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Using GIS to Deconstruct Iberian Iron Age Landscapes: The Territory of Kelin Between 6th–5th Centuries BC (La Plana d'Utiel, València)

Abstract: The aim of this paper is to present a pilot study applying GIS to analyse regional processes among Iron Age societies in the Mediterranean *façade* of the Iberian Peninsula (Iberian Culture, 6th–1st century BC). This is the study of La Plana d'Utiel region (València, Spain), using GIS to analyse the emergence of the spatial and territorial complexity as reflection of the socio-cultural complexity of its inhabitants. GIS has provided us a powerful set of tools to study the landscape, the settlement pattern and the complex spatial relations among all our agents and objects. And most importantly, to analyse the complex process of a territory formation as the construction of places with functions and identities. This research underscores the necessity of developing a research that is holistic rather than atomistic, in order to integrate the many aspects of ancient Iberian society.

Introduction

The survey project "The territory of *Kelin* between the 6th and 1st century BC" and the excavations of 12 sites have provided for the last two decades a lot of information about settlements, local productions, exchanges, social and territorial hierarchy. Recently, we have decided to review part of our hypotheses and data using GIS and spatial technology. In this paper we advance the results on visibility and communication through the calculation of cumulative viewsheds, lines of sight, least-cost paths and cost-surface maps for the 6th and the 5th centuries BC. To accomplish this, we produced a digital geospatial and archaeological database, based on 30 m resolution Terra ASTER DEMs[2] of the study area and the neighbouring territories. Our interests are: the analysis of communication and trade, to define the territory's boundaries with accuracy, to avoid edge effects in our calculations and to compare and interpret our digital data with empirical information such as historical and archaeological features and sites. The preliminary results illustrate an early and new organization of the space in the 6th century BC, that involves an increment of the number of sites, the diversification of the types of settlements and specially the location of hill forts to control the natural corridors that

communicate this area with the nearby ones. This dynamic continues into the next century (5th century BC), expanding the spatial extent of this same pattern into the rural context, where we see an increase in the number and diversity of subordinated sites.

The Territorial Formation Process: Defining the Studied Area

The Iberian Culture begins in the Mediterranean *façade* of the Iberian Peninsula in the 6th century BC (Second Iron Age). Its name comes from the fact that ancient Greek and Latin writers named these people Iberians. The Iberian territories are characterized by a complex, hierarchical settlement pattern which includes *oppida* (high rank settlements), farmsteads and rural hamlets, hill forts, ritual places (caves, sanctuaries) and necropoles (Bonet 1995; Mata et al. 2001; Grau Mira 2002; Grau Mira 2004). Related to the area we study, just a brief introduction: *Kelin* (Caudete de las Fuentes, València) is a central Iberian place with a large territory (2500 km²) – today La Plana d'Utiel region – and a complex organization: hierarchical settlement pattern, mines, saltmines, metallurgy, kilns, wine and olive oil production, local productions and imports, etc. (Lorrio 2000;
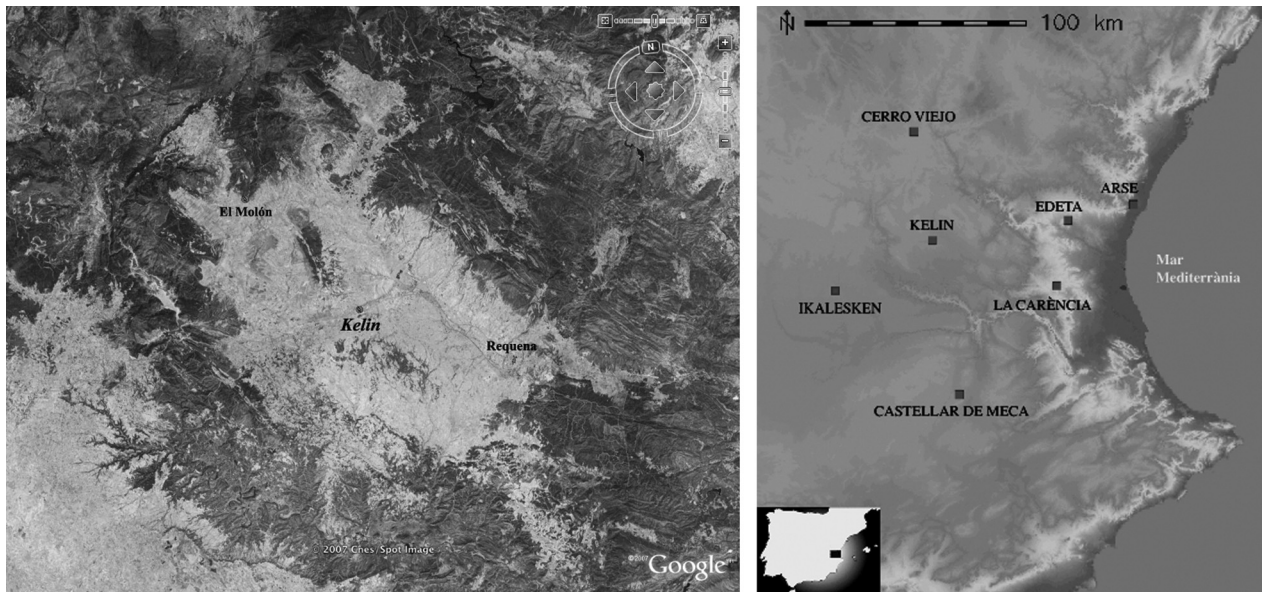
[2] http://edcdaac.usgs.gov/aster/ast14dem.asp.

Fig. 1. Study area: La Plana d'Utiel (source: Google Earth). *Kelin* and its Iberian neighbour territories.

Mata et al. 2001; Mata / Moreno / Ferrer in press)[3]. This area is located between two cultural and bio-geographical zones: the coast, occupied by Iberians and the inlands, the Meseta, by Celtiberians *(Fig. 1)*. This is an area of transition that is extremely interesting not only because of the contact between these different cultures. We have lots of archaeological evidence that allows us to approach the study of the social and territorial formation from a holistic and regional point of view. With this background, then, we decided to use GIS in order to analyse complex spatial relations among the different variables of study. Our aim is to interpret these two centuries as a crucial moment of the territory formation, the construction of the Iberian identity and the emergence of complexity.

Theoretical and Methodological Approach: Using GRASS-GIS

We are not going to explain what a GIS is (Bur-rough / McDonell 1998; Kvamme 1999; Conolly / Lake 2006) but how we use it. Our analyses were implemented with GRASS-GIS, in its version 6.2 for Macintosh (Neteler / Mitasova 2004)[4]. Land-scape Archaeology mainly provides the theoretical framework for our approach, and our methodology is based on traditional spatial archaeology sources and spatial technology. For us, GIS is a tool, which offers new digital information from empirical data we already had. So its results are not our goal but the interpretation of them. Then, Archaeology provides the theoretical framework and controls the GIS applications used, leading our interpretations. The algorithms used are r.cost and r.drain for cost maps and least-cost paths; and r.los for visibility analysis.

r.cost determines the cumulative cost of moving to each cell on a cost surface from specified cell(s) whose locations are specified by their geographic coordinate(s). Each cell in the original cost surface map will contain a category value which represents the cost of traversing that cell. r.cost will produce an output raster map in which each cell contains the lowest total cost of traversing the space between each cell and the user-specified points. The Knight's move option was used to improve the accuracy of the output[5].

r.drain traces a flow through a least-cost path in an elevation model. The input elevation surface might be a cumulative cost map generated by the r.cost.

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[3] www.uv.es/kelin.

[4] More information http://grass.itc.it/.

[5] Although we used r.cost, the new GRASS version 6.3. has a new r.walk program that outputs a raster map layer showing the anisotropic cumulative cost of moving between different geographic locations on an input elevation raster map layer combined with an isostropic friction input raster map layer.
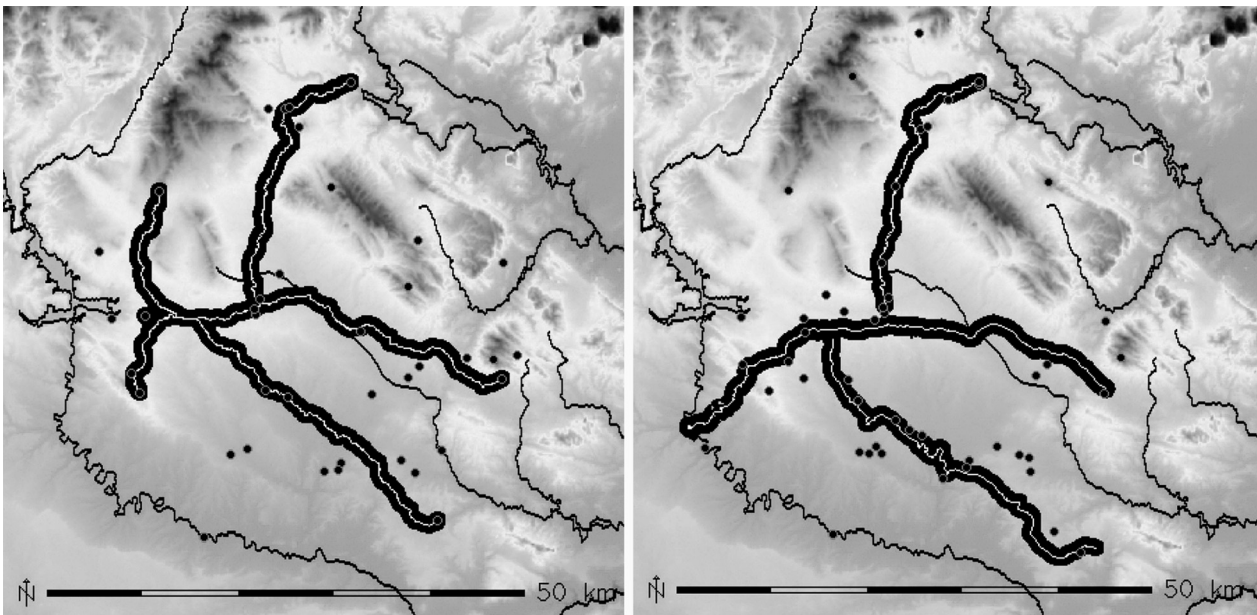
Fig. 2. Least-cost paths and their 1 km buffers during the 6th century BC (left) and the 5th century BC (right).

The output result will show one or more least-cost paths between the user-provided location(s) and the low spot (low category values) in the input map.

r.los generates a raster map output in which the cells that are visible from a user-specified observer location are marked with integer values that represent the vertical angle (in degrees) required to see those cells (viewshed).

Communication: Cost Maps (r.cost) and Least-Cost Paths (r.drain)

The study of paths and communications in Iberian Age suffers from the lack of written sources which describe the routes. Besides, this type of itineraries doesn't have explicit constructions or markers which can help us today to recognise them. On the other hand, protohistorical paths would follow natural ways and passes to construct, maybe unconsciously, long-distance communication nets. Communication and transports were mainly on foot, by horse or by cart. Obviously, each one has advantages and disadvantages depending on the goal of the displacement and the route to follow. When walking, the relief is usually less exigent than with a vehicle of animal traction. This is the reason why it is difficult to predict people's movement. Having in mind these limitations, we are going to offer an approximation to the optimal walking itineraries in the territory of *Kelin* through the analysis of topography, slopes, time and effort.

The study area is a wide plain surrounded by high mountains in the NE, N and NW. In the south and SW a not navigable river with a few fords, El Cabriel, marks another boundary *(Fig. 1)*. So, at first sight, communications are limited to natural corridors and mountain passes. For the 6th century, we have defined three main routes. N-S/ E-W/ NW-SE, in which the starting and endpoints are settlements located in the edges of the territory. The buffers show that there are some settlements located less than 1 km from these hypothetical paths. In fact, some of them are just in the way between two sites. In the 5th century, these routes are kept, though the presence of new sites and absence of others readjusts some itineraries *(Fig. 2)*.

The main hypotheses we have extracted are two:

1) Natural corridors, passes and preexistent paths are outstanding settlement pattern factors, but not determining ones.

2) We have differenciated two types of paths. On the one hand, there are natural corridors which construct long-distance communication routes and organize the territory. On the other hand, there are paths and routes which arrange the communication inside the territory, connecting inhabited sites and places. These last ones are difficult to reconstruct because they can be more dynamic and versatile. Therefore, the first ones seem to be more static diachronically, in fact, some of these paths follow traditional historical routes. Nevertheless, the premise that includes
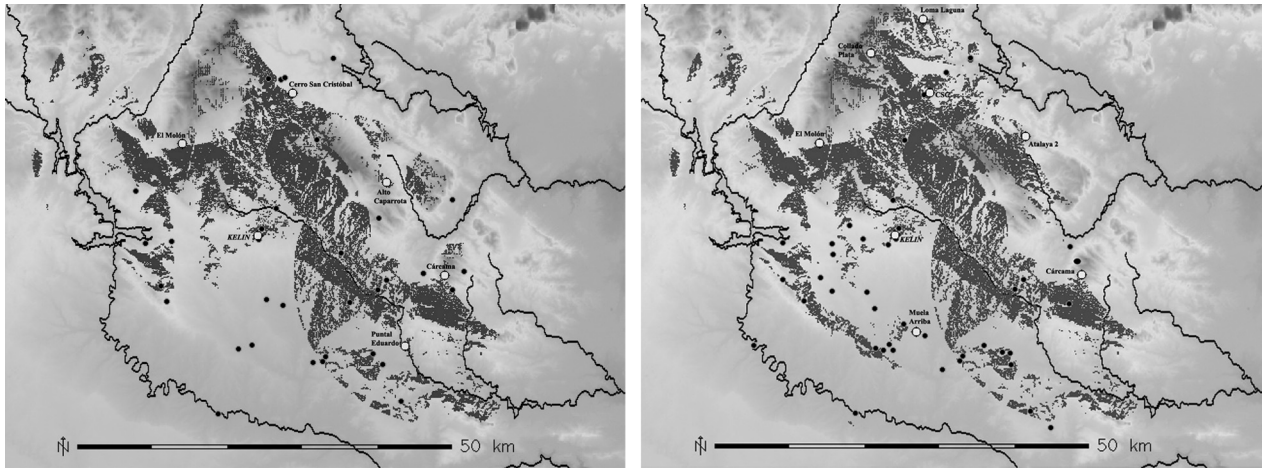
Fig. 3. Cumulative viewshed maps of the fortified sites (in white) in the 6th century BC (left) and the 5th century BC (right).

both types is their role in the spatial articulation because every territory with a hierarchical organization demands a successful communication strategy both on local and interregional scale. And this is the reason why we decided to analyse communication as a variable indicating a unique territorial strategy.

Visibility: Line of Sight (r.los), Cumulative Viewshed Analysis and Intervisibilities

Visibility is a difficult variable to measure. It is not time to approach the debate vision vs. perception, but it is necessary to keep it in mind (Van Leusen 1999, 219; Lock 2000, 1–27; Wheatley / Gillings 2002, 201–216; Llobera 2003). There are signifiers and meanings in the Iberian landscape that are invisible for us because we are not agents of the space we study. Nevertheless, our analysis, at least, sheds some light on the complexity and the construction of a cultural landscape, in other words, a territory. Our applications are addressed to understand the roles of visibility and visual dominance in the settlement pattern. The main aim is to extrapolate possible strategic and structured dynamics among the sites in the construction of their own place. The total visibility from all the sites shows how the area that we define as the territory of *Kelin* is viewed *(Fig. 4)*.

We interpret this premise as an intention of controlling the landscape and define occupied zones and their hinterlands. This area is already defined in the 6th century and corresponds, mainly, with

the corrected Thiessen Polygons[6]. The fortified sites (El Molón, Loma de la Laguna, Collado de la Plata, Cerro San Cristóbal, La Cárcama, Muela de Arriba), located in highlands and areas related to natural corridors or communication paths, are one of the main actors in the territorial structuring since the 6th century BC, as their viewshed maps corroborate *(Fig. 3)*.

As an interpretation we offer several hypotheses:

- In the case we have presented, we understand visibility as a cultural variable which includes more than an active military control on the areas and sites that are seen. Visibility marks the occupied area and defines the territory. There is no threat from outside in this regional and chronological context that justifies the origin of these fortifications. So we understand these constructions as elements of prestigy, passive coercion and social cohesion more than as military (offensive-defensive) sites.

- Fortified sites are landmarks with visual control of the natural corridors, their location reinforces the territorial unity. Although intervisibility aspects in site location are still incipient in the 6th and 5th century BC, they are an evidence of a structuring and organizing strategy. The 6th century shows an incipient intention of organizing the three natural areas that form the territory: north (highlands), central (fluvial plain), east-south-east (secondary valleys). In the 5th century, the net becomes a bit more complex, with the presence of closed circuits of intervisibilities in the three areas. Nevertheless, we must clarify that the main increase in intervisibility between the sites in this region takes place

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[6] The Thiessen polygons were adjusted taking into account geography, cost maps and archaeological data.
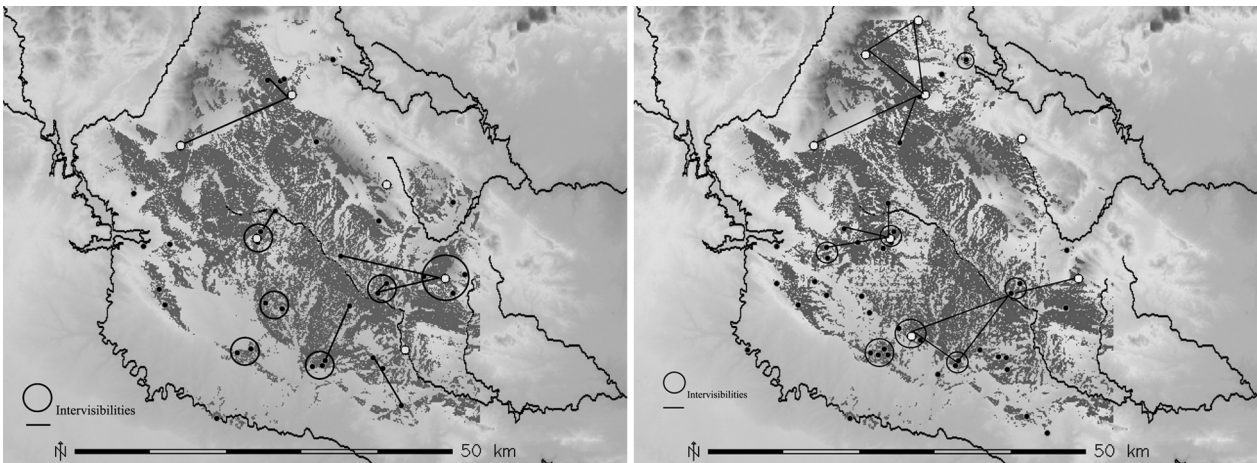
Fig. 4. Total cumulative viewshed and intervisibilities during the 6ᵗʰ century BC (left) and 5ᵗʰ century BC (right).

during the 4ᵗʰ–3ʳᵈ centuries BC. Then, we observe a similar trend in many aspects (settlement pattern, territorial organization, spatial and social hierarchy, etc.) that characterizes the Middle Iberian in the whole Valencian region (4ᵗʰ–3ʳᵈ centuries BC). This is the most splendid horizon, the zenith of the Iberian Culture, which can stand alongside other Mediterranean civilizations of these centuries.

Discussion

With this simple and modest example we have tried to show the dynamics of the *territorialization process*[7], as an example of the appropriation of the landscape and the construction of a cultural territory with boundaries and identity. It is important to point out that this Iberian strategy articulates the three natural areas that form the territory through visibility and communication. Communication is essential for the spatial organization of the settlements and becomes an outstanding factor for the development and the dynamic processes of interchange and economy, as well as it is a perfect marker of the *territorialization process*. The evolution of the settlement pattern shows that in fact during the 6ᵗʰ and the 5ᵗʰ centuries, despite some differences, the same trend is observed. The locations of sites are the same, mainly low and medium elevations (gently sloping hills, hill sides, plains). The settlement's categories

keep the same dynamic too, although during the 5ᵗʰ century BC the number of rural small sites (cat. 4a) increases considerably. Besides, a new category, 2b (big fortified sites; 2.5–9 ha) is developed in the north area, one of the main accesses *(Fig. 5)*.

When comparing the proportions of abandoned and newly created sites it is significant that there is a high percentage of new sites (45%) and 35% of abandonments. Only 23% of the sites are kept, but they are the most important ones: *Kelin*, El Molón, Requena, etc. This allows us to think that the 5ᵗʰ century is not a break but a continuation of the sociocultural process that begun in La Plana d'Utiel during the 6ᵗʰ, maybe a bit earlier. So the new rural settlements and the fortified sites reinforce the existing structure rather than to establish a new one *(Fig. 6)*. Finally, we would like to outline some of our hypotheses which offer a reinterpretation of the main topics in the Iberian Culture of this region: Traditionally, the Iberian sites have been described as fortified and inaccessible places. Nevertheless, these characteristics define a type of settlements, but not the majority. Besides, the rural habitat used to be characterized by concentrations of fortified farms. Recent discoveries show a high percentage of dispersed rural habitat formed by non-fortified small sites and rural establishments (BONET / MATA / MORENO in press; MATA et al. in press). Iberian territories were known as hierarchical political-defensive systems, and despite the fact that this might be their role in later

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[7] We know that this term does not exist in English, although we use it. It is a loan from the Spanish concept *"territorialización"* in reference to the diachronic, cumulative and complex process of formation of a territory as a conscious construction.
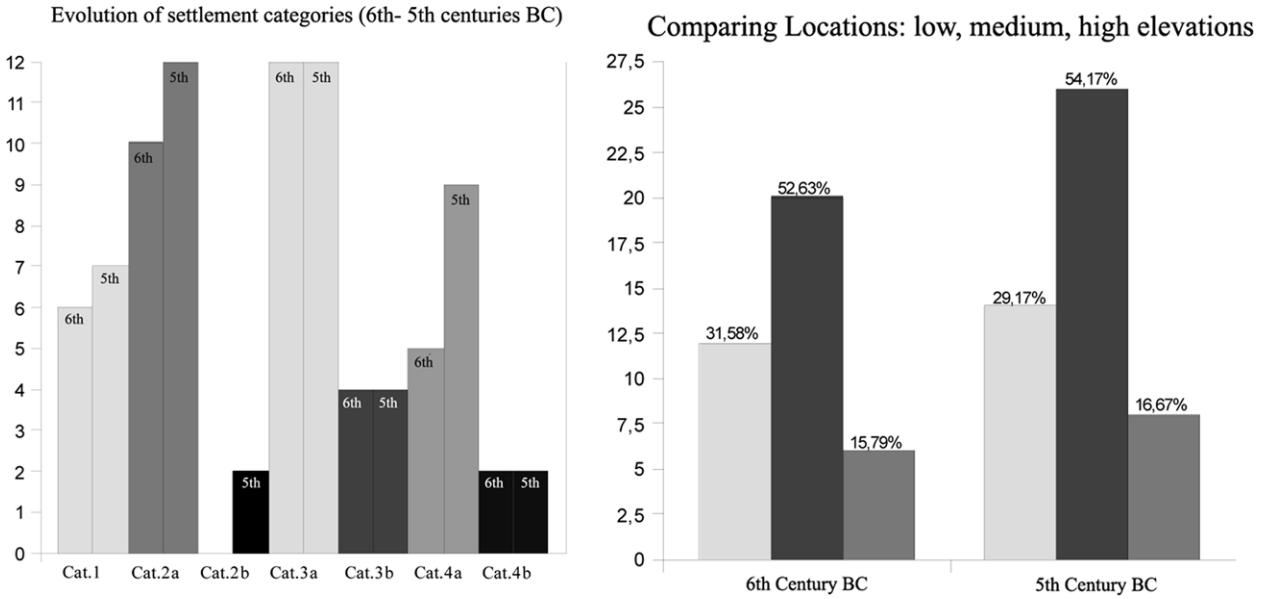
Fig. 5. Evolution of the settlement categories and the locations of the sites.

centuries there are no evidences of active military systems in the territory of *Kelin* for the centuries we are dealing with (6th and 5th centuries BC). We would like to underscore that in the case we have presented the strategic necessities are fulfilled: visual dominance of preferential zones of communication and exploitation, categorization of settlements as indicator of social and territorial hierarchy, di-

versified economic strategies, etc. We are conscious that our hypothesis and arguments go beyond the results presented in this article, but it is impossible to approach them due to the limitation of time and paper. Besides, this is a research still in progress so we will have to wait until more complete and generic conclusions about the whole subject can be offered.
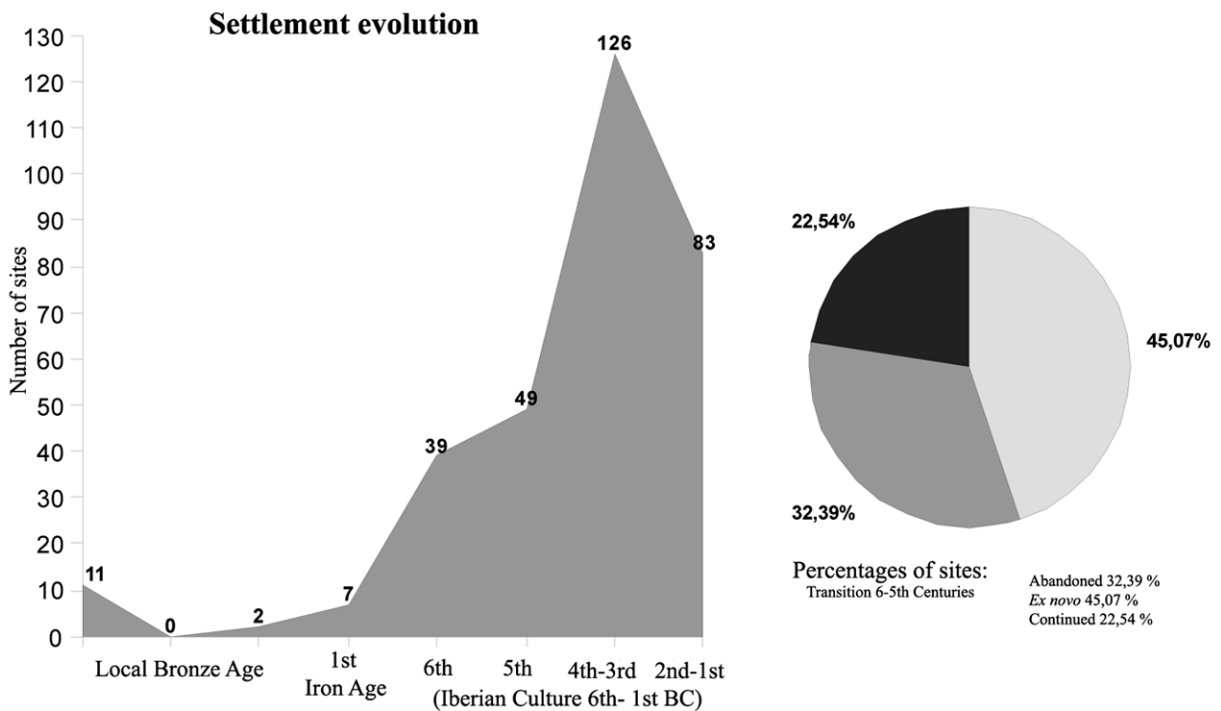

Fig. 6. Evolution of the settlement and percentages of abandonments, continued and new sites.

Our main interest is to analyse the Iberian society through the settlement pattern and the territory formation process in order to approach the study of the Iberians from different scales and perspectives. We have presented only some preliminary results, but we hope that at least they evidence the complexity of the territorial and social fabric of the Iberians.

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