Title: Mapping changes in late prehistoric landscapes: a case study in the Northeastern Iberian Peninsula

Author names and affiliations:

- Maria Yubero-Gómez□, mariayubero@ub.edu
- Xavier Rubio-Campillo□, xrubio@bsc.es
- Javier López-Cachero□, xavierlopez@ub.edu
- Xavier Esteve-Gràcia□ & □, xesteveg@gmail.com

1.-Seminari d'Estudis i Recerques Prehistòriques (SERP), Departament de P

rehistòria, Història Antiga i Arqueologia, Universitay of Barcelona. C/Montalegre 6/8 08001, Barcelona, Spain.

2.-Computer Applications in Science & Engineering (CASE), Barcelona Supercomputing Center. C/Gran Capità 2-4, Nexus I, despatx 105, Barcelona, Spain.

3.- Tríade Serveis Culturals

Corresponding author:

- Author: Maria Yubero-Gómez
- e-Mail address: mariayubero@ub.edu
- Postal address: Seminari d'Estudis i Recerques Prehistòriques (SERP), Departament de Prehistòria, Història Antiga i Arqueologia. University of Barcelona. C/Montalegre 6/8 08001, Barcelona (SPAIN)
- Telephone: (+34) 934 037 521

ABSTRACT

The temporal span of the Late Bronze Age and the Early Iron Age (1300-550) saw the emergence of intense interconnectivity in the Mediterranean sea. The development of colonial trade dramatically increased cultural exchange along its coasts as can be observed in archaeological evidence. These large scale processes had an impact at all scales and territories close to the main trade routes. However, the process was extremely diverse in its forms.

This work presents a case study focused on two adjacent areas in the coast of the NE Iberian Peninsula. Spatial analysis has been carried out to explore the trajectories of settlement location dynamics during the whole period. Basic geographic variables, mobility and distance to trade routes have been explored to identify key differences over periods and areas. Results indicate that the factors guiding settlements location varied between the two zones. Moreover, one of the areas was radically influenced by trade routes in the Early Iron Age while the other did not seem to be affected by this external factor. The interpretation of these analyses suggests that the rise in connectivity was not homogeneous over the Western Mediterranean, but in the regions where it took place this factor was decisive to explain their historical trajectories.

KEYWORDS

Northeastern Iberian Peninsula, Late Bronze Age, Early Iron Age, Geographic Information Systems (GIS), natural corridors, spatial analysis, statistical significance testing, settlement patterns, mobility models.

1 INTRODUCTION

From 1200 to 600 BC, the Mediterranean world saw a period of change, which resulted in the breakdown of Bronze Age civilizations, and the rise of Iron Age cultures in many locations. Despite the complexity of the process, the study of this crucial period covering the Late Bronze Age (LBA) and the Early Iron Age (EIA) has been traditionally focused on the Eastern Mediterranean and its grand civilizations.

The western zone did not see the emergence of cultures such as the Minoan and the Greco- Roman societies, which dominated the work of archaeologists for a long time due to its abundant material culture. However, fieldwork carried out in the last decades has extended our knowledge to include other islands and coastal areas of the Mediterranean Sea, thus balancing this view. The diversity of these studies has increased our knowledge of processes such as the ones that created the Maltese temples, *nuraghi*, *taulas* and *talayots* (Knapp & Blake 2005; Bevan, 2013; Berrocal *et alii*., 2013; Babbi et al., 2015).

This wider perspective on the LBA-EIA Mediterranean is dominated by the concepts of mobility and connectivity. These linked processes of change were promoted by the intensive cultural and commercial interaction rising between the peoples all over the Mediterranean, from the Levant in the East, to the North African and the Iberian coasts in the West (Babbi et alii, 2015: 6).

1.1 Late Bronze Age and Early Iron Age in the NE Iberian coast

This is the research context of the present work. The aim of this paper is to explore and compare under to what extent variables connected to mobility and connectivity influenced settlement locations over the period LBA-EIA. To explore this question we have chosen to focus at a local scale in the North-Eastern coast of the Iberian Peninsula. Our case study includes two neighbouring areas divided by a river (Llobregat): Vallès, located at left bank, and Penedès, located at the right bank (see **Figure 1**).

Figure 1. Current geographical map and features of the case study: the current Catalan coast.

The election of this area has been based on the continued and intense occupation of the territory that the archaeological evidence suggests. In addition, the archaeological record we are dealing with shows a great variety that allows us to link these settlements dynamics to the Mediterranean processes along this period.

During the Late Bronze Age (1300-750/700 BC), the material basis of these societies underwent a profound renewal. New metal typologies appeared during LBA showing an increase of interregional connectivity and trade products, as certain kind of metallic items or pottery decoration (López and Rovira 2012). The record also shows channeled pottery, which we find widely represented across the entire Northeastern Iberian Peninsula. Several new influences can be found on associated material culture, such as the first cremation necropolises by first millennium BC and the appearance of imported pottery in the Early Iron Age (750/700-550 BC). This pattern is strongly linked to the eruption of Phoenician trade near the Ebro River and the colony founded by the Phocaeans that would be known as *Emporion* (580 BC) (Aquilué *at alii* 2000; Santos 2003). These settlements are located south (Phoenicians) and north (Greeks) of the studied area (for a general overview see López Cachero 2007,2011; López Cachero and Pons 2007; Sanmartí 2009; Asensio 2005; García and Gracia 2011; Pons Brun 2014).

For a long period of time, the weight of historical and cultural tradition put the focus of debate on the arrival of new human groups traditionally known as Urnfields culture and on the colonial factor as the key agents behind the changes taking place. Today, however, these stances have become much more moderate. The accent is now on local dynamics and special regional features as the differentiating facts of the territory. Further theoretical insights connected to local scale societies and postcolonial archeologies have also been presented in recent works for this context (Garcia & Gracia 2011, López Cachero 2007 and Fatás et alii 2012*)*.

Previous works on the examined areas identified a general path of cultural continuity. This is particularly evident for the period between approximately 1800 BCE and the end of the LBA in the two largest excavated sites in these areas: Mas d'en Boixos located in the right bank and Can Roqueta located in the left bank (Bouso *et al.* 2004). The only exception is the Penedès (right bank area) precoastal lowlands, where there are only a few documented sites from the Late Bronze Age onwards. This scarcity has been analyzed before, and other authors have noted that it cannot be attributed to a lack of research in the area (Mestres 2008). The alternate hypothesis is that occupation of certain caves and the use of high-elevation pastures provided an alternative to the low-level agricultural exploitation of the most fertile plains which did not developed here except for some coastal regions. The EIA would present a shift between these subsistence strategies, as can be seen from the evidence of numerous storage pits documented from that time. Evidences suggest a complementary exploitation model that took extensive advantage of lands more favorable for agriculture, with the possible rapid planting of grapevines (López 2004). These activities would be complemented by herding, as shown by the appearance of walled enclosures (pens) at higher altitudes of the landscape such as Serra de la Font del Cuscó (Cebrià *et al.* 2003) or Sant Miquel d'Olèrdola (Mestres *et al*. 2009). Coincidentally some of these sites such as Turó Font de la Canya (Asensio *et alii 2005)*, Font del Cuscó (Cebrià *et al.* 2003) and Olèrdola (Mestres *et al*. 2009) among others, have yielded evidence for intensive trade in the form of Phoenician amphorae and other containers. "Phoenician" pottery imitations, metal items such as sympula and iron spits also link this shift to Mediterranean influences (Asensio *et alii 2005)*.

From the beginning of the sixth century BC evidence suggests a new major shift in the right bank area. We find the pens disappearing and new coastal enclaves being established, such as the citadel at Alorda Park. However, this transition to the Iberian world has not yet been fully and satisfactorily explained (Asensio *et al.* 2006).

The scenario described above contrasts with the dynamic described for the Vallès located in the left bank area. Thanks to data from sites such as Can Roqueta (Carlús *et al.* 2007), we know that LBA settlements were mainly located on the plain or on the rolling hills near the floodplains of the Besòs river. They followed a pattern of small semi-excavated farmhouses or huts built from wood and mud and scattered among the fields of crops. These farms were located very close to storage pits and at a certain distance from the cremation necropolises that functioned as the true centers around the landscape seems to have been organized (Carlús *et al.* 2007). The special features of this archaeological context, which is characterized by negative structures and often affected by strong erosive processes as a consequence of agricultural work over the centuries (Terrats Jiménez 2010: 141-155), make it very difficult to determine the existence of denser clusters of huts in the form of small villages. Regarding the EIA sites in the area, some Phoenician items such as amphorae, vessels and hand made pottery “imitating” Phoenician shapes and askos has been found in the necropolis as well as in some of the “houses” (Carlús *et al. 2007).* However, the number of sites with this type of materials is lower that in the Penedés region (Yubero-Gómez *et al.i* 2014).

This model remained constant in the left bank area until the end of the sixth century BC, when widespread settlements in elevation using stone appeared across the coastal and precoastal mountain ranges. At the same time, abandonment of cremation necropolises suggests a profound restructuring of settlement that should be linked to the formation of the Iberian world (López-Cachero and Rovira 2012).

1.2 Mesoscalar analysis of settlement location

It is clear that these dynamics conform a complex and heterogeneous situation with several research challenges. This work focuses on understanding change in settlement patterns during the transition from the LBA to the EIA based on two main questions:

1. **Do site location preferences depend on the chronology?** Our hypothesis is that the relevance of different geographical factors was not constant over time. If there were differences in the patterns of each period we should detect them by means of spatial analysis.
2. **Were communication networks affected by external influences?** The theoretical rise in exogenous contacts from the LBA to the EIA should be reflected in the site distribution over communication networks.

The area of study has been extensively excavated during the last quarter of the XXth century due to urban development (Petit, M. A., 1986; Bouso *et alii, 2004*; Carlús *et alii 2007;* Yubero-Gómez and Rubio Campillo, 2010; Yubero-Gómez *et al.,* 2014; Yubero-Gómez *et al.* 2015; Mestres and Esteve, in press). This situation has generated a large body of data which need to be integrated before any analysis can be undertaken. This is the reason why we have chosen a Geographic Information

System (GIS) as a working framework. In addition to showing geographical information, GIS is also a highly flexible tool for integrating data from different sources and in different formats. This greatly facilitates the task of comparing and analyzing heterogeneous data and extracting knowledge from them. In addition, GIS can be used for more than a descriptive definition of the case study.

This paper presents a mesoscalar study of the Catalan central coast to explore changes in settlement location patterns during the period LBA-EIA. Next section describes the data used to build a geographical model of the area. The third section defines the various methods of spatial and statistical analysis applied to the dataset. Next, we discuss results comparing the patterns generated by the LBA and the EIA communities and assessing the impact of Phoenician colonizing agents. We conclude discussing the implications of our results in the general context of this transition.

2 THE CASE STUDY

The dataset of the analysis has been created from two components: a) geographical features relevant to settlement dynamics and b) archaeological information.

First, the study area presents several biogeographical units with their own characteristics. From the coast inland, we find coastal plains (currently massively modified by substantial urban development), the coastal mountain range (parallel to the coast, highly compartmentalized by riversand a small number of peaks at 500-700 m.) the precoastal depression (a natural open route that runs approximately 200 km from northeast to southwest), and lastly, the precoastal mountain range (where the headwaters of the main rivers emerge from peaks exceeding 1700 metres above sea level).

We used a 15m. x 15m. Digital Elevation Model of the area where some features were corrected. In particular, the current coastline is significantly different from the one present during the chronologies under study. Broadly speaking, the coastal plain appears to have smaller than the present area, and it contained areas of marshland, particularly in the plains of the Llobregat river . Previous works in the Llobregat delta (Gámez, 2007) have been used to recreate the coastline.

Second, the archaeological interventions carried out in the past decades have been used to create a spatial database which can be seen in **Figure 2**.

Figure 2. Distribution of sites by period: a) LBA and a) EIA.

The dataset has one challenge that needs to be considered; the archaeological context documented is negative in the vast majority of cases. The lack of positive structures inhibits the formation of a stratigraphy that would certainly be helpful in capturing the dynamics of construction, use and abandonment of the documented structures, as well as their diachronic or synchronic interrelationship in the space. It is not possible to go beyond the establishment of approximate chronologies, as we are unable to determine whether all of the structures belonging to a period are the result of a narrow temporal span or, conversely, the result of continuous settlement of a single space over two, three, four or more centuries. As a consequence, we need to treat all the sites of one period as part of the same group, while keeping in mind this aggregation in the interpretation; it is not the same to consider 200 storage pits belonging to the same moment as 200 storage pits over the course of 300 years.

The created spatial database integrates information from the set of settlements, combining geographical features with additional data such as as chronologies, the typologies of structures and the current state of the site. As for the dataset studied, the working sample contains 87 sites for the LBA and 67 for the EIA. The sites include dwellings, storage structures, necropolises and occupied caves. From a spatial perspective, we have divided each chronology into two sub-datasets according to whether the sites are located on the right or left bank of the Llobregat (see **Figure 3**). Traditionally, this division has been used by most authors when dealing with the archaeological data (Esteve 2006; Asensio *et al.* 2006; López-Cachero 2007; 2012) because the archaeological record on both banks seem to show significant differences as we mentioned in section 1.

Figure 3 – The Besós river has been traditionally identified as a boundary between areas with different dynamics. We have chosen these areas (left and right bank) as our spatial units of analysis.

3 METHODOLOGY

We have designed a set of spatial analyses to answer our two research questions with this dataset, including a) basic spatial variables (height, slope and aspect), b) visibility and accessibility and c) distance to natural corridors. Exploratory Data Analysis has been performed for each of the six variables in the form of empirical density estimates for the two periods (the LBA and the EIA) and both areas (left and right bank). These density functions measure the probability of finding a site for a given value of the analyzed parameter. This approach is useful to perform cross-comparison analysis of different datasets. To achieve this second step, we have performed Kolmogorov-Smirnov tests (KS tests) between the four datasets (the LBA left bank, the LBA right bank, the EIA left bank and the EIA right bank). This non-parametric test evaluates the probability that two given empirical distributions were generated by the same process. If the computed p-value is smaller than a threshold level (in our case $p<0.05$) the samples were generated from different distributions, thus identifying significant differences between the compared datasets with a confidence interval of 95%.

First, we characterized the first-order spatial variation to identify diachronic and synchronic changes over the two periods. We studied the location of the sites within their surroundings, while calculating their geographical attributes, taking account of their altitude (in metres) and their aspect and slope (both in degrees).

Second, visibility (Llobera et al., 2011; Gillings and Wheatley, 2001; Lake and Ortega, 2013; Eve and Crema, 2014) and accessibility (Llobera et al., 2011; Llobera, 2001, 2000; De Reu et al., 2011) provided new information on the changes in settlement patterns and their relationships (corresponding to second-order spatial variations). For each site, the observed area has been calculated within a radius of 10 kilometres (see **Figure 4a**).

Third, accessibility enables us to quantify the favourable potential of a specific point in relation to the surrounding landscape. This concept can be modelled in several ways, with accessibility analysed as a function of distance, territorial compactness, energy consumption or time (Conolly and Lake, 2006: 243; Llobera et al., 2011). We have used the method applied in archaeology by Marcos Llobera (2000; 2011), see **Figure 4b**. The accessibility value for the sites has been calculated based on the topographical cost of gaining access to each site from its surrounding area. The procedure involved the generation of a regular 25-point grid to cover the area surrounding each site to a radius of 1000 metres. After this operation, the least-cost path was traced from each point of the grid to each of the sites. Then, we calculated the average accumulated cost of all the paths to each site, finally inverting the value to have large values for high accessibility.

To identify natural corridors related to human mobilitty and trade rutes (Bevan and Wilson, 2013; Murrieta-Flores, 2012) we defined a perimeter of points distributed every 10 kilometres. They were located at 25 kilometres from the study area to avoid any border effect. Then, we calculated the least-cost paths from each point on the perimeter to all the other points while quantifying how many of the routes passed through each cell of the original raster map. The most dense areas (i.e. first quantile) define the natural corridors, according to the geography of the area. By computing the distance from each site to these natural corridors we can get a summary statistic of the relevance of strategic route networks as a factor to explain site location (see an example of this analysis in **Figure 4c**).

A follow-up question to the results is to examine what properties differentiate the sites of both banks for a given period. Understanding these differences would allow us to better identify what type of settlement properties characterize each area under study. This final topic was examined with a multivariate analysis of the factors defining the sites of each temporal span. It was independently applied to the sites of the LBA and the EIA. For each period we performed an analysis of variance tst (ANOVA) using a logistic multivariate regression model. The dependent variable was defined as the bank of the river (right or bank), while the independent variables were the 6 factors collected for each site (height, slope, aspect, visibility, accessibility and distance to natural routes) .

Figure 4a – Example of the visibility algorithm. For each site the total amount of visible area (green color-coded) up to 10 km. is quantified.

Figure 4b – Example of the accessibility analysis. The least-cost path of each cell within a 1km radius to the site is computed. It is based on the slope cost of the cells (red to green gradient). A final value for site is quantified averaging the cost in accumulated degrees of slope.

Figure 4c - Definition of natural corridors. A perimeter of points is defined outside our studied region at regular intervals. The least cost path is calculated between each pair of points, and the number of paths passing through each cell is computed. In this example the paths for 3 points (A, B and C) is shown.

4 RESULTS

4.1 Geographical variables

First, our study of the basic geographical variables (altitude, aspect and slope) clearly indicate differentiated settlement dynamics within LBA. In this respect, **Figure 5** shows the density estimates of altitude based on the settlements of the different periods and territories.

Figure 5: Density estimates of settlement altitude for the various combinations of areas and chronologies.

At first glance, we can see how the distribution on the left bank of the Llobregat is quite continuous except for the creation of some highly elevated sites during the EIA. By contrast, the typology of settlements on the right bank changes radically, shifting from elevated settlements to a distribution that is similar to the distribution observed on the left bank in the EIA.

This tendency is confirmed if we examine the slope values (see **Figure 6**), because the probability of finding sites in low-slope areas on the right bank of the Llobregat in the LBA is quite low. In any event, it suggests a tendency similar to the evaluation of altitudes: while the LBA sees very high values (related to the situation of the caves), in the EIA the values level out because of the creation of settlements in low-lying areas. On the left bank, by contrast, the distribution of probabilities is quite homogeneous in both periods even if the presence of sites in low slope slightly increases over time.

Figure 6: Density estimates of settlement slope (measured in degrees).

Tables 1 and 2 shows the significance levels of the pairwise KS tests. They confirm the previous results, as in both factors the right bank sees a higher level of change while the EIA periods are more homogeneous than the LBA.

Table 1: Pairwise KS tests for height. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

Table 2: Pairwise KS tests for slope. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

Our examination of aspect (**Figure 7**) provides no additional information as the distribution is almost homogeneous over the 4 datasets. The only relevant pattern is the situation of the settlements on the left bank toward the south-southwest (200-270 degrees). This tendency is intriguing, as it may be related to solar exposure (Lapen and Martz 1993; Church *et al.* 2000: 153; Esteve 2004: 10) or the direction of river courses. However, **Table 3** shows that the difference is not significant.

Figure 7: Density estimates of settlement aspect (measured in degrees).

Table 3: Pairwise KS tests for aspect. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

4.2 Visibility analysis and accessibility

Accessibility and visibility indices helps us to assess other differences among the studied territories. First, visibility does not seem specially relevant for the LBA sites (see **Figure 8**) while it gains importance in the EIA. There are some exceptions, notably Olèrdola, a site located in a strategic enclave with visual control over the surrounding territory. The patterns is quite similar across both banks, with an increase in visibility from the LBA to the EIA. **Table 4** confirms that there is a major shift ni the relevance of visibility for site location during the change from the LBA to the EIA.

Second, it can be observed that accessibility is similarly shaped for the four datasets, even if the right bank sees a higher peak around the value of 170 (see **Figure 9**). However, the KS tests (see **Table 5**) suggest that the distributions are almost identical for each bank over the two periods, thus portraying non significant changes from the LBA to the EIA.

Figure 8: Density estimates of settlement visibility.

Figure 9: Density estimates of settlement accessibility.

Table 4: Pairwise KS tests for visibility. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

Table 5: Pairwise KS tests for accessibility. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

4.3 Natural corridors

Figure 10 portrays the computed network of natural corridors. The density estimates (**Figure 11**) suggest that a close distance to these strategic routes was not a significant factor in settlement dynamics in the Llobregat left bank for both chronologies. This is an interesting result, specially compared to the basic geographic factors (i.e. altitude and slope). As a consequence, local features seem much more important than geographically broader contexts. In fact, the supposedly relevant impact of the Phoenician arrival during the EIA is not confirmed by these results. Otherwise, we would see a rise in the number of settlements located on the natural corridors over which trade unfolded.

Figure 10. Natural corridors in relation to the sites for a) the LBA and b) the EIA. The analysis makes use of all least-cost routes from each point on the perimeter to all other points, with the colour of each segment of the network identifying the number of routes that pass through it.

Figure 11: Density estimates of settlement distance to natural corridors

Studying this relationship by chronology and area enables us to see the extent to which this variable is similar for the archaeological contexts of the LBA and the EIA (see **Table 6**).

Table 6: Pairwise KS tests for distance to natural corridors. Blue values are significant with p-value<0.05 implying that the compared distributions were not generated by the same process.

The KS test shows how the left bank of the Llobregat did not see a clear pattern of change. The only exception is a number of sites at very large distances during the LBA, which stems from the limited percentage of land with these characteristics. In the right sector, by contrast, a substantial change can be perceived between the two chronological periods, with the largest probability of finding a site at 7,000-8,000 metres of a corridor diminishing to 1,000-2,000 metres during the EIA. Therefore, we can say that the distance from a natural corridor is highly important in the right sector of the Llobregat, but that it is not an essential factor in the left sector. In the latter case, the occupations continuing from the LBA to the EIA that are documented in quite a few of the sites may have had a decisive impact on this factor.

4.4 Multivariate analysis

Results of the ANOVA analysis show that accessibility and height are the most important parameters that distinguish the properties of sites on the right and left bank during the LBA (c.f. **Table 7**).

Table 7: ANOVA test for a logistic multivariate regression model for bank location of the LBA sites. Height and accessibility are the most important factors to explain the differences between the river bank where sites are located.

These results suggest that settlements at the right bank of the river were preoccupied by the defensive value of the region where they were located. This would explain why elevated, difficult to reach zones were predominant here in contrast with the left bank. The same method was applied to the EIA sites, with significant different results (see **Table 8**).

Table 8: ANOVA test for a logistic multivariate regression model for bank location of the EIA sites. Distance, accessibility and height are the significant variables that explain the differences between the river bank where sites are located.

Distance to natural routes is by far the most important factor that difference both banks, followed by slope and accessibility. This result confirms the trend that was already seen in previous figures, as the relevance of natural corridors is much more relevant in the right than in the left bank.

5 DISCUSSION

The aggregation of these results depicts a radical shift of dynamics over the LBA to the EIA in the right bank, while the left bank portrays less evidence of change. Distance to natural corridors is the determinant factor to explain these dynamics: during the LBA the sites were located at large distances from travel routes. The situation changed in the EIA: a majority of settlements were located on a natural corridor in the right back area. This enables us to confirm the shift in the tendency that occurred in this territory and may indicate a settlement model closely bound up with commercial exchanges during the EIA. However, we continue to find a portion of the population that appears to have avoided these routes, remaining instead in easily defensible, but isolated locations.

Other authors have also have documented a search for soil with greater agricultural potential during the EIA (Asensio *et al.* 2005) in the right bank area. This tendency is confirmed by the appearance of arrays of storage pits with occasional associated huts (e.g., Mas d'en Boixos (Bouso *et alii*, L'Hort d'en Grimau (Esteve 2004) and el Turó de la Font de la Canya (López 2004)). These sites have been interpreted as surplus accumulation centers (Asensio *et al.* 2005) which would present a new scenario of genuine agricultural colonization. The number of storage pits and their enormous capacities suggest a significant change in the economic dynamics of resource exploitation in the area, which would from this point onward promote surplus grain production intended for trade.

This change, however, did not involve the abandonment of the higher-elevation, high-slope settlements. In this respect, what is detected is the occupation of various strategic points in the landscape, which have a high degree of visibility in relation to the surrounding landscape. Good examples are provided by the sites of Olèrdola and la Font del Cuscó, which feature the main element of a pen or wall built of stone enclosing a sizable area (Cebrià *et al.* 2003; Mestres *et al*. 2009). Few dwellings associated with these pens have been discovered, but everything seems to indicate that there were no more than a few slightly built huts, a fact that stands in stark contrast to the significant size of the occupied areas and the magnitude of the encircling walls. This has led some authors (Cebrià *et al*. 2003; Asensio *et al.* 2006) to maintain that the final function of these settlements may have been linked to a communal use of the space, more specifically to the amassing and management of livestock, and to signal wealth. Paradoxically, the occupation of caves, which was so common in the prior period, now ceases to be important after this shift . This site specialization is also confirmed by the diversity of visibility indices during the EIA.

On the left bank of the Llobregat we do not observe this shift. Particularly interesting is the lack of relevance of the distance to natural corridors, considering the presence of Phoenician materials and metallic objects. Despite this moderate evidence, objects are similar to materials found in close zones where trade was much more intense (e.g. the Empordà and southeastern France, López-Cachero and Rovira 2012). Nonetheless, the situation is not static as there are some changes in the settlement location dynamics. There seems to be a higher interest on plains which could be related to more intensive agricultural practices (confirmed by a greater number of excavated storage pits).

The aggregation of these results suggest that there were relevant differences between the studied areas and periods. Of particular interest is the sharp distinction between the territories regarding the LBA, which we have been able to interpret correctly in relation to the materials and types of structures documented in the excavations.

To conclude, the interpretation of these results suggest that natural corridors play a key role to better understand settlement dynamics during the LBA and the EIA. However, both areas present a different evolution. While left bank sites seem to follow a similar dynamic during the LBA and the EIA, dynamics in the opposite bank present a very different panorama. The right bank of the river saw during the EIA a transformation of the landscape that could be related to a more strategic view of the territory. The shift that we can observe in the location of sites during the EIA was intended to establish the sites close to natural travel routes and to achieve better control over the territory. This changed coincided with an increase in commercial activity as a result of the integration of the Northeastern Iberian Peninsula in Mediterranean-wide trading networks.

Even at this local scale spatial analysis was able to identify sensible differences between neighboring territories. This diversity of dynamics perfectly illustrates the complexity of processes that affected the Mediterranean Sea over these two periods.

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Table 1

Table 1 – K-S height				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	**<0.001**	1.000		
EIA – left	0.457	**<0.001**	1.000	
EIA – right	0.163	**<0.001**	**0.024**	1.000

Table 2

Table 2 – K-S slope				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	**0.026**	1.000		
EIA – left	0.231	**0.003**	1.000	
EIA – right	0.089	**<0.001**	0.703	1.000

Table 3

Table 3 – K-S aspect				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	0.079	1.000		
EIA – left	0.331	**0.009**	1.000	
EIA – right	0.497	0.105	0.621	1.000

Table 4

Table 4 – K-S visibility				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	0.232	1.000		
EIA – left	**0.026**	**0.023**	1.000	
EIA – right	0.071	**0.024**	0.930	1.000

Table 5

Table 5 – K-S accessibility				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	**<0.001**	1.000		
EIA – left	0.321	**<0.001**	1.000	
EIA – right	**<0.001**	0.483	**<0.001**	1.000

Table 6

Table 6 – K-S dist. Natural routes				
	LBA – left	LBA – right	EIA – left	EIA – right
LBA – left	1.000			
LBA – right	0.486	1.000		
EIA – left	0.119	0.869	1.000	
EIA – right	**0.008**	**0.004**	**<0.001**	1.000

Table 7 – ANOVA LBA	
Variable	**Pr**
height	**0.011**
slope	0.084
aspect	0.998
visibility	0.401
accessibility	**0.013**
distance	0.751

Table 8

Table 8 – ANOVA EIA	
Variable	**Pr**
height	**0.008**
slope	0.183
aspect	0.973
visibility	0.834
accessibility	**0.006**
distance	**<0.001**

Figure
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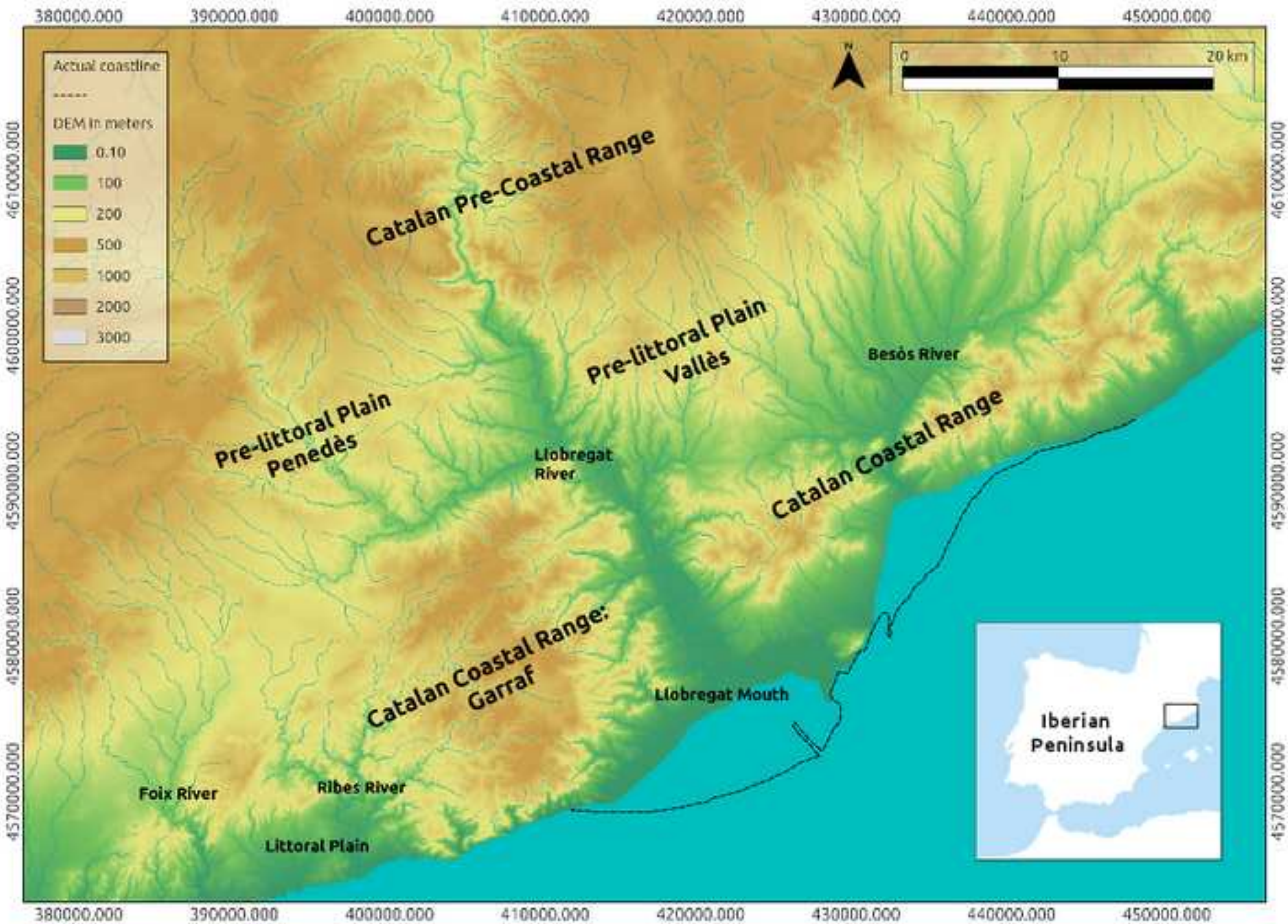

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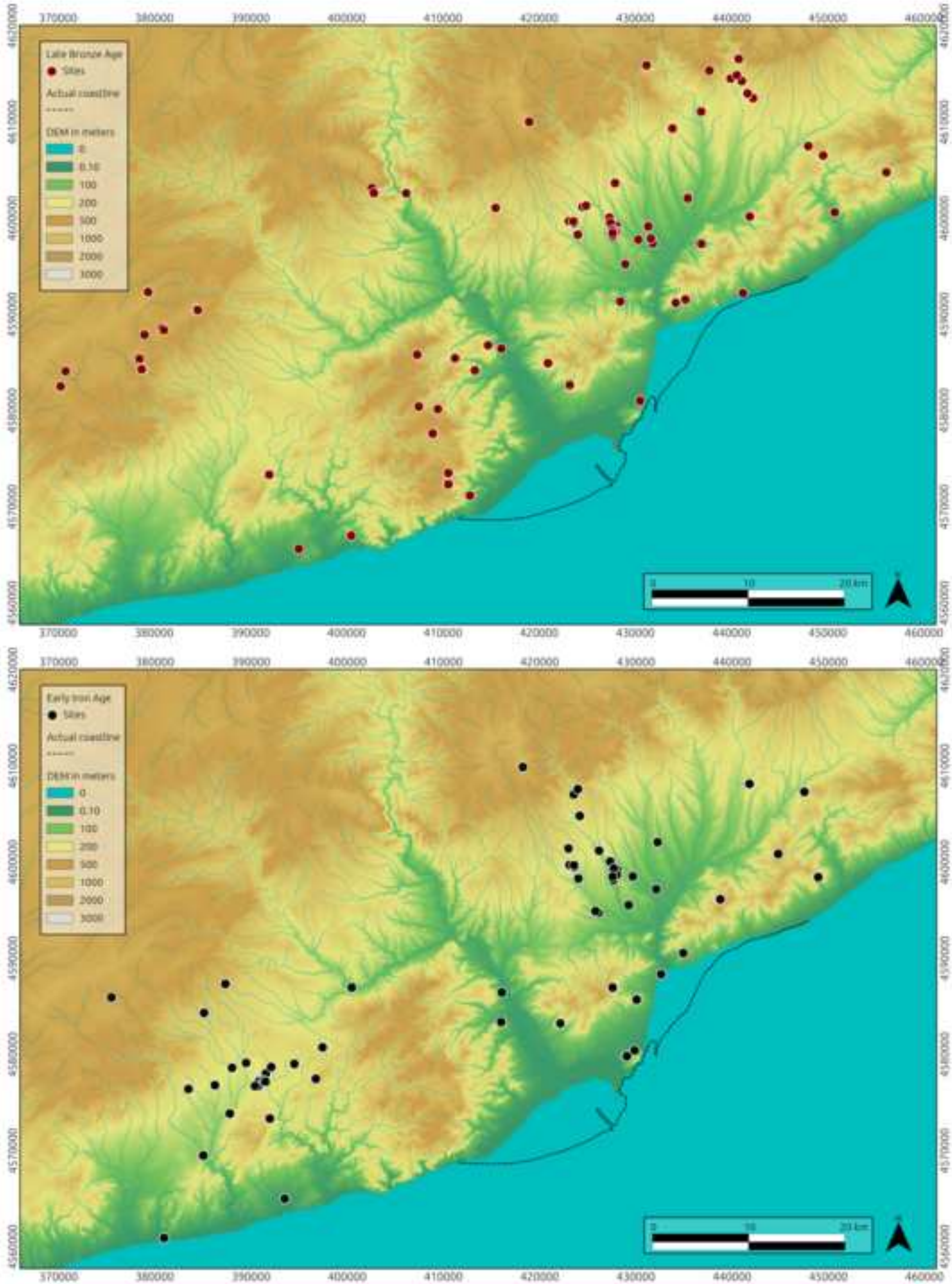

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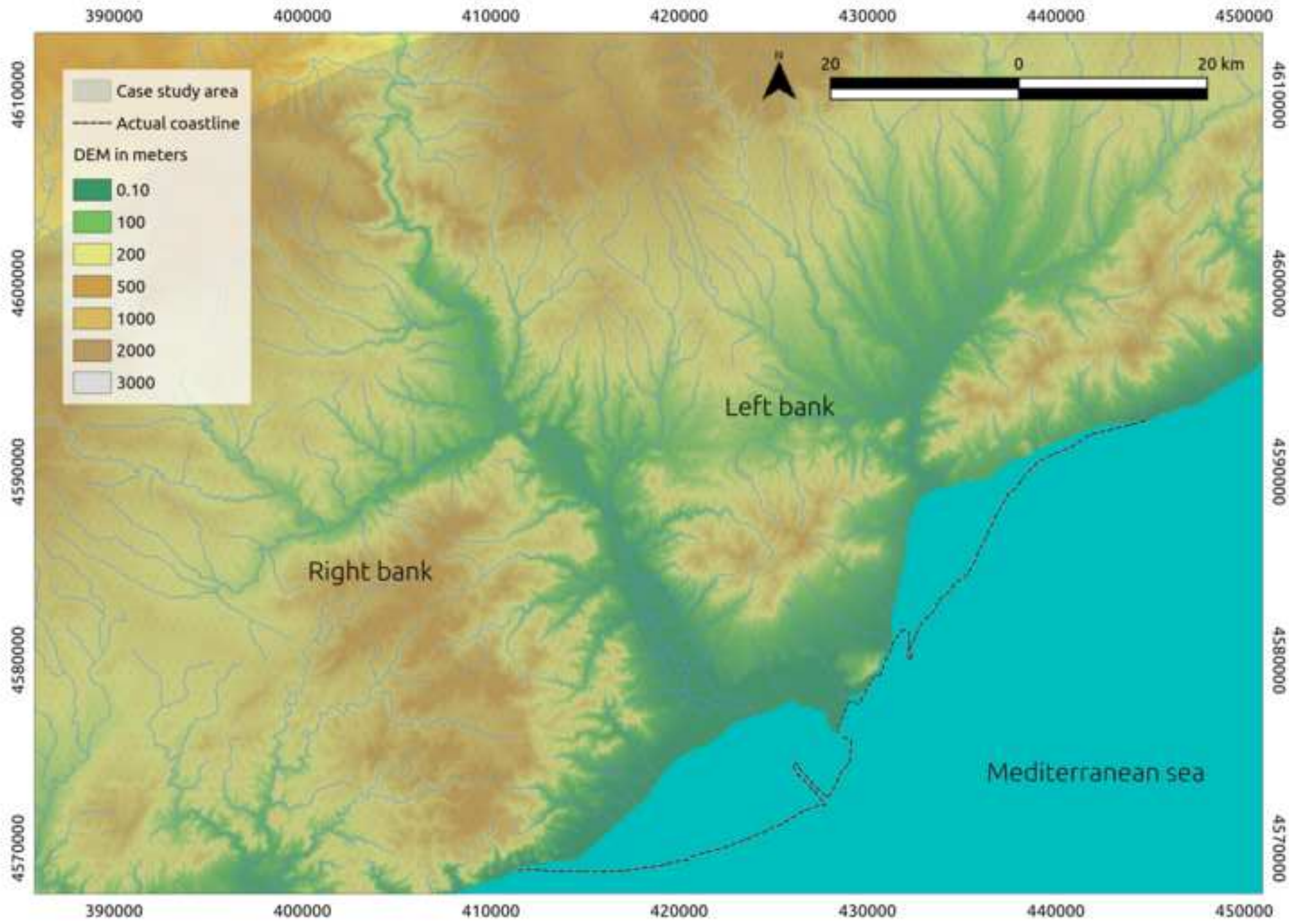

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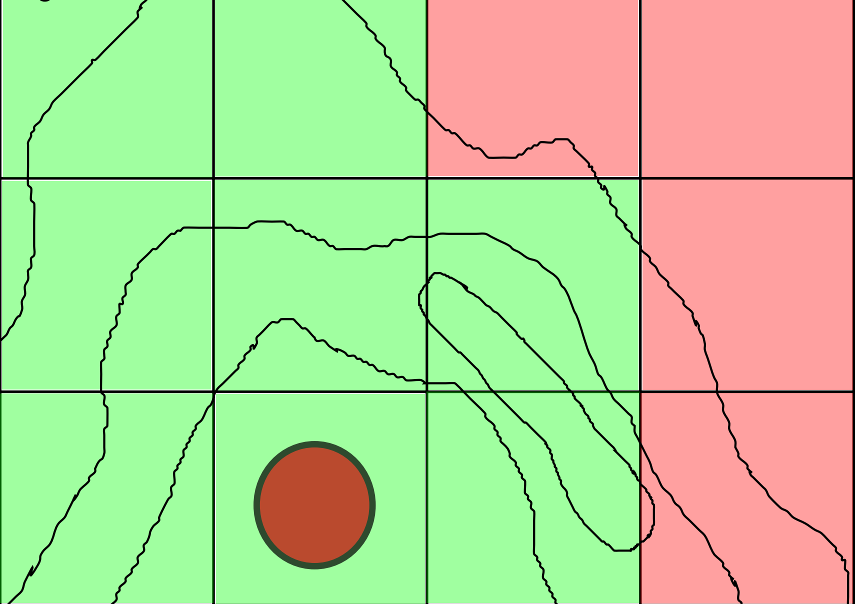

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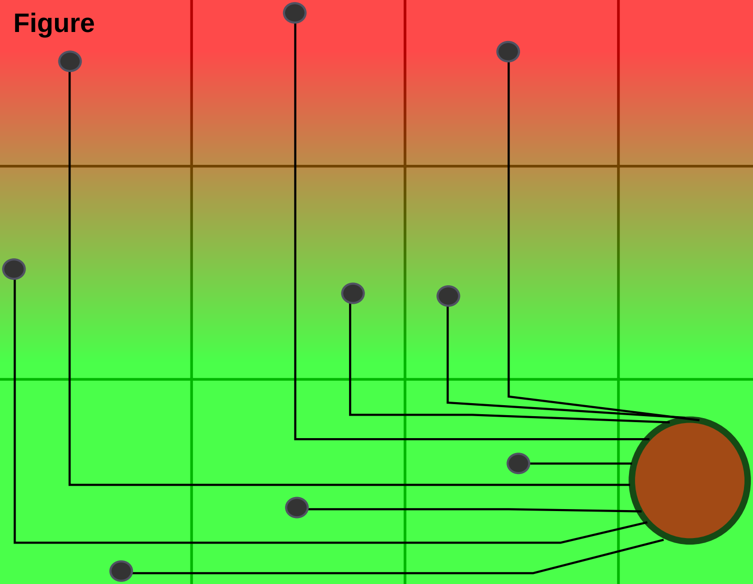

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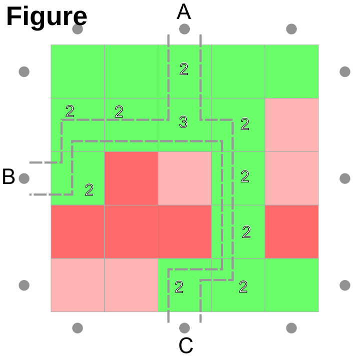

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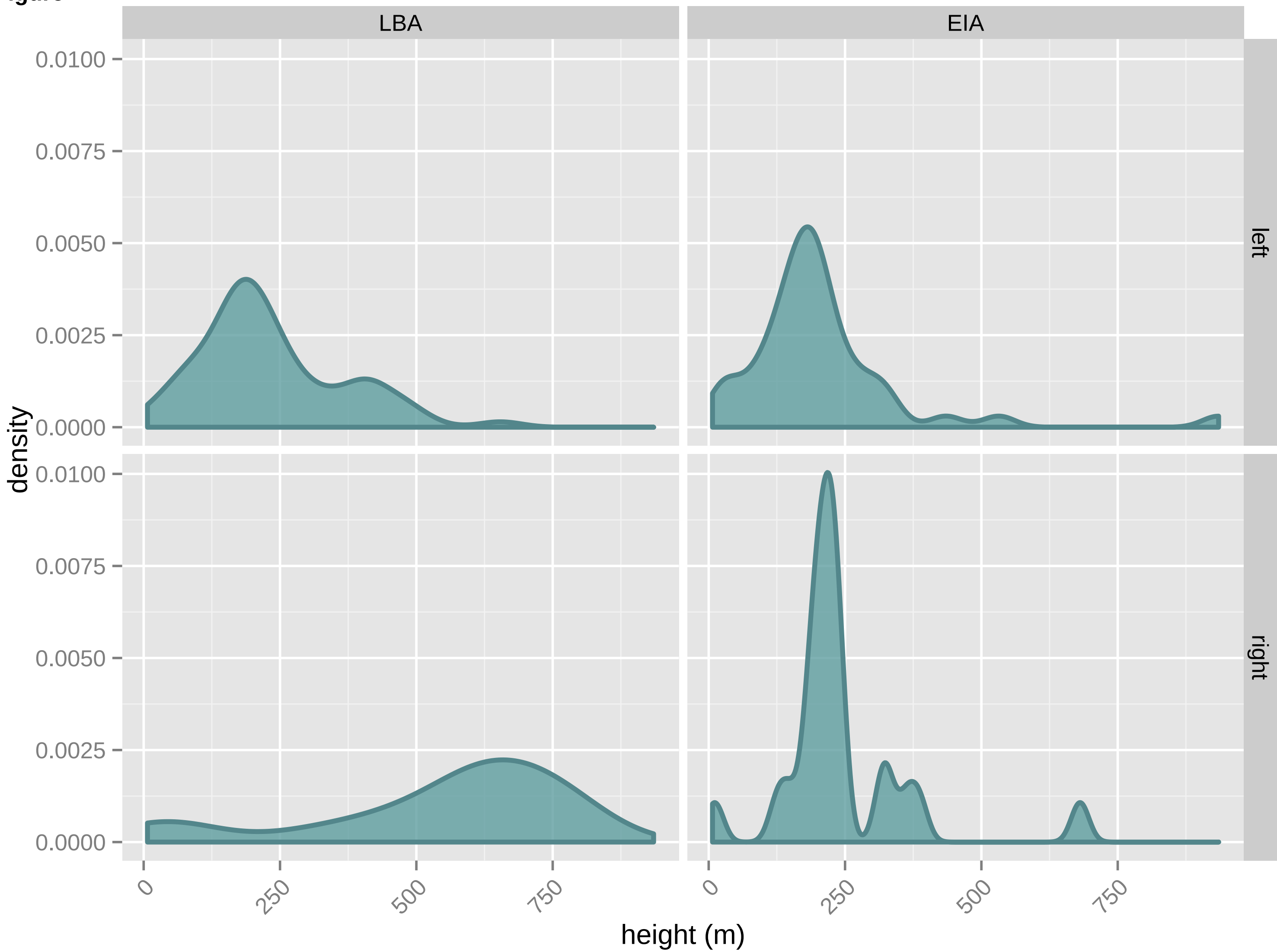
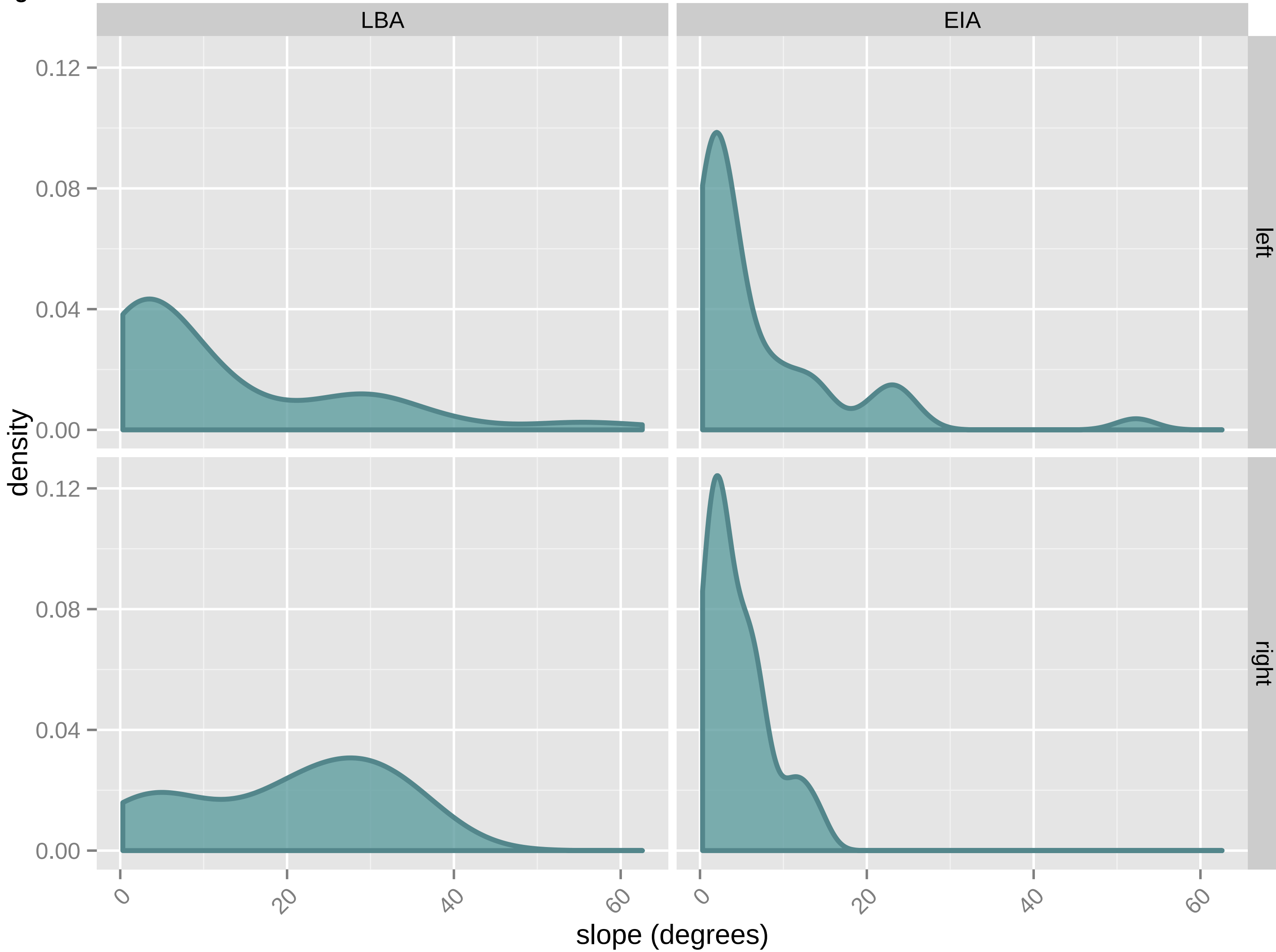


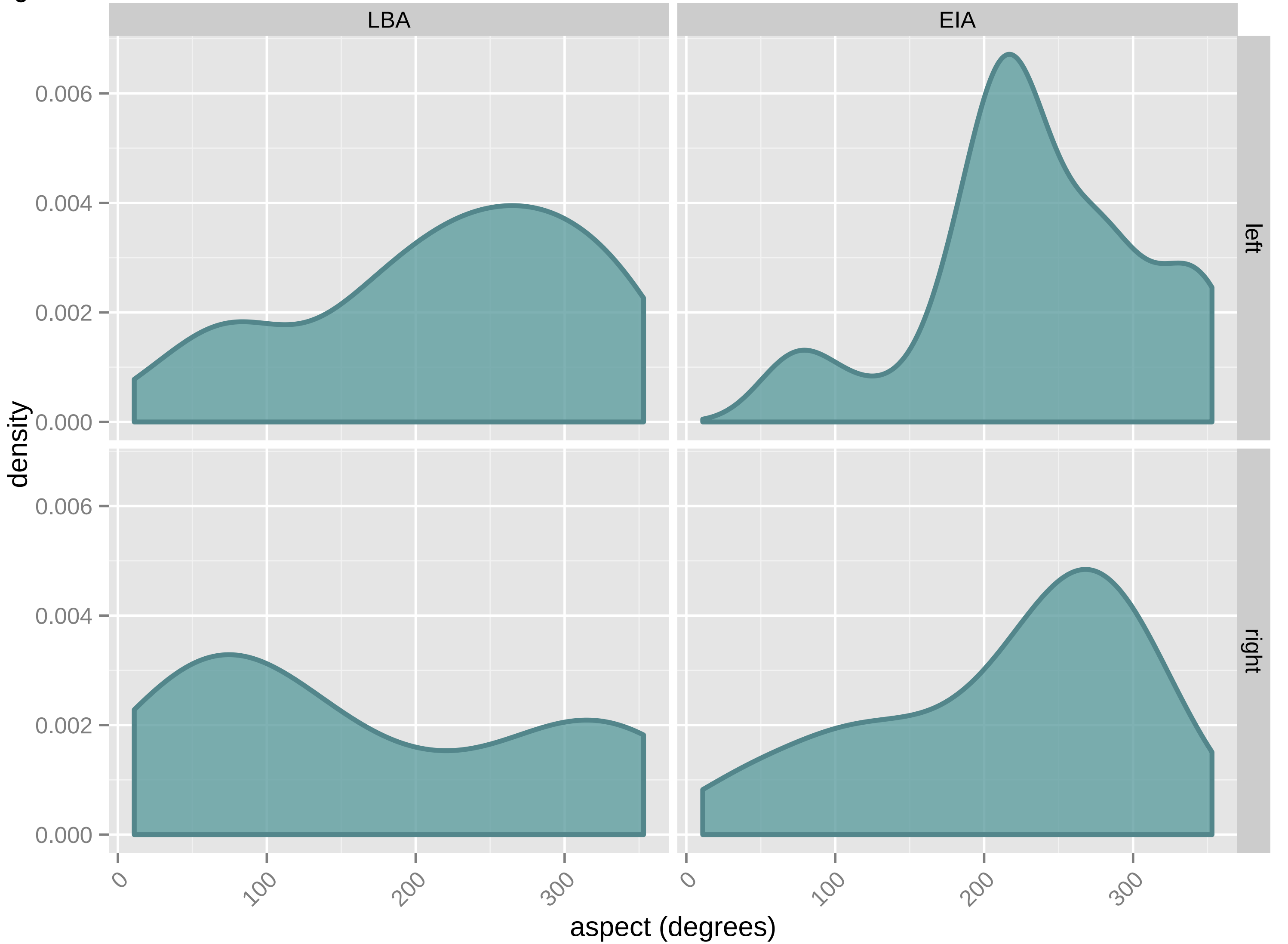
LBA
EIA
left
right
density
0.0100
0.0075
0.0050
0.0025
0.0000
0
250
500
750
height (m)

Figure



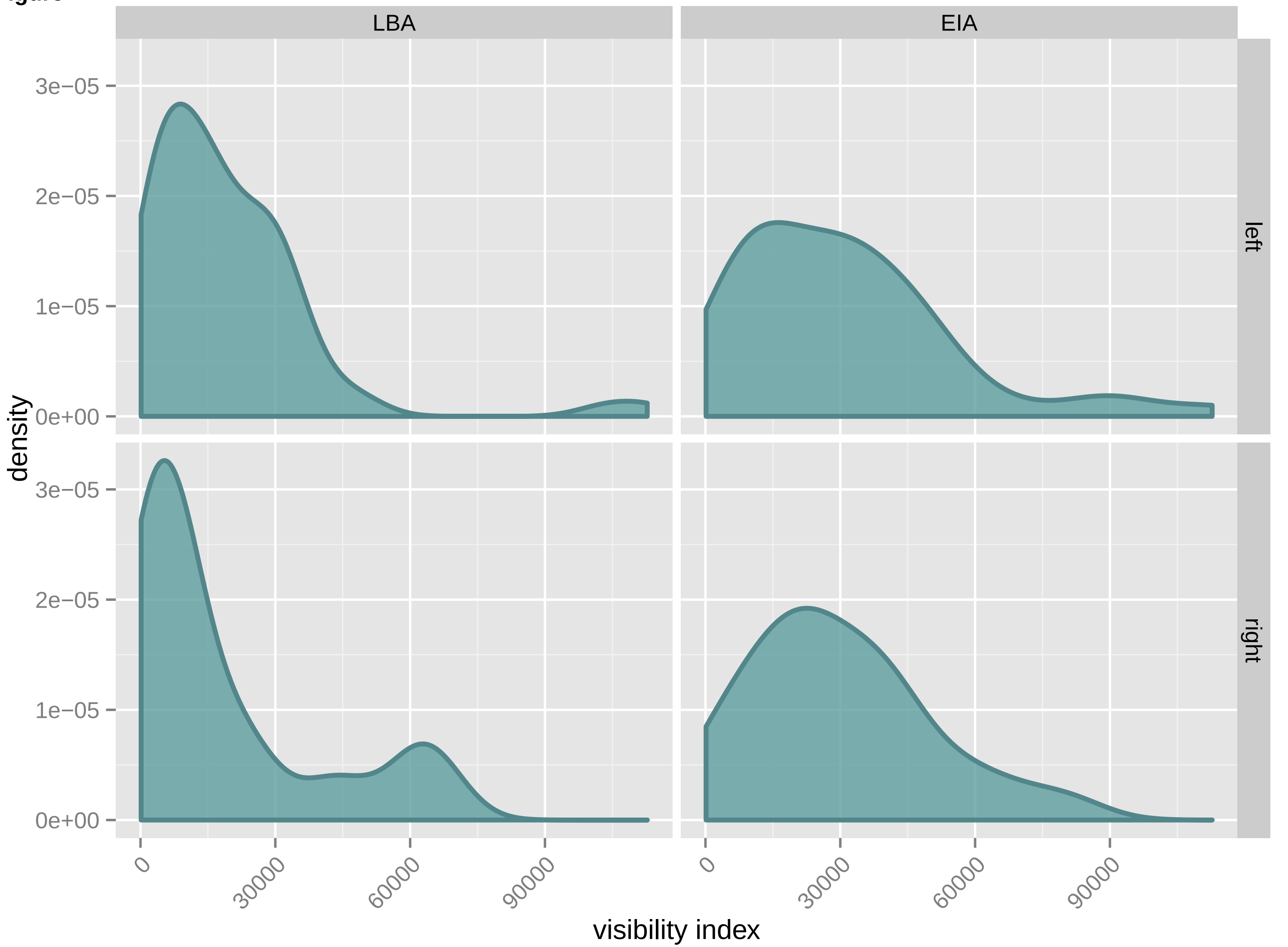
LBA
EIA
left
right
0.12
0.08
0.04
0.00
density
0
20
40
60
slope (degrees)

Figure



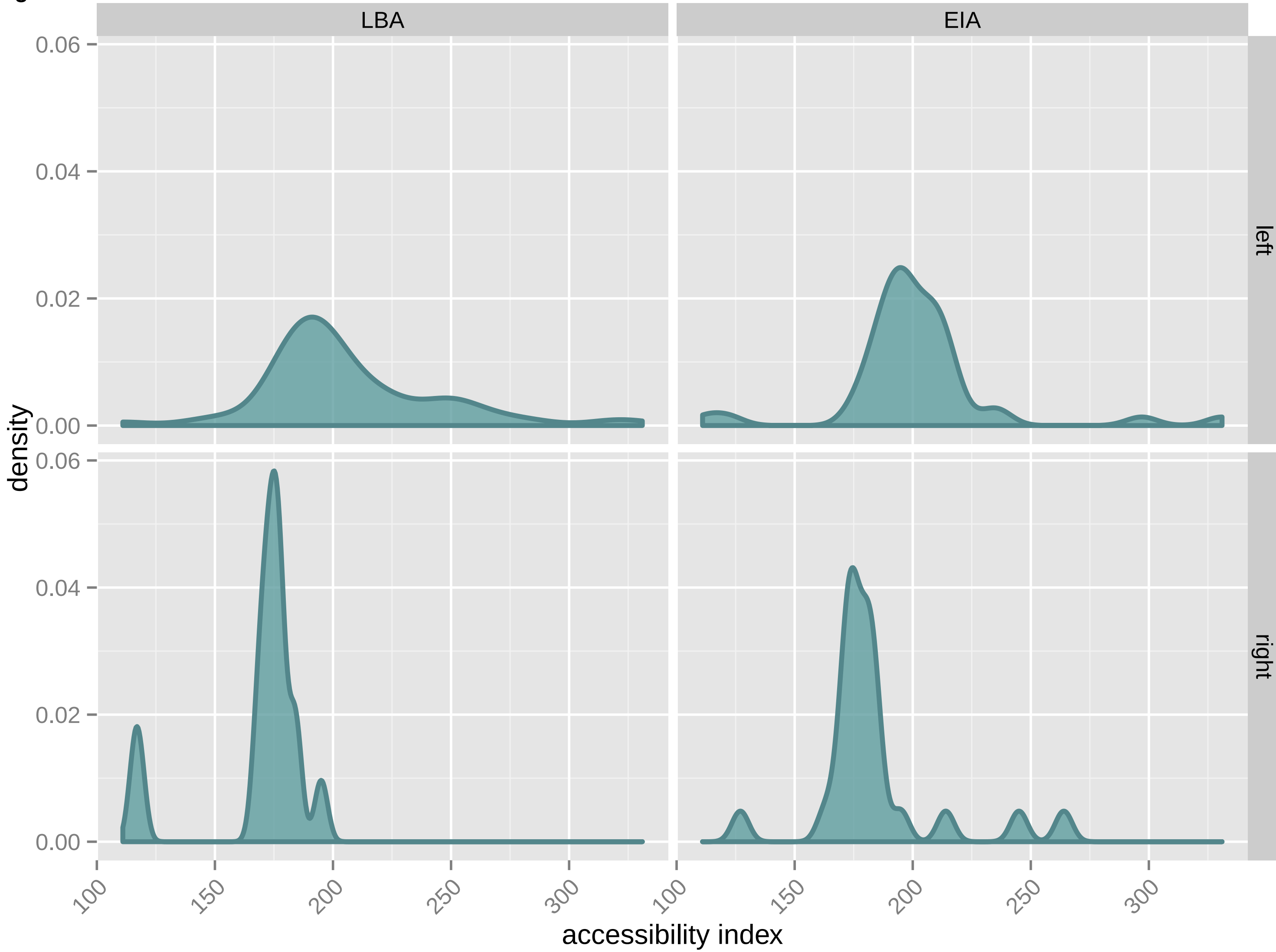
LBA
EIA
left
right
density
0.006
0.004
0.002
0.000
0.006
0.004
0.002
0.000
0
100
200
300
0
100
200
300
aspect (degrees)

Figure



LBA
EIA
left
right
density
3e−05
2e−05
1e−05
0e+00
3e−05
2e−05
1e−05
0e+00
0
30000
60000
90000
0
30000
60000
90000
visibility index

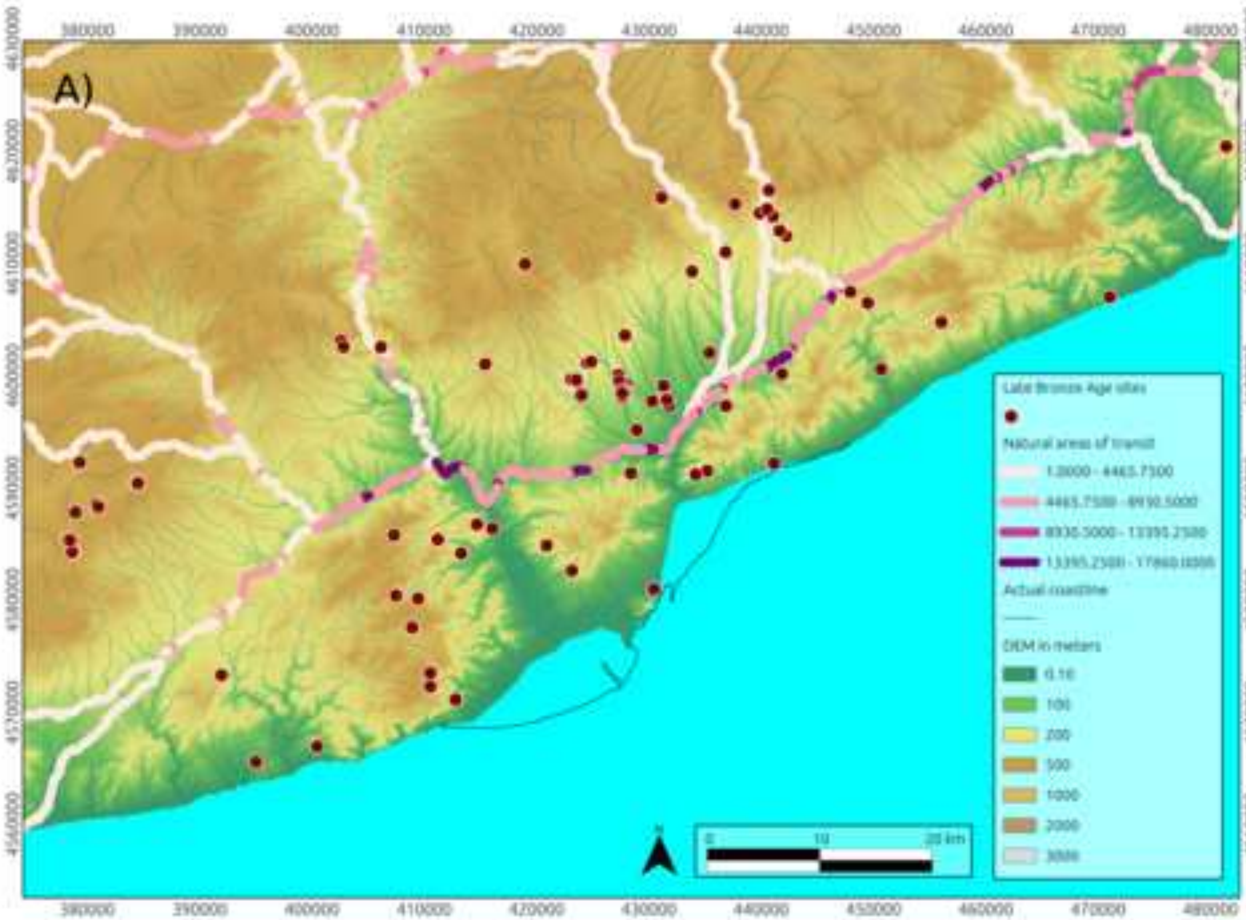
Figure

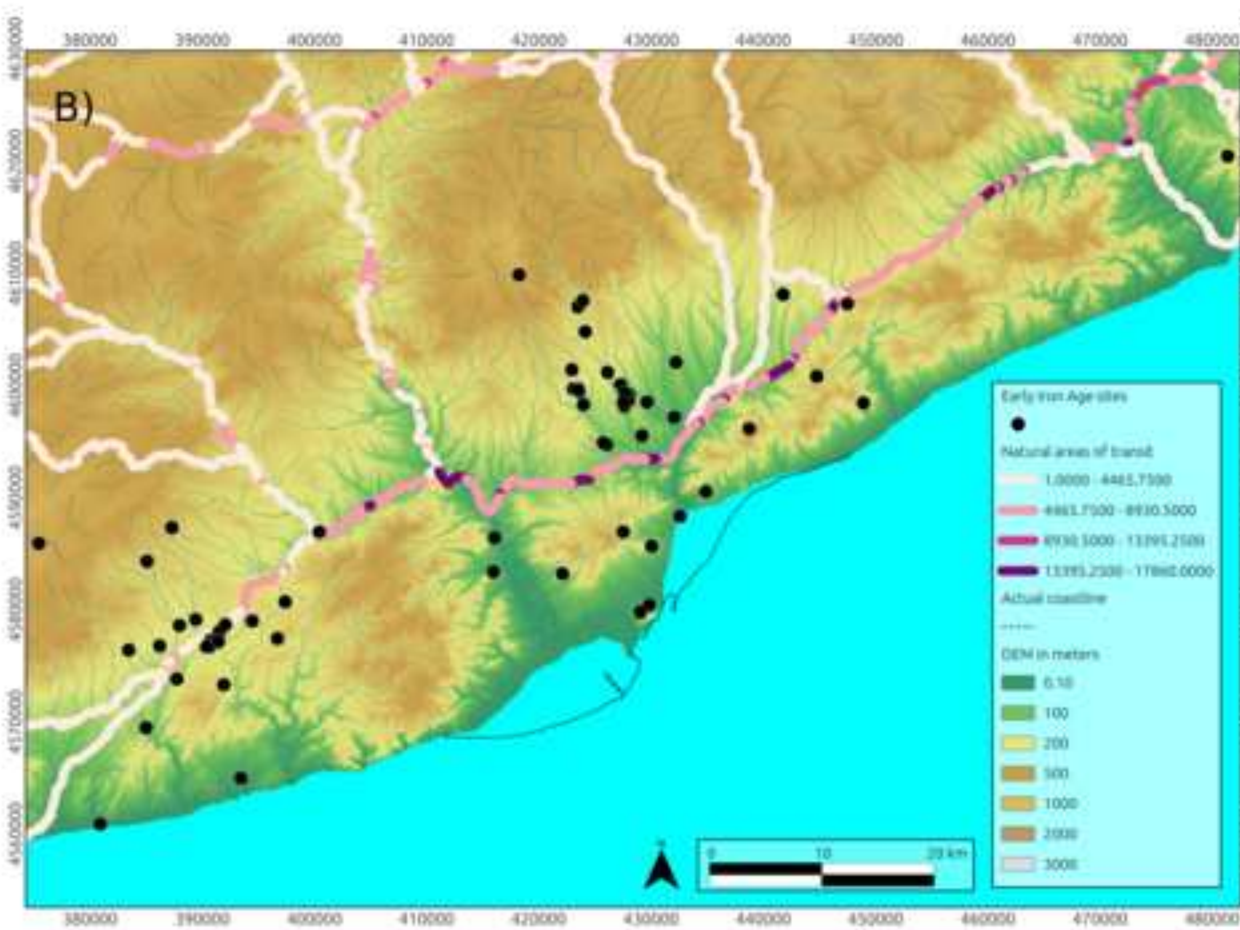


LBA
EIA
left
right
density
0.06
0.04
0.02
0.00
0.06
0.04
0.02
0.00
100
150
200
250
300
100
150
200
250
300
accessibility index

Figure

Click here to download high resolution image





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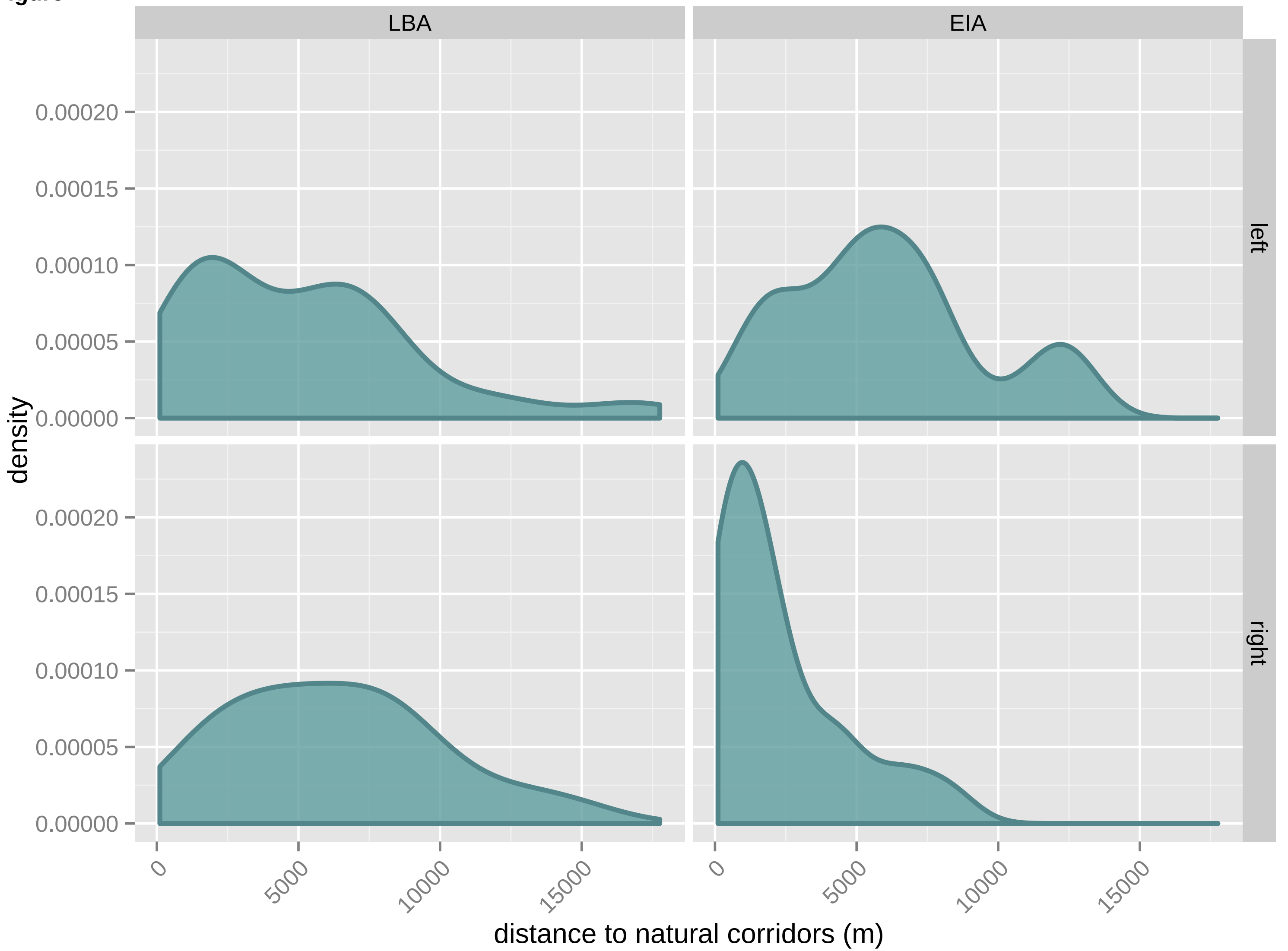
LBA
EIA
left
right
density
0.00000
0.00005
0.00010
0.00015
0.00020
0
5000
10000
15000
distance to natural corridors (m)