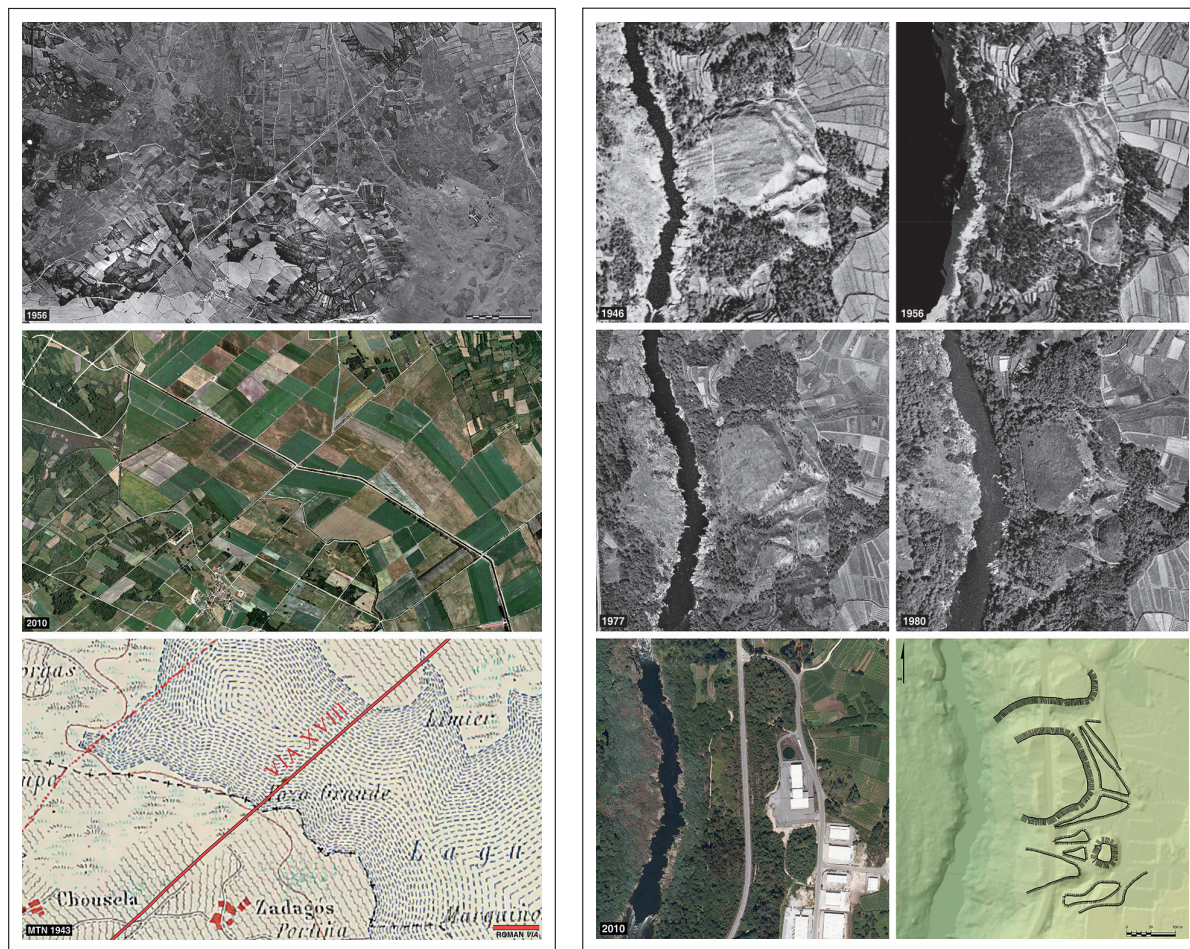


Figure 4. Photo-interpretation of the layout of the Via Nova or Via XVIII of the Antonine Itinerary on the 1943 National Topographic Map (1: 50.0000) (A Limia, Ourense). The important changes caused by the drying of the Lagoa (lagoon) of Antela and the subsequent restructuration of the agrarian plots can be observed. © Elaborated by EST-AP, CSIC from the USAF “American flight” (series B, 1956), the IGN PNOA flight (2010) and the National Topographic Map (1943).

Figure 5. The Roman mining hillfort of Os Castelos (Melgaço, Portugal). Morphological analysis, made from the combined use of historical aerial photographs, shows a settlement bounded by the mining works undertaken with hydraulic power. The sequence shows the impossibility of analysing the settlement in the IGN PNOA flight (2010) due to the recent destruction of the site. © Elaborated by EST-AP, CSIC from the USAF “American flight” (series A and B, 1945–1947 and 1956), the “inter-ministerial flight” (1977–1983) and the “national flight” (1980–1985).

Sequential analysis of multi-temporal imagery supports understanding of abandonment processes and their consequences for landscape features. Recent evolution of elements such as road networks or land divisions show how some processes are deeply changing the traditional rural landscape, so such sequential analyses are very significant. However, the destruction and alteration of the archaeological record is not only a product of recent processes related uniquely to the abandonment of traditional rural land-uses and the disappearance of a traditional peasant society. Rather, while this is a process which has undoubtedly accelerated since the 1960s and 1970s, it is also easy to identify in the 1950s when the traditional peasant society still maintained its elemental structure, before rural depopulation gathered place (Currás 2014, 31). In this context the “American flight” is extraordinarily valuable as it allows us to establish an assessment of conservation over a period of more than 50 years. It can be considered as a true historical document.

Formal analysis of ancient settlement and mining structures

One of the crucial aspects of our work is the formal analysis of ancient settlement. Different data are considered in the diverse study areas, depending on the historical questions and the aspects of interest for a quantitative study that will allow identification of historically significant patterns and locational strategies. For every historical analysis the main aims and specific methodology must be adapted to the specific spatial and temporal reality and, even more important, to the specific problems that the work aims to solve (Currás 2014, 39).

Complementary to the survey, the historical aerial photographs and the cartography (mainly at 1:25.000 scale) have been essential in the formal study of archaeological sites, the determination of their situation and the characterization of their location. Here again the “American flight” of the 1950s is a basic source. As stated above its main advantage is that it offers a vision of the landscape at a very particular moment before the urban developments of the 1960s, where the spatial extents of agriculture were at their greatest. Figure 5 illustrates how it is much easier to work on the characterization of sites (settlements) from the “American flight” rather than on later images; some of the archaeological structures no longer exist (as is the case here) or are covered by the forest or vegetation that has grown after the abandonment of agriculture activities. As Figure 5 shows, the combined analysis of different flights, along with current ortophotographs, allows us to perform sequential diachronic studies and evaluate the transformation experienced by particular sites.

Morphological analysis concerns settlements as well as other structures and factors related to the ancient exploitation of resources. In our work historical photographs have been a key document for the evaluation and global restitution of large exploitation systems. In fact our research focuses on the Roman mining structures with large hydraulic networks. Its morphological study requires suitable documents to this scale (Figure 6; see also Figure 2).

Historical aerial photographs have allowed us to detect and to study a series of mining structures that do not stand out either through size or productivity. The surface prospecting mining works of Rosinos de la Requejada, Zamora (Figure 7) are a very good example. The Roman works at Rosinos are an example of an extensive prospection over secondary deposits through the use of the aurum tallutium method (Currás et al. 2014; Plácido, Sánchez-Palencia 2014). When identified, several prospecting trenches were excavated with



Figure 6. Morphological analysis of the Roman gold mining exploitations of Cortes (Monção, Portugal). The combined analysis of aerial photographs of the “American flight” and the ALS-derived topography shows mining workings carried out by the so-called method of “series of convergent furrows”. © Elaborated by EST-AP, CSIC, from the USAF “American flight” (series B, 1956), the IGN PNOA flight (2010) and an ALS-derived terrain model (contour line interval = 0,5 m).

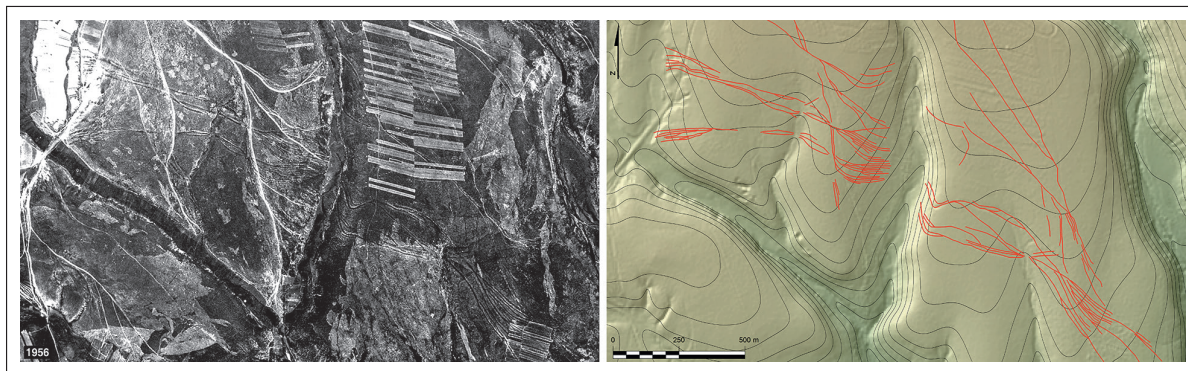


Figure 7. Photo-interpretation of the Roman surface prospecting mining works (Rosinos de la Requejada, Zamora). © Elaborated by EST-AP, CSIC, from the USAF “American flight” (series B, 1956) (contour line interval= 5 m).

the aim of evaluating the gold content of the area. These works (3 m wide, no more than 0,5 m deep, 900 m long) are almost imperceptible on the ground. Here, the aerial photo-interpretation on the 1950s images has been a key element for the identification, analysis and historical evaluation of the mining activity in the area.

Qualitative analysis

Historical aerial photographs also have a great analytical potential that goes beyond the formal understanding of the sites. The study of the relationships between resources and forms of land occupation is one essential aspect that allows us to interpret the locational logic of the settlement strategy. Many of the studies in the north-western Iberian Peninsula have analysed it from a descriptive point of view. Such work is often based on an overview of contemporary attributes of the region, the climate, the geological characteristics and land uses. The result is a picture which actually bears no relation to the nature of the ancient settlement.

In contrast, a number of authors have emphasized the relationship of each settlement to the potential resources of their environment. The Peña Redonda hillfort (Zamora) provides a good example of how aerial photographs can be very useful when analysing potential land uses (Figure 8). In this case the study combined several factors: pedological (soil depth, stoniness or rockiness), geomorphological (slopes), water (access to water resources) and historical (land use in the 1950s, from the “American flight”, which shows the period of wider agrarian exploitation in Spain, before the mechanization of the agriculture). From these factors four categories were established, based on the types marked on the maps of potential land uses from Galicia and north-western Portugal (MCPSG and CSATEDM) and the FAO project Agro-Ecological Zones: <http://webarchive.iiasa.ac.at/Research/LUC/GAEZ/index.htm>. A fourfold classification of potential land uses was obtained (irrigation/pastures, intensive, extensive, none/forestry) that applied to the catchment areas of each site and allowed the analysis of the exploitation model developed for every site. To this end, analyses of both physical factors (such as slope, calculated by GIS) and of historical land uses were combined as reference to evaluate the potential of the land. The advantage of using the “American flight” of the 1950s is that this is the period when rural areas of the Iberian Peninsula had almost all productive lands under intensive agricultural use. Also this period predates the mechanization of agriculture.

An integrated view

Often historical aerial photographs have been used in the analysis of single sites out of the context of their environment. The great potential of aerial photographs applied to the research of the past, from a landscape archaeology perspective, is precisely that it allows us transcend this type of restricted analysis of single sites and to achieve a comprehensive view of the territory, understood as an historical construct. In the different projects developed by our research team we have combined the formal study to a reduced scale of every site with a broader analysis of the forms of exploitation of the territory as whole. By incorporating different working scales, aerial photographs allow us to integrate the formal analysis of a settlement, the small agrarian structures such as terracing, the large mining infrastructures, and potential forms of land use.

A good example is the recent study of one of the routes of the Antonine Itinerary, the Via XVIII, where we have addressed the joint understanding of road structures with the system of settlement and gold mining resources. The holistic view that provides the combined use of different scales allows us to obtain a broad historical perspective of the landscape. At a first level, we can identify the layout of the road, very much altered today and often only recognizable on the historical photographs. In order to reconstruct the route of the road the first step was a broad reading of the record, including the location of milestones and the identification of surviving road elements, such as sections of road or bridges. “American flight” was used to integrate all these elements and to identify stretches of road now disappeared, and to obtain a complete picture of the layout.

On a smaller scale, the photo-interpretation shows the direct relationships between the Roman road and the settlement system. Through the “American flight” we identified and morphologically analyzed those settlements in the immediate vicinity of the road. We paid special attention to the mining exploitations, which were photo-interpreted individually. The results of the photo-interpretation of historical aerial photographs were combined with the analysis of ALS-derived topography, allowing us to obtain a more precise image of the formal elements of the settlements and mines. As a result, we obtained a map that reflects the landscape of the Via Nova (Figure 9).

This way of approaching the study of a Roman road, through the systematic use of aerial photographs, reveals that the Roman road is much more than one communication system, but a means of territorial articulation. The Roman road system played a key role in the *cursus publicus* and in the communication of the different provinces of the Empire. But, at the same time, the route also played a leading role in shaping the territory at a local scale.

FINAL CONSIDERATIONS

Historical aerial photographs have a long history of use as a powerful means of documentation and highly effective tool for Archaeology. And, contrary to some voices, despite the advent of new data sources, they are

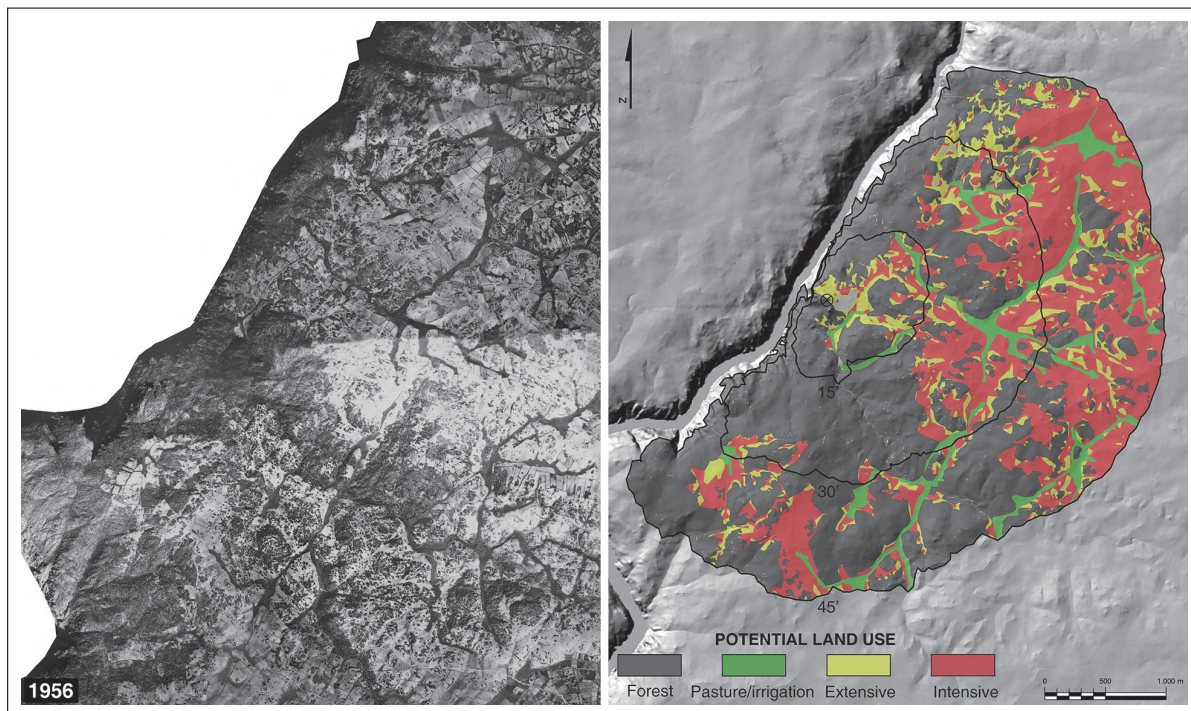


Figure 8. Clasificación de la potencial land use of the Peña Redonda hillfort (Villardiégua de la Ribera, Zamora) based on historical aerial photographs of the “American flight”. This is the period of maximum agrarian exploitation, before the mechanization of agriculture. The analysis is based on the combination of several parameters (pedological, geomorphological, hydrological and historical). © Elaborated by EST-AP, CSIC, from the USAF “American flight” (series B, 1956).

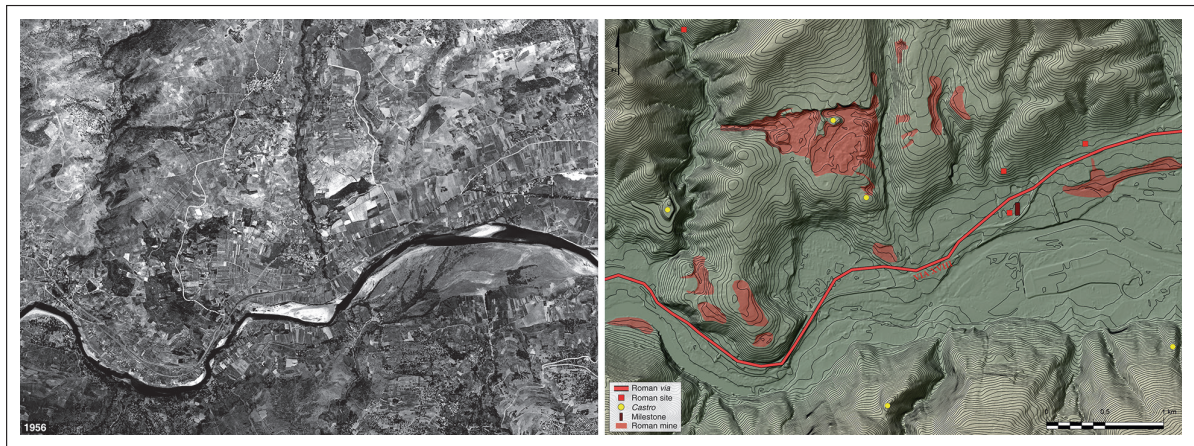


Figure 9. *Via XVIII of the Antonine Itinerary in Valdeorras (Ourense).*

The photo-interpretation has been elaborated by EST-AP, CSIC, from the USAF “American flight” (series B, 1956) and it allows detection of the gold mining exploitation, the hillforts and the layout of the Roman road.

The results are presented on an ALS-derived topographic model (contour line interval = 5 m). © EST-AP, CSIC.

not obsolete as they offer a large amount of data in a flexible (different film types, scales and formats) and accessible way (its acquisition is cheap). Historical aerial photographs are indispensable to interdisciplinary research, especially to the morphological study of landscape landmarks in which a large scale interpretation is necessary, such as opencast mining. Also, they are a fundamental basis for sequential multi-temporal study, important when a pre-industrial or a pre-mechanized situation is recorded in the photographs, and essential to the evaluation of the degree of landscape transformation and conservation.

Accumulating data adds nothing to an investigation, if these data do not support the analysis of hypotheses and if not organized in such a way that they can offer some analytical results in an integrated historical interpretation. Landscape is not a formal or monolithic reality that we can touch. Landscape is the relation between several aspects and thus analysis necessarily has a global character, which demands the articulation of several and distinct aspects and records (such as productive spaces, delimited spaces, and perceived spaces). These records form part of an epistemological strategy of research of the landscape as an object of historical investigation. They cannot be isolated. The research process needs an analytical approach, a dissection, but only the synthesis allows the study of the landscape. Historical aerial photographs, in conjunction with other geospatial methods, have the potential to support the comprehension of the significance of the different individual aspects that conform and structure the territory as a whole.

In the several regions investigated our work has come a long way: the analysis has been designed from the perspective of the historical questions and, at the same time, the analysis allows us to check these hypotheses. The incorporation of Geospatial digital technologies and GIS analysis to spatial studies raises the risk of driving us into a purely technical dimension of the landscape. In recent years the democratization of powerful spatial computing tools and papers addressing complex analyses in understanding ancient landscapes are becoming more frequent. This technological innovation, together with the advance of geo-archaeological and palaeo-environmental investigations, allows us to obtain a greater amount of information with increased accuracy, and these improve the study of the history of the landscape. However, at the same time, all this technological development does not lead us to hegemony of the techniques and methods of history, and we run the risk of the nonsense that the spatial analysis becomes an end in itself devoid of any historical significance. In this context, historical aerial photographs constitute a useful tool and, integrating them with the more technical components, to maintain a focus on what should be the goal of Archaeology: the posing and solving of a historical problem.

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