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Civitates Hispaniae : urbanisation on the Iberian peninsula during the High Empire

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CHAPTER VI

QUANTIFYING THE URBAN NETWORK

> For nothing is so conducive to greatness of mind as the ability to examine systematically and honestly everything that meets us in life, and to regard these things always in such a way as to form a conception of the kind of Universe they belong to, and of the use which the thing in question subserves in it; what value it has for the whole Universe and what for man, citizen as he is of the highest state, of which all other states are but as households.[1]
>
> M. Aur. *Med*, III.11

6.1 Introduction

As we have seen in the first chapter, the size of a settlement is perceived today as an important proxy for defining a city; 35% of modern-day definitions are based on, or include, demographic size. In contrast to the modern-day definition, this study has not considered size as a defining feature for urbanism on the Iberian Peninsula in Roman times. Nonetheless, size is an aspect of the city that needs to be taken in account when investigating the Roman settlement system of the Iberian Peninsula.

This chapter sets out to collect all the sizes available for the Roman period based on existing surveys and new archaeological evidence. The existing lists often date to the last decades of the 20th century and are generally used uncritically. Newly published lists and updates of older lists of sizes seem to have escaped the attention of many researchers. Marzano uses the 1996 list by Carreras without taking into account any later publications.[2] Hanson (2016) has overlooked a relatively recent survey by Keay and Earl (2011) and the updated list by Carreras (2014). The critique in Hanson's work on published estimates is also minimal.[3]

Taking into account the most recent estimates, an analysis of the settlement system will be made based on a rank-size analysis. This form of analysis allows for a study

[1] Οὐδὲν γὰρ οὕτως μεγαλοφροσύνης ποιητικον, ὡς τὸ ἐλέγχειν ὁδῷ καὶ ἀληθείᾳ ἕκαστον τῶν <ἐν> τῷ βίῳ ὑποπιπτόντων δύνασθαι καὶ τὸ ἀεὶ οὕτως εἰς αὐτὰ ὁρᾶν, ὥστε συνεπιβάλλειν, ὁποίῳ τινὶ τῷ κόσμῳ ὁποίαν τινὰ τοῦτο χρείαν παρεχόμενον τίνα μὲν ἔχει ἀξίαν ὡς πρὸς τὸ ὅλον, τίνα δὲ ὡς πρὸς τὸν ἄνθρωπον, πολίτην ὄντα πόλεως τῆς ἀνωτάτης, ἧς αἱ λοιπαὶ πόλεις ὥσπερ οἰκίαι εἰσίν. (Loeb translation).

[2] Marzano (2011); Carreras Monfort (1996).

[3] Hanson (2016) *An Urban Geography of the Roman World, 100BC to AD 300*; Keay and Earl (2011); Carreras Monfort (2014).

based on the hierarchy of the settlements. How are the urban settlements of the Iberian Peninsula distributed across various size brackets? Do we find clusters of sizes, and how can we explain possible clusters?

In addition, we will look at the geographical dispersal of settlements belonging to various size categories. Can we observe a clustering of larger cities in certain areas? Can we find a relation with the pre-Roman system as described in chapter two? In order to gain a better understanding of this spatial pattern, we will turn to network analysis to discover whether larger cities are better connected within the urban system, and whether these cities indeed have an edge.

6.2 City sizes

As has already been asserted, we can identify at least 430 self-governing communities in the three provinces of the Hispaniae. One of the aims of this chapter is to collect the sizes of the urban centres of these self-governing communities. The starting point for this endeavour is the 1996 article by Carreras Monfort in which 107 sizes are given.[4] Since the origin of Carreras' sizes is unclear, his sources have been checked. As Carreras already acknowledges, several of these are based on the Republican or even pre-Roman sizes given by Almagro-Gorbea.[5] Some of Carreras' estimates were derived from sources such as Taracena.[6] Only after reading the work of Taracena does it become clear that several of the sizes found in his work are guestimates. For instance, the cities of *Blandae*, *Iluro* and *Baetulo* are all credited with a built-up area of 9 hectares, the same size as *Barcino*, based on the fact that *Mela* referred to all of them as *parva oppida*.[7] Other estimates are based on the function of particular settlements within the urban network or their origin as a new foundation.[8]

Despite Carreras' call to improve the data, the figures have been used with little discrimination during the past twenty years.[9] In 2014 Carreras published an updated and extended list of sizes containing 209 sites, each with an indication of its size.[10]

[4] Carreras Monfort (1996). The English publication is often used in the Anglophone publications: Carreras Monfort (1995-1996) 'A new perspective for the demographic study of Roman Spain.' *Revista de Historia da Arte e Arqueologia* Vol. 2, 59-82.
Marzano already spotted that there was a discrepancy here: Carreras' mentioning in text only 106 cities, whilst the list contains 107 cities, see (2011): 207. After a close look at the list of cities, it appears that Carreras has not given Santarem (*Scallabis*) a number for mapping in his list, hence the highest number on the map is 106.
[5] Almagro-Gorbea (1987); Almagro-Gorbea (1994); Almagro-Gorbea and Dávila (1995).
[6] Taracena (2007 [1949]): 2027 [429].
[7] Mela II.90; *ibid*. 2025 [427].
[8] *Ibid*. 2024 [426].
[9] Marzano (2011); Hanson (2016).
[10] Carreras Monfort (2014).

Several other publications also list the sizes of settlements on the Iberian Peninsula.[11] Unfortunately, several of these lists repeat each other's sizes or only mention those of well-studied settlements. For the purpose of this study, the sizes of the different lists have been compared with each other and checked against the underlying archaeological reports or satellite imaging of individual sites. After collecting and screening all the size estimates published, 265 sizes remain for the Imperial period. Of these 265 sizes, 25 belong to settlements of which the self-governing nature cannot be established. The remaining 240 sizes account for just over half of the 430 self-governing communities that are known to have existed in the Imperial period. Unfortunately, the data do not allow for a precise dating within this period. As Carreras has commented, we have to make do with the information we have at our disposal.[12]

A complete treatment of the origin of all 265 would be a lengthy and tedious exercise. A detailed discussion of the sizes that have been used in this study is therefore given in Appendix I. A major point to be made concerns the difference between the sizes of walled areas and those of built-up areas. In principle, we would like to collect the evidence for built-up size. One can easily imagine a city growing beyond its walled area in the case of early Imperial walls. An example would be *Corduba,* where extramural habitation has been attested.[13] Conversely, we might also find a city whose walled area was larger than its built-up area. This may have been the case for *Clunia.* The size mostly mentioned for *Clunia* is 130 hectares.[14] Despite the dispersion of ceramic material within the whole walled area, the excavated archaeological remains of the inner city are clearly dispersed and discontinuous.[15] Even in well-studied cases, such as *Corduba*, the exact size of a settlement cannot be determined precisely. Like Carreras, I invite other scholars to improve those estimates that have been used in this study.

[11] Hourcade (2004) 'Géographie des villes fortifiées en Lusitanie Romaine: tentative de definition de réseaux et de hiérarchies urbaines.' In: Gorges, Cerrillo and Nogales Basarrate (eds.), *V Mesa Redonda Internacional sobre Lusitania Romana: Las Comunicaciones*, 223-53; Almagro-Gorbea (1987); Almagro-Gorbea (1994); Keay (1998b); Fatás Cabeza (1990b) *De Zaragoza*; Keay and Earl (2011).
[12] Carreras Monfort (1996): 98: "uno se debe conformar con la información de que se dispone". .
[13] Ventura *et al.* (1998) 'Roman Cordoba in the light of recent archaeological research.' In: Keay (ed.), *The Archaeology of Early Roman Baetica*, 87-107; Dupré i Raventós (2004a) *Córdoba: Colonia Patricia Corduba*: 39; Vaquerizo (ed.) (2010) *Las áreas suburbanas en la ciudad histórica: topografía, usos, función*: 476.
[14] Palol (1991): 19; Taracena (2007 [1949]): 2043 [441].
[15] Palol (1991): 19 & 361; Diarte Blasco (2012): 116.

6.3 Rank-size analysis

Recent years have seen a reappraisal and increased use of rank-size analysis (RSA) in the study of Roman urban settlement systems.[16] Rank-size analysis started when Auerbach in 1913 found a regular pattern when the population numbers of cities were ranked according to size. Simply put, he found that the largest city of a region has twice as many inhabitants as the second, and three times as many as the third. This regularity has been shown by Zipf to follow a log linear distribution with a coefficient close to one. In an important article that appeared in 1996, Krugman tries to find an explanation for the fact that the Rank-size graph for the largest U.S. metropolitan populations obeys the linear distribution predicted by Zipf's Law.[17] Such a Rank-size distribution is often taken to indicate a highly integrated urban system.[18] Opting for a different interpretation, Krugman argues that Zipf's Law could be the result of essentially random processes, as is often observed in nature.[19] In this context it must be emphasised that random processes lead to a set of numbers that is not random but follows Zipf's law.

Although no convincing explanation for Zipf's Law has yet been found, geographers and archaeologists continue to use this analysis. In general, a lack of conformity to Zipf's Law has been observed, and much of the literature has been dedicated to explaining why this should be the case.[20] These deviations from Zipf's Law are mostly explained as resulting from incomplete data or from the combination of different data sets, but they are most probably a representation of reality. There are four basic shapes to be recognised in the rank-size analysis: Zipf's Law and three different deviations.[21] The most important of the three deviations is the concave shape, which is erroneously referred to as 'convex' in many archaeological publications.[22] This chapter will use the correct terminology (see fig. VI.1).

[16] Almagro-Gorbea and Dávila (1995); Marzano (2011); Smith (2011) 'Empirical Urban Theory for Archaeologists.' *Journal of Archaeological Method & Theory* Vol. 18, 167-92; Keay and Earl (2011); Graaf (2012) *Late Republican-Early imperial Regional Italian Landscapes and Demography*; Hanson (2016).

[17] Krugman (1996); Zipf (1949).

[18] Nitsch (2005) 'Zipf Zipped.' *Journal of Urban Economics* Vol. 57, 86-100; Zipf (1949).

[19] Krugman (1996): 414.

[20] Nitsch (2005); Marzano (2011); Johnson (1980) 'Rank-Size Convexity and System Integration: A View from Archaeology.' *Economic Geography* Vol. 56, N° 3, 234-47; Ligt (2016).

[21] Drennan and Peterson (2004) 'Comparing archaeological settlement systems with rank-size graphs: a measure of shape and statistical confidence.' *Journal of Archaeological Science* Vol. 31, 533-49: 534. For a good review of the multitude of interpretations based on these shapes, see: Savage (1997) 'Assessing Departures from Log-Normality in the Rank-Size Rule.' *Journal of Archaeological Science* Vol. 24, 233-44: 234ff.

[22] Ligt (2016): 33; Johnson (1980); Vries (1984) *European Urbanization 1500-1800*: 89.

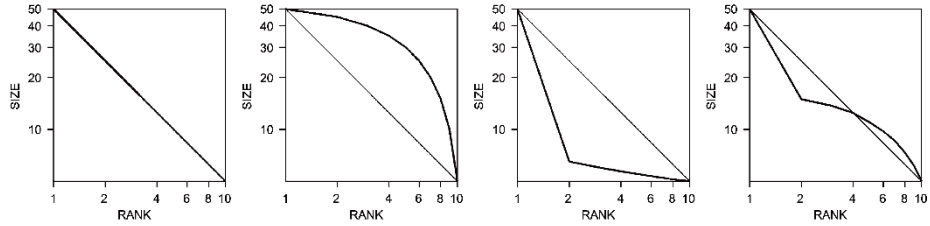

Fig.VI.1 Examples of the different shapes for RSA graphs (Drennan and Peterson (2004) fig.1 p. 534) From left to right: Zipf's Law, concave, primate and primo-concave.

Within this study RSA will not be used as an explanatory tool, but simply as an instrument to present and compare the distribution of population within the settlements of a region or period.[23] In brief, RSA will be used as a descriptive method to reveal differences between urban systems and to understand the relations between settlements within the system.

To support the interpretation and comparison of graphs with similar shapes, we have to add two elements to the graph: firstly, the line indicating the trend line of Zipf's Law, which shows the deviation from Zipf's Law and thereby the general shape of the graph, and secondly, the most fitting trend line of the graph, given with an equation. The equation of the trend line gives two values: the *q*-value, the exponent in the y equation, which gives the slope of the graph (in the case of Zipf's Law this would be -1) and the R^2 value, which indicates the degree of fit between the best fitting trend line and the data.

6.3.1 Earlier RSA for the Iberian Peninsula

In a recent chapter by Marzano, an RSA was carried out for the Iberian Peninsula and for the individual provinces based on the sizes given in the 1995-1996 article by Carreras, which contains the sizes of 107 settlements in Antiquity. Since we lack population figures for the ancient Roman cities, Marzano uses the size of a city in hectares. A simple multiplication of the size by a chosen density per hectare would not influence the distribution, but Marzano argues that the population density of a city may be higher in the case of larger cities.[24] However, Marzano admits that any estimates relating to population densities for the different tiers of cities would be arbitrary.[25] She therefore decides to adhere to the actual data and rank the cities based on their sizes in hectares.

[23] Drennan and Peterson (2004): 533.
[24] Marzano (2011): 203.
[25] *Ibid.* 204. She proposes to use 216 for settlements larger than 40 ha, 180 for those between 39 and 10 ha and 130 people/ha for the smaller settlements.

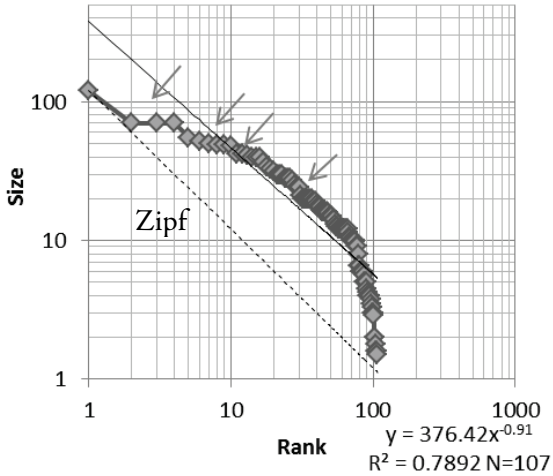

Fig. VI.2 RSA by Marzano (2011), arrows indicate the effect of levelling at intervals of a decade.

When looking only at the equation for the Carreras dataset, we observe that the projected size of the largest city would be 452.73 hectares and that the slope or *q*-value of the trend line is 0.91. However, with an R^2 value of 0.7892, it is clear that Marzano's rank-size graph does not obey the 'rank-size rule' at all. Marzano concludes that the urban system of the Iberian Peninsula in Roman times follows a concave distribution.[26] She buttresses this conclusion with the following observations:

> A convex (sic!) distribution signifies that the settlements below the size of the largest one are larger than the rank-size rule would predict; an alternative view holds that the largest settlement in the examined system is smaller than the rank-size would predict.[27]

The top ten cities are all of a similar size. Only *Augusta Emerita* stands out from the group of 70-hectare cities. In other words, the concave distribution is the result of a relatively small primary centre and a relatively large number of similarly sized cities.[28] We should note that the dataset tends to level out at certain size ranges. There are three cities occupying the second rank at 70 hectares[29] and another group occupying the third rank at 50 hectares, both leading to a levelling of the graph.

In addition, Marzano notes the lower-limb problem, the drop at the tail end of the concave curve. This drop might be interpreted as the result of the absence of undetected small places. In order to rule out that the graph may have been heavily influenced by missing data, Marzano estimates the number of undetected settlements

[26] Marzano (2011): 209.
[27] *Ibid*. 211. Note that Marzano uses the terminology of Johnson and thus refers to a convex distribution.
[28] *Ibid*. 211.
[29] Carreras states he has estimated the size of *Clunia* as among the range of *Corduba* and *Tarraco.* See Carreras Monfort (1996): 103.

and adds them to her graph. According to Carreras, 293 sites are missing, based on the total of 399 self-governing places mentioned in Pliny.[30] He states that of these 293 settlements, 93 would have been approximately 10 hectares and the remainder about 5 hectares.[31] Marzano then adds the 293 sites with randomly allocated sizes following the distribution proposed by Carreras. As the graph representing these adjusted data looks very similar to the shape of the original one (the *q*-value -0.83 and the R^2 0.793), Marzano concludes that the missing data did not influence the graph. Unfortunately, no conclusions were drawn based on the shape of the graph for the whole Iberian Peninsula.

After presenting her graph for the Iberian Peninsula, Marzano discusses the three provinces separately. However, she only shows the graph for the province of *Baetica,* stating that it is the most urbanised province. The trend line for the graph of this province has a *q*-value of -1.015. However, as the R^2-value is 0.826, we have to conclude that we are far from a rank-size rule. Instead of a linear appearance, the graph is clearly concave.

Marzano does not pay a great deal of attention to *Hispania Citerior/Tarraconensis* either, but she notes that the trend line for this province has a *q*-value of -0.895 and an R^2 value of 0.7799. As a possible explanation for the difference between the provinces, Marzano points out that the urban centres of *Citerior* are most likely to be found close to the coastal areas as the inland regions are rather mountainous.[32]

Nonetheless, a short interpretation is given for *Baetica* and *Citerior*. Marzano states that, based on the middle segment of the graphs, the largest settlements must be considered too small for the settlement system. She attributes this "missed growth" to the consumption of the resources of these provinces by other parts of the empire.[33] She points out that not all resources are traded but some are also siphoned away as taxes or rents.

For the RSA of the province of *Lusitania,* Marzano gives an interpretation based on 14 sizes. The *q*-value of the set by Marzano is -1.257 and the R^2 value 0.8472. Her graph is close to log-normal.[34] Her conclusion is that the province of *Lusitania* was well integrated, which she deems possible based on its topography, the area being less mountainous than the two other provinces. However, there are a number of problems with the data. First, the size of the so-called primate centre *Augusta Emerita*,

[30] Carreras has calculated the 293 missing sites by retracting the 106 known sizes (in text Carreras wrongly used the number 106 for his amount of sizes) from the 399 cities mentioned in Pliny. See also: Chapter III footnote 24.

[31] De Vries notes that the number of smaller towns might not actually be larger, because small settlements with urban functions, such as administration, are a rarity. See Vries (1984): 91.

[32] Marzano (2011): 218.

[33] *Ibid*: 221.

[34] *Ibid*. 218. Marzano states it is 'almost log-linear'.

120 hectares, is based on a guestimate given by Taracena in 1949.[35] Some of her other estimates can also be improved upon and new data can be added. In addition, the small size of the dataset for *Lusitania* is problematic. The slightest deviations from reality will distort the graph. In particular, Marzano's inflated estimate for the largest city has a major distorting effect on the graph.

6.3.2 RSA Iberian Peninsula

As has already been explained, the sizes of 240 of the 430 self-governing communities that have been identified in this monograph can be estimated. Since the number of self-governing communities according to Pliny stood at 513, we have missed the size of 275 self-governing communities, but this figure includes the 114 dispersed *civitates* with no central *urbs*.[36] The sizes of the self-governing settlements span from 90 hectares to 1 hectare.

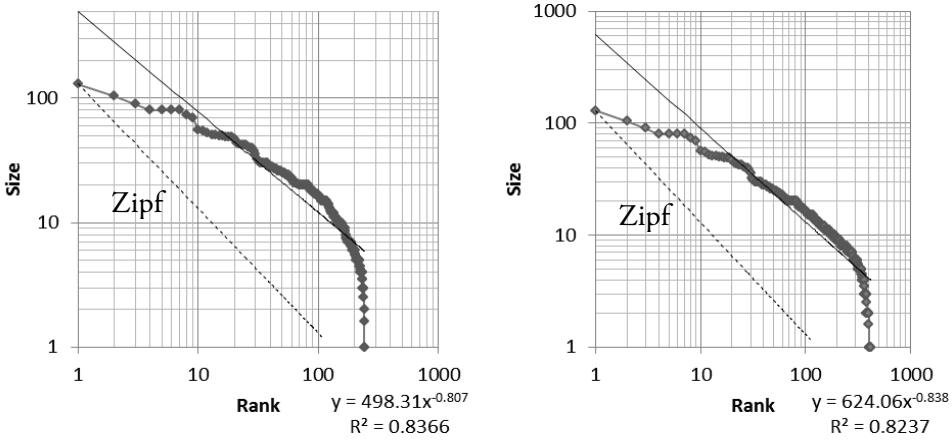

Fig.VI.3 RSA graphs for the self-governing cities, the current dataset (left) and the dataset with projected sizes (right).

As we have seen, Carreras has suggested that the vast majority of those settlements for which no data are available must have been small and that about one-third would be on average 10 hectares and the remaining two-thirds 5 hectares.[37] Based on this idea I will add 54 sizes between the range of 6 to 14, on average 10 hectares, and 107 sizes between 1 and 9, on average 5 hectares. Similar to the graphs drawn by Marzano,

[35] Taracena (2007 [1949]): 427.: "[...] Emerita Augusta, cuyo caserío solo fue después cuando llegó a medir 120 hectáreas, como la más importante de Lusitania, [...]". This large size for *Augusta Emerita* is not supported by archaeology: the walled size of *Emerita Augusta* is 71 hectares, whereas the built-up area is estimated to be about 80 hectares: Hourcade (2004): 227; García y Bellido (2009 [1966]): 247.

[36] Note that the self-governing communities did not necessarily function with an *urbs* (see the dispersed *civitas* chapter III). Nonetheless, there would be smaller settlements present; if a size is known for one or more of these settlements the largest is taken to be the *urbs*.

[37] Carreras Monfort (1996): 106; Marzano (2011): 211.

no major difference is observed between the original graph and the projected graph. Both the *q*-values, -0.807 and -0.838 respectively, and the R^2 value or fit, 0.8366 and 0.8237 respectively, are within the same range. It follows from this that the steep decline of the right-hand part of the graph is not caused by missing data.

In all likelihood, few self-governing cities were very small due to their administrative function.[38] A drop at the lower end of the graph is therefore to be expected.[39] As the lowest limb does not help us to understand the graphs and the standard RSA is made on the largest settlements, the RSA will be made on settlements with a size of 10 hectares and above.

Obviously, the effect of deleting the lower limb has a levelling effect on the graph. However, while the adjusted graph is less steep, it is still concave, reflecting the relatively small size of the highest-ranking cities and the existence of a large group of middle-sized cities between 20 and 50 hectares. The gentle slope and concavity of the rank-size graphs for northern and peninsular Italy have been interpreted as evidence for the "modular nature of the urban system".[40] The underlying idea is that the vast majority of Roman cities interacted more intensely with their administrative territories than with each other. This has been contrasted with the 'global' system, where we see the Roman urban system as a well-thought-through and integrated system of several layers of administration working towards Rome.[41]

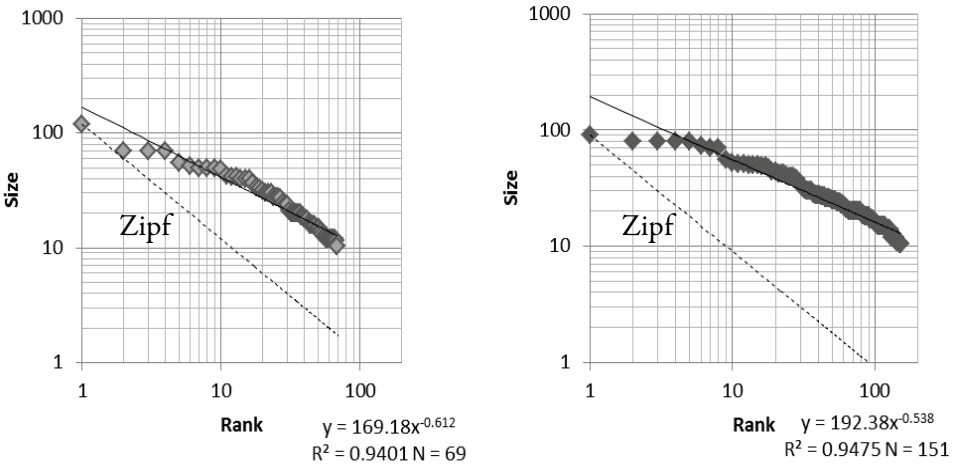

Fig. VI.4 RSA of settlements > 10 ha. Carreras dataset (1996) left current dataset (right).

[38] Vries (1984): 91. Nonetheless, we find small self-governing settlements below 5 hectares in Hispania. For example, the *municipium Flavium Munigua* has a walled size of 4.5 hectares (See: Schattner (2005), 254), its built-up area is estimated at only 3 hectares, personal communication T. Schattner. Therefore, it is very likely that this group is incomplete.

[39] Still, a considerable number of small self-governing cities might be missing. However, adding these has no influence on the graph.

[40] Ligt (2016): 39.

[41] Corbier (1991) 'City, Territory and Taxation.' In: Rich and Wallace-Hadrill (eds.), *City and Country in the Ancient World*, 214-43: 216.

Many cities were approximately within a range of between 20 and 50 hectares, based on the size and productivity of their territory in relation to the history of the individual cities. There seems to be a natural break between the larger eight cities and the rest. However, the few larger cities seem not to have relied on access to regional and supra-regional resources, but on their larger territories.[42] None of these cities reached beyond 100 hectares. It therefore appears that the absence of very large centres reflects the inaccessibility of regional and supra-regional resources.[43]

It has been argued that those places with a higher status, such as provincial capitals, *conventus* capitals and *coloniae*, are larger than non-privileged communities.[44] Figure VI.5 shows box and whisker plots for the different status categories:

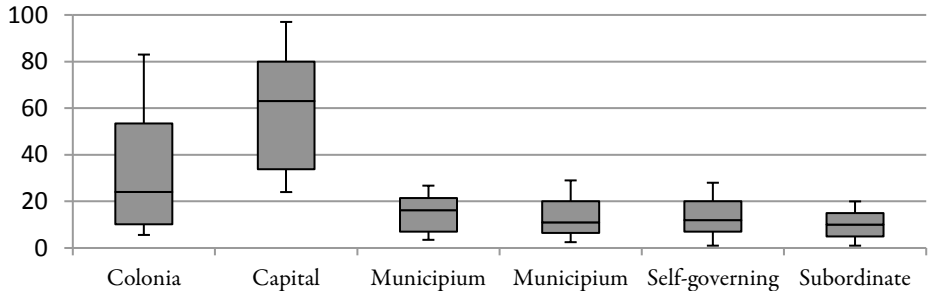

Fig. VI.5: Box and whisker plot of size distribution per status and conventus capital function of cities.

Indeed, we observe that the *coloniae* are larger than cities with other statuses. Up to a point this reflects the fact that the four largest cities are all *coloniae*. However, if we look at the median for all the *coloniae,* we observe that this value even surpasses the Q3 of the other statuses. We can conclude that the *coloniae* are significantly larger than the other settlements. The explanation for this difference may be found in the different nature of this type of settlement. As we shall see, the territories of these *coloniae* are rather large[45], which would have allowed them to draw resources from a larger territory and as a result support a larger population.

The effect of state intervention becomes even clearer when considering the 'capitals', even though probably not all of these were *coloniae.* The provincial capitals, *Corduba*, *Augusta Emerita* and *Tarraco*, are the largest cities on the Iberian Peninsula. It is clear that the large territories of these cities in combination with their administrative role has led to the development of larger settlements. Their larger size is partially due to the representative areas, such as the larger *fora* of these capitals.[46] In addition,

[42] Infra section 6.4.1.
[43] Ligt (2016): 40.
[44] Keay (2001): 107. Referring as well to: Millett (1991) *The Romanization of Britain: An Essay in Archaeological Interpretation*: 144; Woolf (1997) 'The Roman urbanization of the East.' In: Alcock (ed.), *The Early Roman Empire in the East*, 1-14: fig. 5.
[45] Infra section 6.4.1.
[46] On the *fora* of capitals supra section 5.2.4 on the *forum*.

their assize function must have drawn people and with it trade opportunities to the city, leading to an advantageous position within the urban network.

The 'self-governing' box represents those settlements whose municipal status cannot be demonstrated with the help of the published evidence, but they were most likely promoted after the grant of *ius Latii.* When comparing this bar with the bar representing the *municipia,* we observe that they are very similar, suggesting that they belong to the same group.

6.3.3 RSA Lusitania

Lusitania is not well covered by Carreras' data set. Pliny states that there were only 45 *populi*, and the size of 23 of the 45 central places of these communities can be established. In the corrected data set *Augusta Emerita* remains the largest settlement, although it has a significantly smaller size than in the Carreras dataset.

The corrected dataset gives different values from those calculated by Marzano. Interestingly, the slope of the graph is -0.514, leaving no doubt that we are far from a log-normal distribution. In addition, the fit of the line is significant and the R^2 is 0.962. The concave shape of the graph is mostly due to the fact that the size of 50% of all the settlements is within the range of between 30 and 15 hectares. The sharp drop at the end of the graph, indicated by the last size, is mostly due to settlements in the northern part of the province, where we find the dispersed *civitas* and small central settlements. Interestingly, we do not find the city of *Olisipo* amongst the higher-order cities; instead we find *Mirobriga Vettonum* (Ciudad Rodrigo) and *Balsa*. The latter was a port for trade passing through the Strait of Gibraltar and had connections to the Guadiana River leading towards *Myrtilis* and further to *Augusta Emerita*. The size of *Mirobriga Vettonum* is slightly problematic: it is based on the walls of the old *oppidum*, and the size of its built-up area may have been lower.

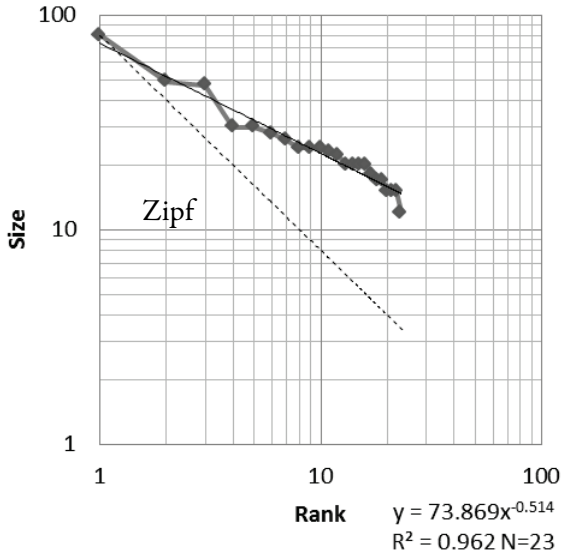

Fig. VI.6: RSA for Lusitania (n=23)

We observe that the provincial capital is the largest centre. *Augusta Emerita* was founded in Augustan times to settle the veterans of the Cantabrian Wars. Its territory

was of considerable size and would have easily supported the urban population.[47] In addition, *Emerita* was given at least three *praefectura*.[48] Apparently, the land available to create the continuous territory was too small and more land had to be granted. Moreover, the city was located along what is nowadays called the Via Plata, the route connecting the mines of the north with the main harbour at *Hispalis*. It is clear that *Emerita* was ideally placed to become the largest city of the region.

Lusitania as a whole can be described as a province where most cities are of moderate size, between 30 and 15 hectares, pointing to a heterarchical system. At the same time, the settlement system imposed by Rome was clearly dominated by *Augusta Emerita*. This can also to be observed when looking at its network, with *Augusta Emerita* clearly positioned in the centre of the network, despite its position on the boundary of the province.[49] We can conclude that Marzano's interpretation of the RSA of *Lusitania* was based on a too small and incorrect dataset. *Lusitania* clearly was not as integrated as she thinks it was.

6.3.4 RSA Baetica

A rank-size graph for *Baetica* that is based on revised size estimates looks somewhat different from Marzano's graph. The *q*-value of -0.67 fits well with an R^2 value of 0.932. The slightly steeper slope, in respect to that of *Lusitania,* and the good fit indicate a more hierarchical pattern, although the overall shape of the graph remains concave.

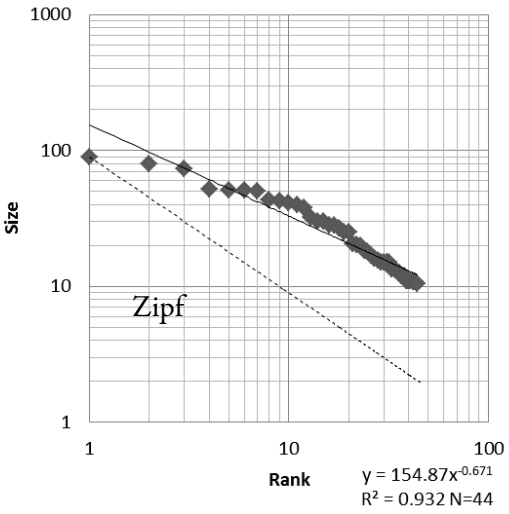

Fig.VI.7: RSA Baetica (n=44)

As Marzano already states, *Baetica* was one of the most urbanised regions of the Iberian Peninsula, and even of the Roman West.[50] Hence it is not very surprising that, in contrast to *Lusitania*, the urban

[47] Cordero Ruiz (2010) 'Una nueva propuesta sobre los límites del *Ager Emeritensis* durante el Imperio Romano y la Antigüedad Tardía.' *Zephyrus* Vol. LXV, 149-65: 149. See below for a further analysis of the territory of *Augusta Emerita*.

[48] Hyg. Grom. *De Lim. Const.* La. 171, 6-10 = Th. 136, 3-7. Ramírez Sábada (1994) 'La demografía del Territorium Emeritense (excepto el casco urbano) según la documentación epigráfica.' In: Gorges and Salinas de Frías (eds.), *Les campagnes de Lusitanie romaine. Occupation du sol et habitats*, 131-47: 131.

[49] Carreras Monfort and De Soto (2010): 32.

[50] Marzano (2011): 2018.

populations of this province lived in settlements of widely varying size. This explains why the trend line follows the graph rather closely from 50 hectares to 10 hectares.

The different shape of the graph for *Baetica* might reflect a difference in the history of urbanisation. *Baetica* had fertile lands and mineral-rich mountains. The area played important role within the Mediterranean trade from early times.[51] We find that settlements within the province are well connected due to its extended road network and the importance of the Guadalquivir River (*Baetis*). These factors may have enhanced urban development.[52] Clearly, the integration of *Baetica* within the Roman economic network as a source for olive oil and grain only enhanced its position.[53] The combination of the concentration of natural riches, early contact with other regions and a well-integrated network of settlements led to the development of a strong urban settlement pattern. The larger cities controlled large territories with abundant resources, and also controlled the trade derived from the territories of the smaller cities.[54] In the Roman period we find several large settlements[55], such as the *conventus* capitals *Corduba* (90 hectares), *Gades* (80 ha), *Astigi* (73.3 hectares) and *Hispalis* (51 hectares), which were granted large territories and in addition were important fluvial or maritime ports.

The settlement system is mostly concentrated along the Guadalquivir. Here we find a rather regular pattern of cities of different sizes located on average 12.67 kilometres apart. The locations of larger cities can be related to their roles as shipment centres. At the extreme end, the furthest one can travel on board a small ship, we find *Castulo* (44 hectares) as a relatively large city.[56] The next large city, which happens to be the largest on the Peninsula, is *Corduba,* located at the furthest point that large river ships could sail.[57] *Celti* occupied an area of only 17 hectares, but was still among the larger cities along the Guadalquivir. It was located at the confluence of the Genil and the Guadalquivir. Finally, we find *Hispalis*, the last city accessible for maritime ships, as a large city.[58] This interesting pattern may be the result of larger ports functioning as transhipment ports, where goods were unloaded from maritime ships and put on board barges. Between these large cities we find a multitude of smaller cities,

[51] Ponsich (1998) 'The rural economy of western Baetica.' In: Keay (ed.), *The Archaeology of Early Roman Baetica*, 171-82: 171.
[52] See supra sections 4.5 and 5.4 for the network.
[53] Remesal Rodríguez (1998) 'Baetican olive oil and the Roman economy.' In: Keay (ed.), *The Archaeology of Early Roman Baetica*, 183-99: 188.
[54] Rodríguez Gutiérrez (2011): 132.
[55] In the work by Keay (2011) we find rather large sizes for *Urso* (115.5) and *Ostippo* (104.5). Keay already admits that these sizes are rather large and can be doubted since almost no archaeological research has been done to verify these settlement sizes (Keay 2011: 305). Since these fall well beyond the range of what are known to be the largest cities on the Iberian Peninsula and it has been impossible to falsify the size, these have been omitted. Cities like *Gades* and *Corduba* are more likely to be the largest, e.g. Strabo mentions *Gades* as the most famous and most populous city in the west (III 1.8; III 5.3).
[56] Str. III 2.3; Carreras Monfort (2014): 74.
[57] Carreras Monfort and De Soto (2010): 31.
[58] Carreras Monfort and De Soto (2010): 31.

the size of which remains unknown, although they are unlikely to have been much larger than ten hectares.

To the north of the Guadalquivir, in the Sierra Morena, we find mining cities. This category again includes *Castulo*, controlling the silver mines, but also *Corduba* with its large territory stretching into the mountains.[59] Another example of a mining

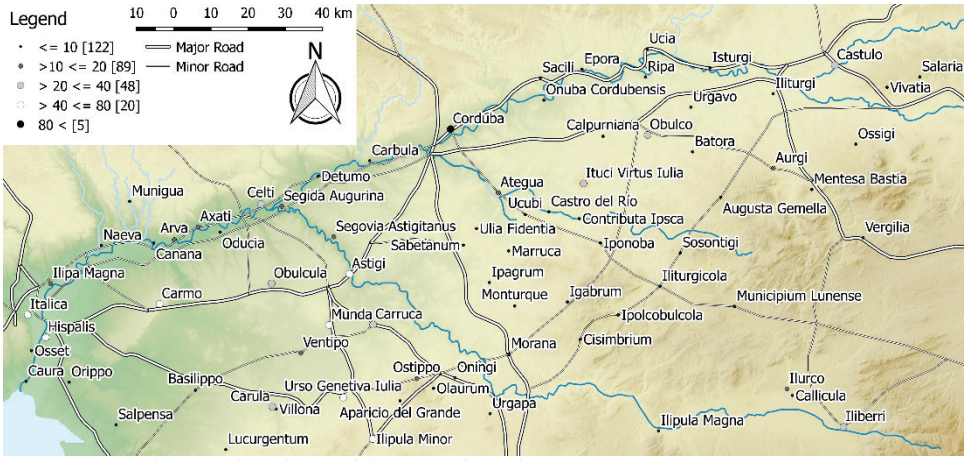

Fig. VI.8 Settlements along the Guadalquivir and Genil.

city is *Munigua*. This rather small but heavily monumentalised city is a good example of a central place controlling the mining area within its territory.[60] The mining operations were located throughout the territory of the city, with the town-based *mercatores* controlling the mining operations and the transportation of ores or metal to *Hispalis* for onward shipment.[61] Along the banks of the Guadalquivir and Genil rivers we find the kilns for the Baetican olive oil amphorae. This pattern was dictated by the presence of good clay deposits and by a strong demand for amphorae.[62] The valleys of these rivers were rich in olive orchards that produced the olive oil for the market in Rome, as shown by the mountain of broken amphorae at Monte Testaccio.

The Baetican settlement system consists of three subsystems. The most important was that in the Guadalquivir valley, which was bounded by two mountain ranges, the Sierra Morena and Sierra Nevada. Marzano considers it was these mountain ranges that led to a less integrated system in *Baetica*. However, while the significance of these barriers cannot be denied, the cities to the north of the Sierra Morena were connected to the Guadalquivir via roads along which they could transport the metals obtained from the mines.[63] The settlements to the south of the Sierra Nevada were

[59] Domergue (1998) 'A view of Baetica's external commerce in the 1st c. A.D. based on its trade in metals.' In: Keay (ed.), *The Archaeology of Early Roman Baetica*, 201-15: 205.
[60] Schattner *et al.* (2008): 139; Domergue (1990): 384.
[61] Domergue (1998): 203.
[62] Remesal Rodríguez (1998): 188.
[63] Monterroso-Checa and Gasparini (2016) 'Aerial Archaeology and Photogrammetric Surveys along the Roman way from Corduba to Emerita. Digitalizing the Ager Cordubensis and the Ager Mellariensis.' *SCIRESit* Vol. 6, N° 2, 175-88: 176.

port settlements that were connected to the ports at the estuary of the Guadalquivir by sea and via roads to the inland centres. Clearly, these settlements were not as well integrated into the system as those in the Guadalquivir valley. Nonetheless, they were an integral part of the Baetican system.

6.3.5 RSA Hispania Citerior

In the case of *Citerior,* the values calculated using the updated dataset are very different from those calculated by Marzano: the slope is -0.499 and the R^2 value 0.9635. The rank-size graph has a flat appearance. Again we see that the system levels out at the top, with the largest cities being of similar size, as in the graphs of *Lusitania* and *Baetica*. In this case we find two cities occupying areas of 80 hectares, *Tarraco* and *Carthago Nova*. Both were *conventus* capitals and provincial capitals, although *Carthago Nova* only became a capital after Diocletian's reorganisations. *Clunia*, another *conventus* capital, followed these two cities. However, the other *conventus* capitals of *Citerior*, namely *Caesaraugusta, Asturica Augusta, Bracara Augusta* and *Lucus Augusti*, are not among the largest in the province, although they are relatively large within their own regions. Their role as assize centres may have created more opportunities for these cities. This observation applies especially to the north-western *conventus* capitals. These cities were created by Augustus to provide a rather unurbanised region with administrative centres. Naturally, these cities were granted large territories from which to draw.

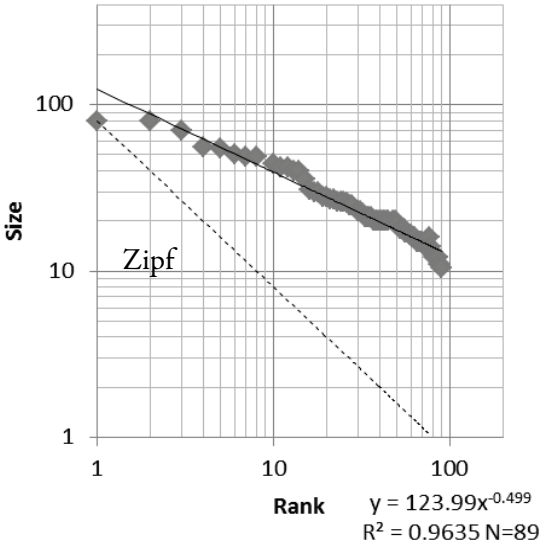

Fig. VI.9 RSA Citerior (n=89)

In general, the distribution of the graph can be described as concave, with all the dots representing the large and medium-sized cities above the Zipf line and a drop being visible at the end of the graph. As has already been stated, we find the largest cities on the Mediterranean coast. In contrast to this, the second category (40-80

hectares) is found inland. However, if we want to achieve a better understanding of the settlement system of *Citerior* we need to go beyond these basic observations and look at individual regions.

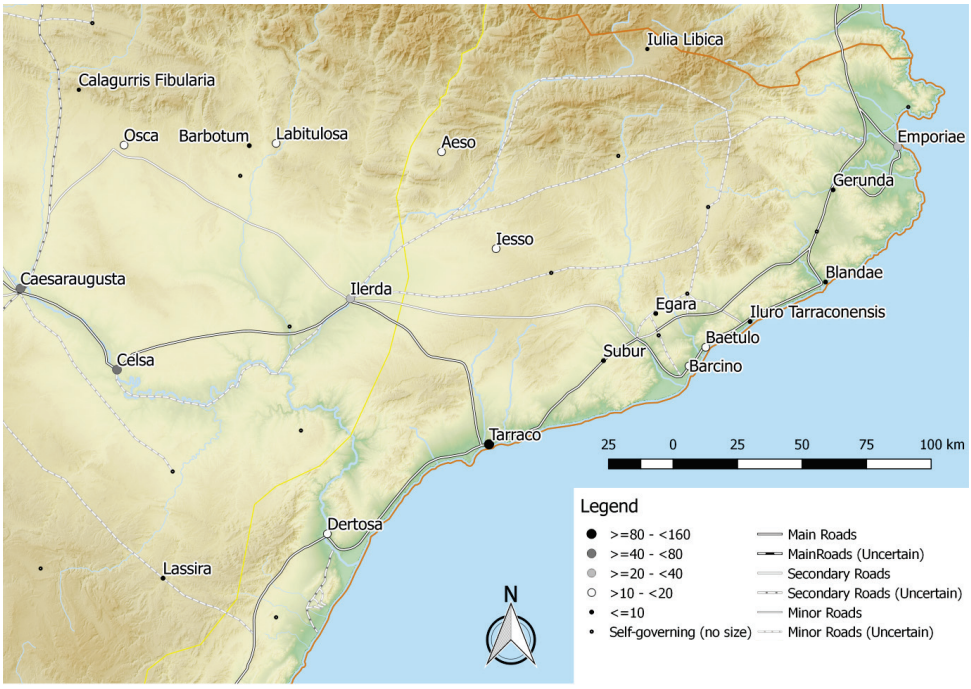

Fig. VI.10 The urban system at the modern-day Catalan coast

In the area corresponding largely to modern Catalonia we find the major urban centre of *Tarraco*, with its 80 hectares. The function of *Tarraco* as the provincial capital can be seen as the result of its history as the base of operations during the republican period, and its role as a maritime port.[64] To the north we find a medium-sized city, *Emporiae* (31 hectares), with a similar history, and inland we find *Ilerda* (23 hectares). Both these cities played important roles during the early conquest and consolidation of the area. The two former Republican bases of operations, *Tarraco* and *Emporiae*, were separated by a distance of almost 200 kilometres. Between these Republican cities we find the Augustan *colonia Barcino* mentioned by Mela as *parvum oppidum*. One of the aims of this colonial foundation must have been to strengthen control over the *Via Augusta*.[65] In addition, located along the coast we find the other *parva oppida* of *Blandae*, *Iluro* and *Baetulo*.[66] These small cities must have been maritime ports from which surpluses produced in the coastal zone or the inland region could be shipped to *Tarraco* and further afield. The city of *Ilerda*, which exceeded

[64] Panzram (2002) *Stadtbild und Elite: Tarraco, Corduba und Augusta Emerita zwischen Republik und Spätantike*:123.
[65] Guitart i Douran (2010): 26.
[66] Mela II 90.

most coastal cities in size, is located at an important road axis leading inland to *Caesaraugusta* and *Pompelo*. The inland city of *Celsa* was most probably abandoned in the second half of the first century.[67] In addition, we find such cities as *Iesso* (18 hectares) and *Aeso* (18 hectares) located further apart controlling these inland regions. In between these medium-sized inland centres and the coastal settlements we find several cities, most of which were founded by the Romans with the aim of controlling and exploiting the inland districts.[68] The concentration of cities between *Emporiae* and *Tarraco* along the different routes of the *Via Augusta* is clearly related to the fertile lands of this region, which produced large amounts of wine and olives.

The north-western part of the Peninsula comprised the *conventus Bracarum* and the *conventus Lucensis* (see fig. VI.11). The *conventus* capitals *Bracara Augusta* and *Lucus Augusti* were the largest cities in this region. In the 20 to 40-hectare bracket we find *Iria Flavia* and *Castellum Tyde,* the size of which can be related to their position along the coast and the coastal road. The 10 to 20-hectare bracket contains two maritime settlements, *Cale* and *Aquae Flaviae*. The latter must have been an important roadside settlement, between *Bracara Augusta* and *Asturica Augusta*.[69] *Cale* is again a port city. In general, the other settlements are small, occupying less than 5 hectares. As has been explained in an earlier chapter, the population of the *civitates* and *municipia* in the north-western region was dispersed over multiple smaller settlements. The urban settlement pattern is therefore rather limited, but well spread over the area.

When looking at the territories as drawn by Rodríguez Colmenero, we observe that the territories are of roughly similar size.[70] However, they are based on the tribes mentioned in the literary sources, such as Pliny and Ptolemy, and must reflect the situation just before the conquest. It is most likely that the two *conventus* capitals, created by Augustus, obtained larger territories. Moreover, Rodríguez Colmenero's map also shows *civitates* that might have been *civitates contributae*, the territories of contributed *civitates* would have belonged to other *civitates*. Nonetheless, the large territory of the small city of *Brigantium*, only 7 hectares, stands out. Gonzalez postulates that *Brigantium* was an important centre for trade, controlling the route from *Gades* to the British Isles and the interior of this region.[71] That this small city continued as an important maritime port is shown by the presence of the Roman pharos, the Torre de Hercules.

[67] Beltrán Lloris and Martín Bueno (1982) 'Bilbilis y Celsa, dos ejemplos de ciudades romanas en el Aragon Antiguo.' *Caesaraugusta* Vol. 55-56, 143-63: 146.
[68] Guitart i Duran (2010): 10.
[69] As ten *civitates* constructed with the *Legio VII Gemina* a bridge at the crossing of the Tamega, see CIL II 2477.
[70] Rodríguez Colmenero (1999) *Aquae Flaviae I fontes epigráficas da Gallaecia meridional interior*: 15.
[71] González Ruibal (2006): 517; López Pérez (2010) 'Reflexiones sobre la época Flavia en Brigantium a partir de los datos proporcionados por la Terra Sigillata.' *CuPAUAM* Vol. 36, 95-106: 97.

Fig. VI.11 The urban system of the conventus Bracarum and Lucensis

In addition to the urban centres, we also find two garrison settlements, which belong to the *Cohors I Celtiberorum* and the cohors located at *Aquae Querquernae*, both located in areas between the urban centres. As Rodríguez Colmenero's map represents the Late Republican situation, it does not show the territories of the military cohorts. As has already been stated, we find a complementary relationship between the cohort positioned at *Aquae Querquernae* where the *mansio* was located, and Castro de Rubiás, where the inscriptions mentioning the *civitas* are found.[72]

The north-western part of the Iberian Peninsula was rich in minerals, especially gold, which was controlled by the military. Moreover, the region was only incorporated and pacified during the reign of Augustus. Another difference between this region and the eastern districts of *Citerior* is the relatively small size of the *civitas* capitals in the north-west. As has already been discussed, here we find the dispersed *civitas*, characterised by a dispersal of administrative, economic, social and religious functions among multiple settlements, none of which appeared 'urban' in terms of size or levels of monumentalisation.

6.4 Geographical distribution of large and small cities

The geographical distribution of the cities belonging to various size brackets gives new insight into region-specific patterns of urbanisation of the Iberian Peninsula and the nature of the urban network. The importance of geography as a key to understanding economic patterns was proposed by Krugman in 1991 and led to the New Economic Geography.[73] Here we find two competing ideas. One of these is based on Central Place Theory that starts from the premise that the most important role of cities is to provide various services: economic, religious or administrative.[74] The place with the highest number of services is the central place of the highest order. Its service area is the largest as it provides, among others, services that are rarely needed. Each lower order centre provides fewer services, with the lowest order settlement providing services that are needed on a regular basis. If Central Place Theory were valid for Roman Hispania, we would expect to find the largest cities evenly distributed over the landscape, with medium-sized and small cities filling the gaps between the large centres. Of course, this theory is based on the idea of an empty landscape with all resources evenly distributed. Since in reality resources are not evenly distributed over the landscape, the cities are consequently unevenly distributed. Nonetheless, we would still expect the largest cities to be distributed more or less evenly and the lower order cities to be separated by smaller distances.

[72] Supra section 3.5.1 and 4.4.1.
[73] Krugman (1991) *Geography and Trade*.
[74] Christaller (1933); King (1984) *Central Place Theory*: 37; Kunow (1988) 'Zentrale Orte in der Germania Inferior.' *Archäologisches Korrespondenzblatt* Vol. 18, 55-67: 55.

Similarly, Bekker-Nielsen has argued that the dispersion of larger cities is based on their functions. In his view, the largest self-governing cities of various Roman provinces, such as those of Gaul, have too large a territory to function as the main market centre for their region. He also argues that a peasant needs a market to sell his surplus produce. Half a day's walk (15 km) would be no problem and economically profitable.[75] However, the locations of the Roman administrative system were not always separated by distances of less than 30 kilometres.[76] If the rural population of such areas needed a market, this would be provided by smaller settlements taking up the market function or by periodic fairs and markets.[77]

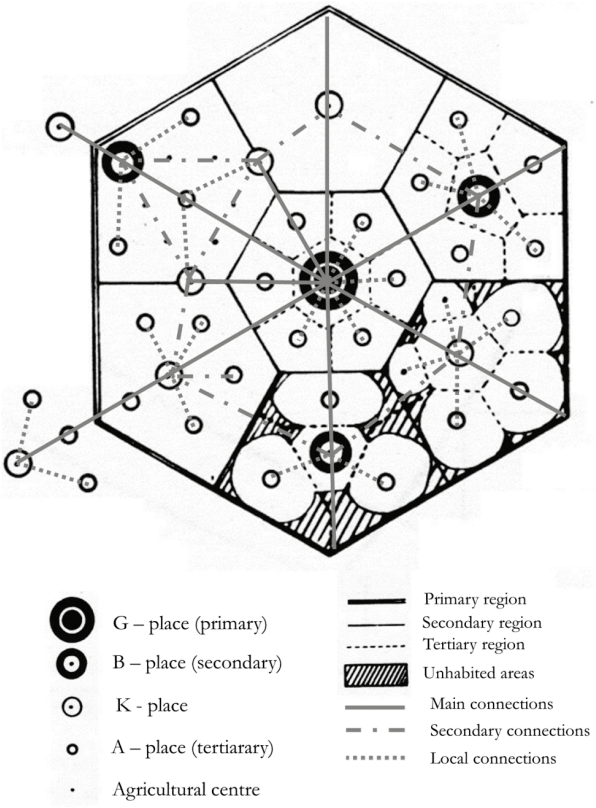

Fig. VI.12 CPT based on the administrative and traffic principle (after King (1984) Figs. 3.4 & 3.5 and Kunow (1988)

Challenging some of the assumptions of Central Place Theory, Krugman has argued that the larger cities would not be evenly distributed, but would be randomly dispersed, centring on the most advantageous locations, along rivers or coastal areas, controlling fertile lands and on important trade routes.[78] He postulates that, due to their advantageous position, these cities would be able to develop into demographic and economically more important centres. This concentration is followed by what he calls the concept of *cumulative causation*: a concentration of trade opportunities will attract more trade,

[75] Bekker-Nielsen (1989): 57; Bintliff (2002): 217.
[76] Bekker-Nielsen (1989): 55.
[77] *Ibid.* 62; Ligt (1993): 108.
[78] Krugman (2009) 'The Increasing Returns Revolution in Trade and Geography.' *The American Economic Review* Vol. 99, Nº 3, 561-71: 567; Kunow (1988): 57.

thereby further increasing trade opportunities.[79] Kunow has posited a similar development, emphasising the effect of the road system on the settlement system. He states that large centres are well served by the road system as this system allows them to supply goods and services to the smaller centres. However, as the road system develops, new opportune locations arise where different roads meet, leading to the development of small centres at these intersections.[80] In this model we expect to encounter large cities in geographically and economically advantageous locations. Following the idea of cumulative causation, these large cities would draw in more settlements to make optimum use of the geographically advantageous areas.

In order to test these hypotheses, different approaches will be used to uncover relationships between geographical distribution and size. As a first step, we will simply look at the distribution of the cities on the map per size category. A nearest neighbour analysis will be carried out for each size category in order to define distance categories.

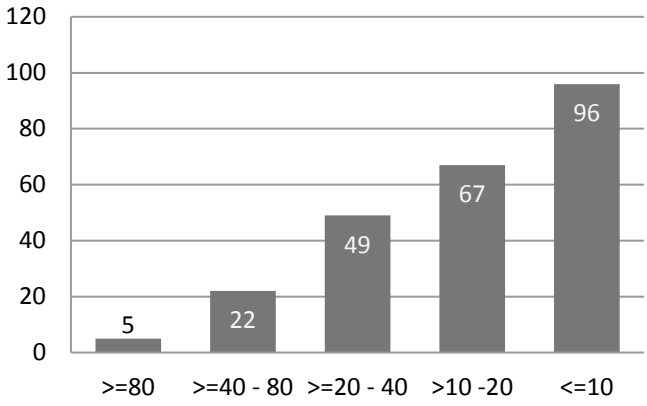

Fig. VI.13: Bar-chart of size categories

In order to illuminate the importance of the lower size categories, my map shows all self-governing communities whose size can be estimated with a reasonable degree of confidence. For analytical purposes the sizes will be grouped into five categories:

1. 80 hectares and higher;
2. 40 ha (incl.) to 80 ha (excluding 80);
3. 20 ha. (incl.) to 40 ha (excl.);
4. 10 ha (excl.) to 20 ha (excl.);
5. 10 ha. (incl.) and lower.[81]

[79] Krugman (1998) *Development, Geography, and Economic Theory*: 47; Krugman (2009): 569.
[80] Kunow (1988): 57.
[81] The reason for including ten hectares in the fifth category is in order to avoid including settlements smaller than 10 hectares in the fourth, as these have been rounded to the nearest ten (in total we find 14 sizes of 10 hectares). This will be of importance in the later rank-size analysis, which is distorted if we include too many sites in the lower categories.

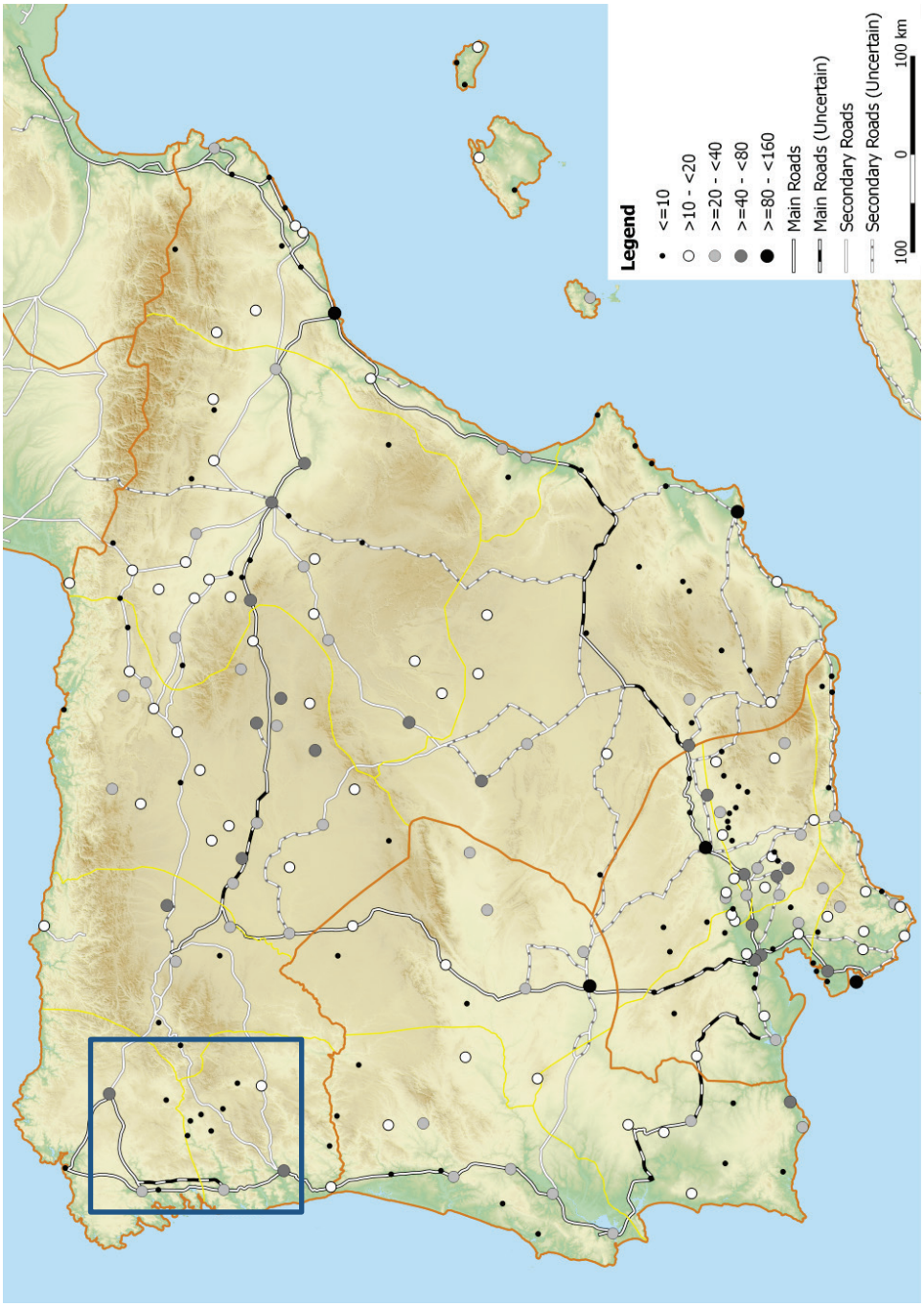

Fig. VI.14: Geographical distribution of all estimated sizes

In general, cities belonging to these five size brackets are rather equally distributed over the Iberian Peninsula. However, there is a clear concentration in the Guadalquivir valley (see fig VI. 14). In addition, some regions have a rather dense pattern, for instance the northern part of the *conventus Bracarum*. This concentration of settlements with estimated sizes is mostly a result of the effort that has been made in this study to understand the dispersed *civitas* (see fig. VI.14 box). Such discrepancies resulting from research biases are unavoidable. Nonetheless, the extremely dense settlement pattern in *Baetica* is a historical reality rather than a research focus.

With these general observations in the back of our minds, we can look at the different size categories one by one. The first map shows all places with a size of 80 and over (see fig. VI.15). This category comprises only five cities: *Corduba* (90 hectares); *Carthago Nova* (80 hectares); *Augusta Emerita* (80 hectares)[82]; *Gades* (80 hectares) and *Tarraco* (80 hectares). The estimated sizes of these cities are all multiples of ten, thereby highlighting the fact that we are dealing with rough approximations. Nonetheless, the estimations are based on lengthy research and we can be certain they are the minimal extent of these cities.

Among these five cities we encounter the three provincial capital cities, *Augusta Emerita*, *Corduba* and *Tarraco*.[83] As we have already seen, these cities had multiple *fora*. The need for more than one *forum* must be related to a higher concentration of functions. The epigraphic evidence for provincial *flamen* in the *concilium provinciarum provinciae* of *Tarraco* indicates a higher concentration of religious activity in *Tarraco*.[84] However, it must be said that the majority of these inscriptions have been found in the lower city.[85] It is possible that a higher level of religious activity was also found in the other capitals. What is equally important is that these provincial capitals had large territories bestowed upon them by the Roman state. These cities thus had large amounts of cultivable land that could support large numbers of inhabitants. Nonetheless, this cannot be the whole explanation, as *Gades* and *Carthago Nova* also belong to the top five of large cities.

Looking at these five cities from another angle, we observe three coastal cities, which are large ports: *Tarraco*, *Carthago Nova* and *Gades*. Ports obviously attracted economic activity and people. However, other port cities are a lot smaller. Hence their function as port settlements is not the sole explanation for their size.

[82] Although we encounter sizes as great as 120 hectares, as given in the work by Taracena based on its importance: "[...] Emerita Augusta, cuyo caserío solo fue después cuando llegó a medir 120 hectáreas, como la más importante de Lusitania, [...]". Unfortunately, this estimate by Taracena has been repeated, whereas the actual size of the walled city is only 71 hectares and another ten hectares are expected to be found outside the walls. Hourcade (2004): 227; García y Bellido (2009 [1966]): 247.

[83] *Carthago Nova* did not become a provincial capital until Diocletian's reforms.

[84] Ruiz de Arbulo (2007) 'Das "Provinzialforum" von Tarraco.' In: Panzram (ed.), *Städte im Wandel: Bauliche Inszenierung und literarische Stilisierung lokaler Eliten auf der Iberischen Halbinsel*, 149-212: 179-80.

[85] Haensch (1997) *Capita provinciarum: Statthaltersitze und Provinzialverwaltung in der römischen Kaiserzeit*: 165.

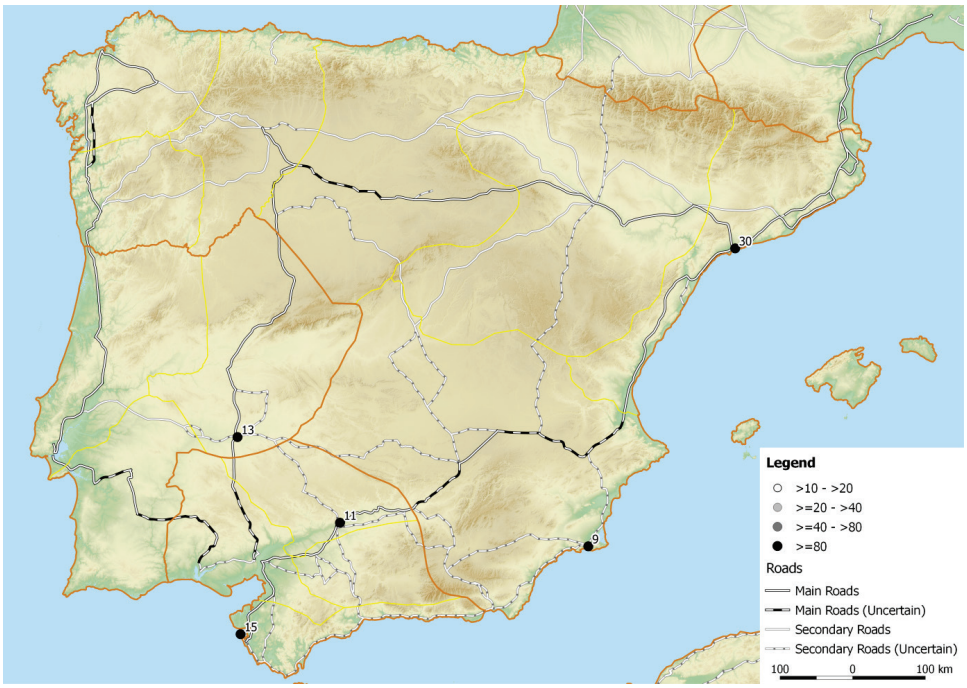

Fig. VI.15 Distribution of places with a size of 80 ha or higher

Part of the reason why *Augusta Emerita*, *Carthago Nova*, *Corduba*, *Gades* and *Tarraco* were larger than other cities has to do with their pre-Roman or early Roman history. As was explained in an earlier chapter, *Gades* played an important role in trade between the Atlantic and the Mediterranean due to its position at the strait of Gibraltar. As Strabo observes:

> There is more to be said about it than the others. For example, [In Gades] live the men who fit out the most and largest merchant-vessels, both for Our Sea and the outer sea.[86]

According to Strabo, *Gades* was the Empire's largest city after Rome. The size of the territory of *Gades* is unknown; located on two islands its immediate surroundings do not allow for a large territory. Nonetheless, the coastal area opposite to the islands does not have large settlements, possibly because it was the territory of *Gades*. This is supported by the location of *Portus Gaditanus* on this coast.[87]

[86] Str. III 5.3. (Loeb translation)
Πλείους δ' εἰσὶ λόγοι περὶ αὐτῆς. οὗτοι γάρ εἰσιν οἱ ἄνδρες οἱ τὰ πλεῖστα καὶ μέγιστα ναυκλήρια στέλλοντες εἴς τε τὴν καθ' ἡμᾶς θάλατταν καὶ τὴν ἐκτός.
[87] Str. III 5.3; Mela III.4. Present-day Puerta Real.

Carthago Nova founded by Hasdrubal between 229 and 228 BCE, was the Barcid centre of power.[88] Its location on the Mediterranean coast and a lagoon gave it a large and well-protected port. As such, it remained an important port city from the moment it was conquered by Scipio in 206 BCE. Moreover, the territory of *Carthago Nova* contained several mines, providing it with a steady income.[89]

Corduba was an old Turdetanian city whose origin can be traced back all the way to the Copper age.[90] It grew into an important centre on the banks of the Guadalquivir during this period. Its territory contained rich farmlands as well as rich metal deposits in the mountains, putting the city in a strong position. This centre remained important in Punic and Roman times and became the provincial capital of *Baetica*.

In the case of *Tarraco,* direct Roman influence played an important role. The city started as a *castra hiberna* near an *oppidum*, probably *Kesse*, and developed into the main centre for the Roman conquest of the Iberian Peninsula. Its promotion to provincial capital followed naturally from there. In addition, the city acquired a large and fertile territory, making it possible to support a large population and yielding a steady surplus of produce that could be traded.[91]

Augusta Emerita was an entirely new foundation that appeared on the map in 25 BCE. Although this city was a newcomer, it still managed to become the largest city of *Lusitania*. It cannot be a coincidence that *Augusta Emerita* was a provincial capital, just like two other members of the highest size bracket.

Tarraco	Carthago Nova	435.8	Median	202.3
Carthago Nova	Corduba	335.7	Average	265.84
Corduba	Emerita	177.7	Largest	435.8
Emerita	Corduba	177.7	Smallest	177.7
Gades	Corduba	202.3		

Table VI.1: Intercity distance largest cities

The intercity distances for the five largest cities of the Hispaniae range from 435.8 km (*Tarraco-Carthago Nova*) to 177.7 (*Corduba-Augusta Emerita*); it is clear that their distribution is rather uneven. If we add those cities belonging to the 40 to 80-hectare bracket, which is a total of 22 places, the surprising absence of more port cities

[88] Polyb. II.13; Str. III 4.6; Mela II.94; Rodríguez Gutiérrez (2011): 49; Noguera Celdrán (2012): 124. Most scholars base the size of *Carthago Nova* on the peninsula giving an estimation of 52 hectares. The map by Ramallo Asensio shows that the *necropoleis* are located further inland, allowing for extra mural quarters, leading to an estimation of 80 hectares Ramallo Asensio *et al.* (2010) 'Carthago Nova y su espacio suburbano: Dinámicas de ocpación en la periferia de la urbs.' In: Vaquerizo (ed.), *Las áreas suburbanas en la ciudad histórica: topografia, usos, función*, 211-54.

[89] Plin. *NH* II 96-98; Domergue (1990): 166.

[90] Jiménez and Carrillo (2011): 56.

[91] Prevosti (2010) 'La ciutat de Tarraco, entre nucli urbà i territori / The city of Tarraco, between an urban centre and a territory.' In: Prevosti and Guitart i Duran (eds.), *Ager Tarraconensis 1: Aspectes històrics i marc natural / Historical aspects and natural setting*, 25-112: 27, 56 & 63. See infra for a detailed treaty on the relation between the territory and the size of the city.

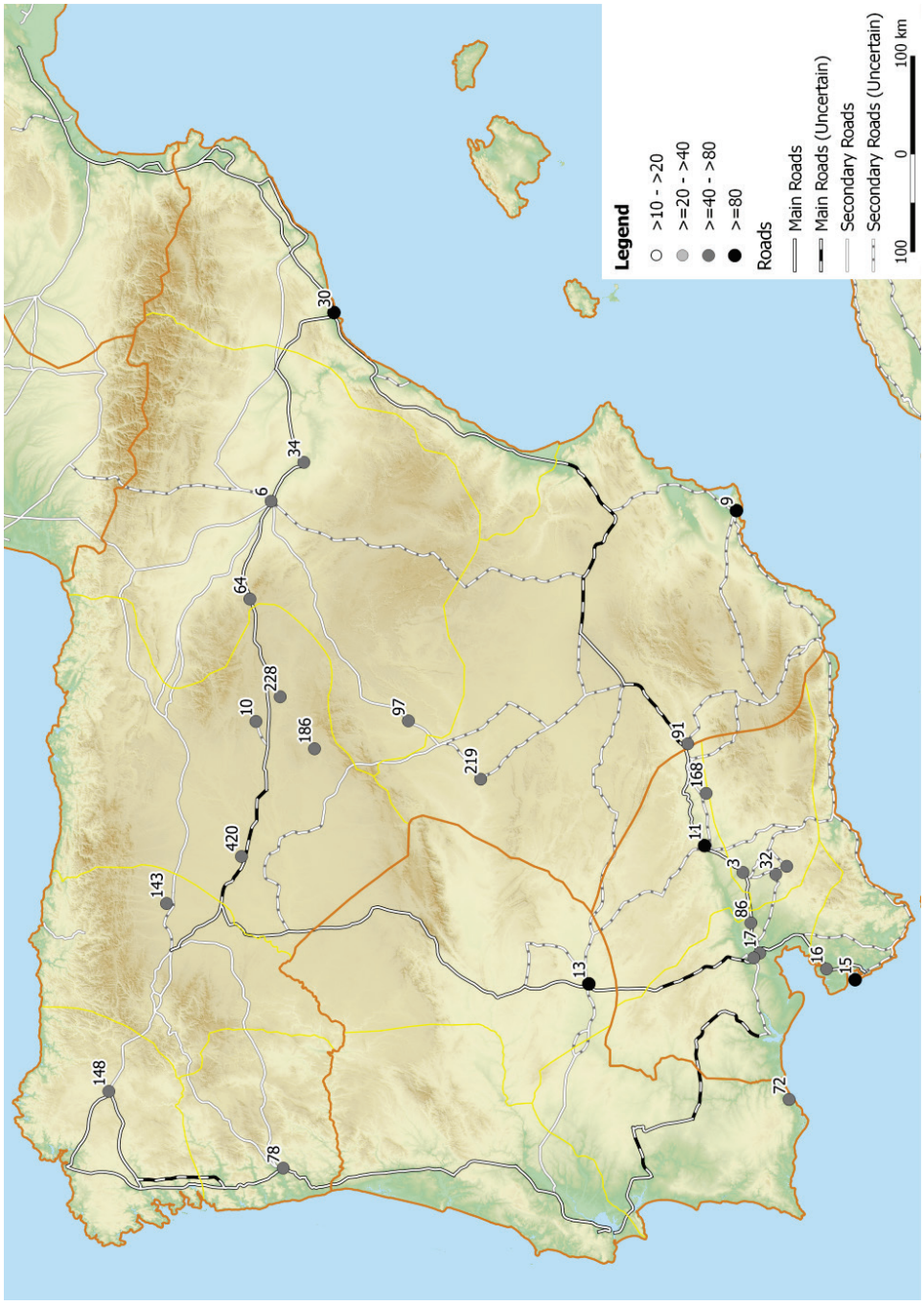

Fig. VI.16 Distribution of places with a size 40 hectares or higher, the ID numbers can be found in appendix II. In text the cities mentioned have their ID in brackets behind the names.

becomes apparent. This shows that the presence of a port was an insufficient precondition for the emergence of a larger urban centre.

Along the southern Atlantic coast, only the city of *Balsa* (72: 47 hectares) appears as a large city.[92] This city must have been of importance for the coastal trade as it, too, was monumentalised.[93] Fraga da Silva argues that evidence for its special position can be found on its republican coinage. Whilst cities in its vicinity have dolphins or tuna fish on the reverse of coins, we see the prow of a warship on the coins of *Balsa*. This seems to support the idea that *Balsa* was an important harbour for Pompeius' war against the pirates.[94] Bernardes has advanced a similar explanation for *Ossonoba*, a smaller port city in the vicinity. He argues that the growth of *Ossonoba* in the early first century could be explained by the role it played as an Atlantic harbour during the conquest of *Britannia*, where ships had to pass in order to go north.[95] *Balsa* may at a later stage have become a stopping place for ships sailing along the Atlantic coast to the north-western provinces of the Empire.

Inclusion of 40 to 80-hectare bracket also gives the first cities in the Central Meseta and the northwest. The high density of large settlements in the Upper Duero valley on the Central Meseta are, as already stated, most probably the result of the large pre-Roman *oppida* attested in this region. The custom of living in fortified hilltop settlements has led to large fortified settlements with a much smaller built-up area. In the case of *Clunia* (#10), probably only 70 hectares of the 130 hectares enclosed by the city wall were built up.[96] Some of the pre-Roman *oppida* of this region were abandoned, but interestingly those along the roads seem to have continued. In the Guadalquivir valley we find a similar pattern of larger cities following the major road, including two *conventus* capitals: *Hispalis* and *Astigi*.

In the north-western region, the two *conventus* capitals of *Bracara Augusta* (#78: 42 hectares) and *Lucus Augusti* (#148: 42 hectares) belonged to the 40 to 80-hectare bracket. These cities were founded by Augustus to function as centres for an underurbanised region.[97] The new cities founded by the Romans are oversized in comparison to the other settlements of this region. Surprisingly, the largest city of the *conventus Asturum* was *Lancia* (#143: 44 hectares) rather than the *conventus* capital of *Asturica Augusta* (#63: 27 hectares). Again, this can be explained by the pre-Roman

[92] Although I use a more reserved estimation given by Fraga da Silva, the publication alludes to a massive size of over 100 hectares, this seems to be including the *necropoleis*.
[93] See section IV.3.2.
[94] Fraga da Silva (2007): 52; *ibid*. 23; Fraga da Silva (2010).
[95] Fabião (2009) 'A dimensão Atlântica da Lusitânia: periferia ou charneira no Império Romano?' In: Gorges, d'Encarnação, Nogales Basarrate and Carvalho (eds.), *Lusitânia Romana- entre mito e realidade: Actas da VI Mesa-Redonda Internacional sobre a Lustânia Romana*, 53-74: 64; Bernardes (2012): 13. Fraga da Silva (2010): 62.
[96] Palol (1991): 19; Carreras Monfort (2014): 74.
[97] Rodríguez Gutiérrez (2011): 61; Pereira Menaut (1982).

origin of *Lancia*, which has been taken as the former "capital" of the *Astures*.[98] However, the size of *Lancia* is based on the walled area. The habitation area might well have been substantially smaller, as in the case of *Clunia*. In this area the top three is formed by *Lancia, Asturica Augusta* (#63: 27 hectares) as the second largest and lastly the legionary camp of *Legio VII* (#363: 20 hectares).

If we add those settlements in the 20 to 40-hectare bracket to our map, we still have just about half of all settlements; adding 49 sizes brings the total number of sizes to 76 (see fig. VI. 17). Cities belonging to this bracket are more evenly distributed over the peninsula, although we still observe a relation between the main roads and these cities. A road was present connecting *Norba Caesarina* (#25) with *Toletum* (#219) via *Caesarobriga* (#80) and *Augustobriga Vettones* (#65), although this is not shown on the map due to its very uncertain route. The connection between roads and cities seems logical; however, we are only considering the main routes here.[99] If we expand the scope of our inquiries, we see that smaller centres are found along secondary roads.

A quarter of all cities above 20 hectares were situated in *Baetica*. In *Lusitania* cities only seem to appear when looking at the third tier, its settlements are in general smaller. Treating this category as the one showing the most important cities of *Lusitania,* a relatively large proportion of cities belonged to this size category, reflecting the relatively small size of settlements in this province. The *conventus* capital of *Pax Iulia* (#29) occupied 30 hectares and *Scallabis* (#27) 24 hectares. In addition, we find *Metellinum* (#23: 20-25 ha), *Norba Caesarina* (#25: 24 ha) and *Olisipo* (#174: 26 ha).[100] These cities were of military importance in the republican period.[101] This might explain not only their origin as Roman settlements of considerable importance, but also their promotion to *colonia*, and in the case of *Olisipo* to *municipium c.R.*[102]

In the 20 to 40-hectare category we find one subordinate settlement: *Portus Ilicitanus* (#50: 24 hectares). This port city was subordinate to the much smaller *colonia immunis* of *Ilici* (#19: 9.8 hectares).[103] This subordinate settlement has been included in this analysis because of its large size. As we have already seen *Portus Ilicitanus*,

[98] Edmondson (2014): 19; Santos Yanguas (2004) 'Lancia de los astures: ubicación y significado histórico.' *Hispania antiqua* Vol. 28, 71-86.
[99] Krugman (1998): 47; Krugman (2009): 569.
[100] Although Carreras (1996 & 2014) gives 48 hectares, the 26 hectares given by Fraga da Silva (2007) matches the description of the distribution of archaeological remains by Mantas (1990).
[101] Brunt (1971): 250.
[102] *Olisipo* was fortified and made into the base of operations in 138 BCE by Decimus Iunius Brutus Callaecus. The role the city played in the early history might be the reason for its promotion, it is noteworthy that it is the only *municipium c.R.* in the province of *Lusitania*. Similarly, we find *Metellinum* and *Norba Caesarina* named after the commanders and founders, they were founded respectively in 79 and 37 BCE to protect the route to *Baetica*.
[103] Plin. *NH* III 19; Mela III 6; Ptol. *Geog*. II 6.14. *Ilici* is measured to be only 9.8 hectares whereas 24 hectares is given for *Portus Ilicitanus* at Santa Pola. Aranegui Gascó (2011); Carreras Monfort (2014).

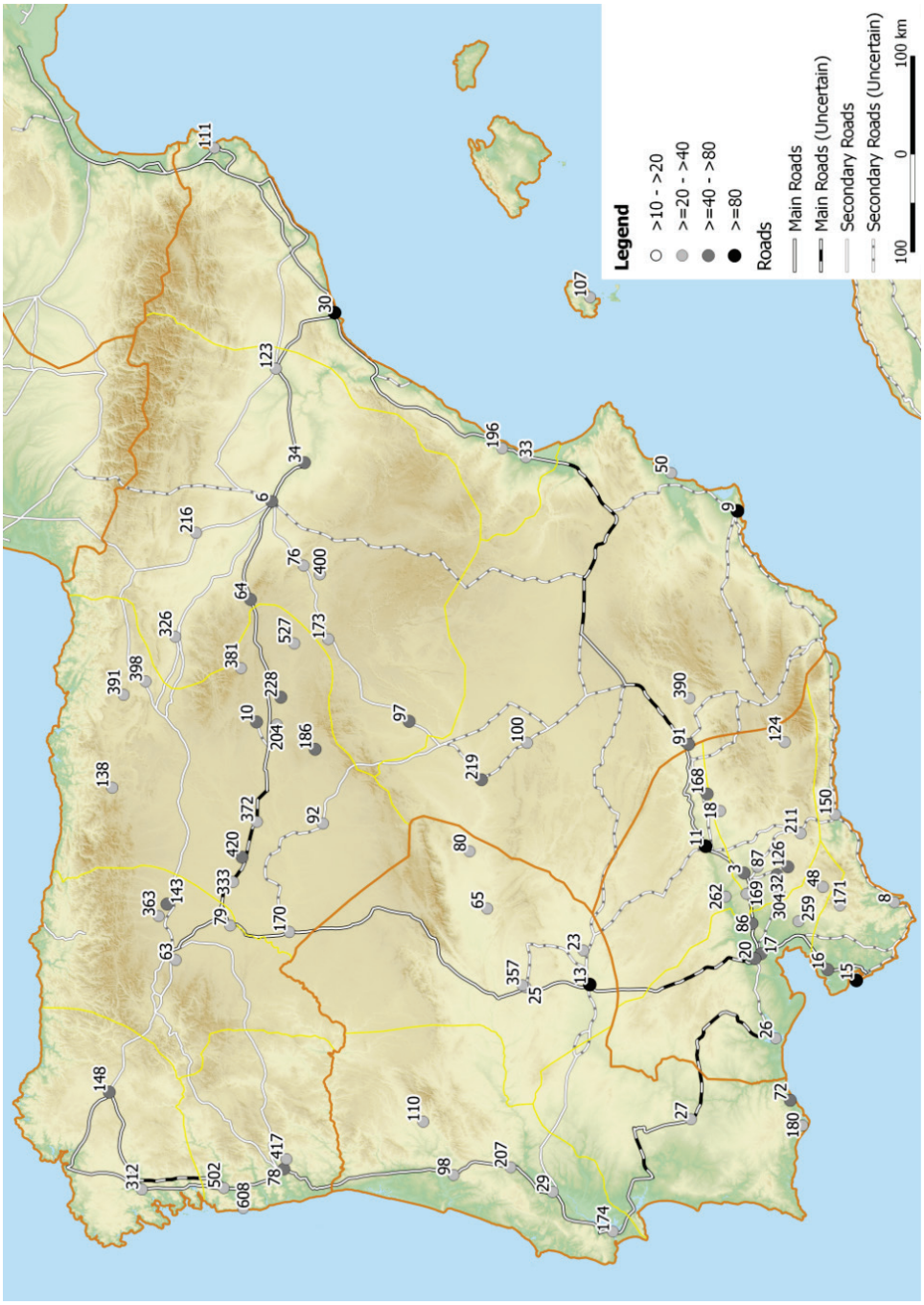

Fig. VI.17: Distribution of places 20 hectares or larger

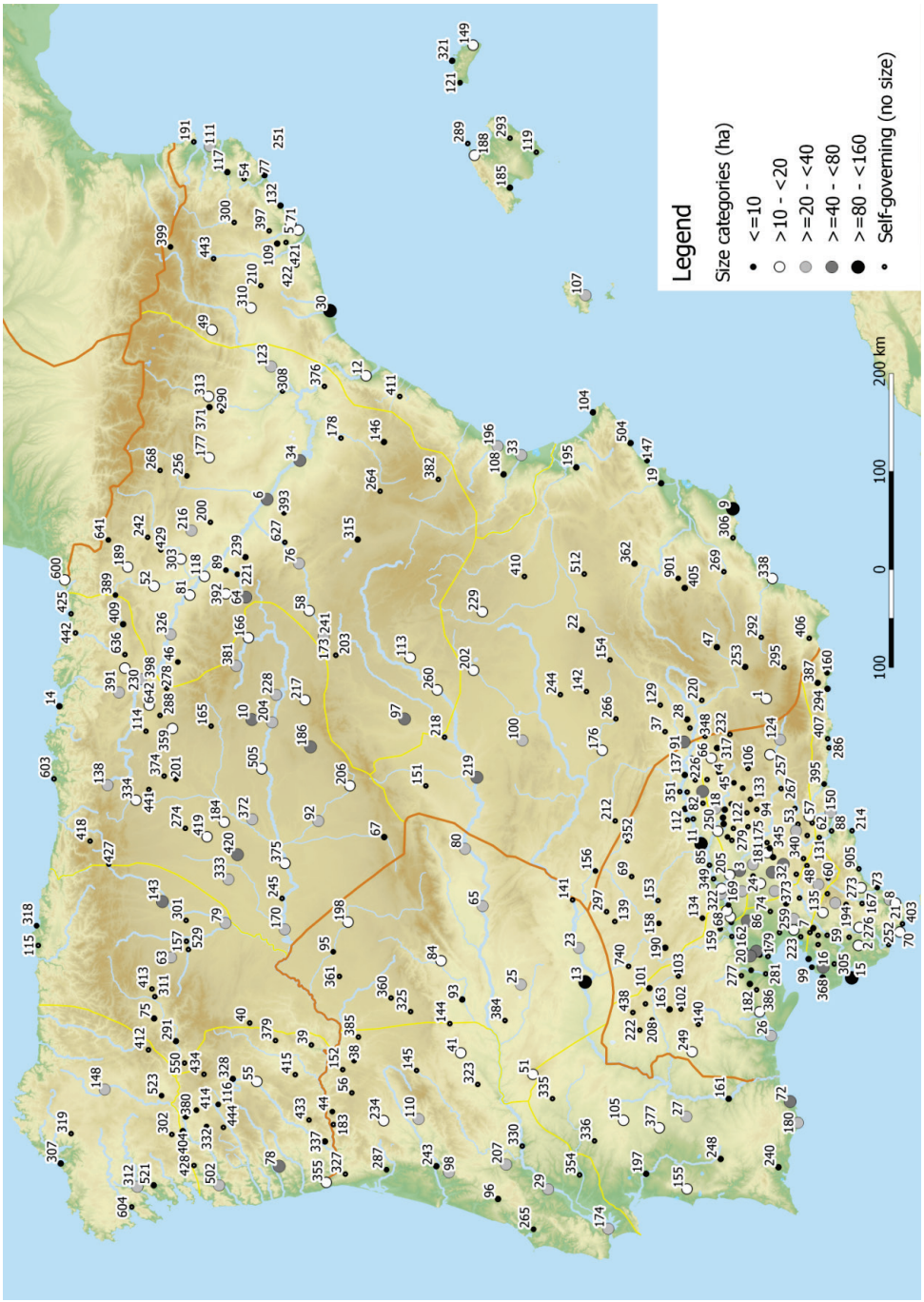

Fig. VI.18: Distribution of self-governing places with a size

although not being the centre of a *civitas*, played a role in Mediterranean trade. This may help to explain why *Ilici* was promoted to *colonia immunis* and received permission to mint coins in the Early Empire. In addition to *Portus Ilicitanus,* we find some other ports in this size bracket, such as *Emporiae* (#111), *Saguntum* (#196), *Valentia* (#33), *Malaca* (#150), *Carteia* (#8) and *Ossonoba* (#180).

The majority of self-governing communities had a centre that belonged to the 10 to 20-hectare bracket. Unsurprisingly, such small cities are found everywhere, along the coasts as port cities as well as along main and secondary roads, and also in the less connected inland areas.

6.4.1 Site distribution and size

The geographical distribution of cities belonging to various size brackets can be analysed further by looking at the distances between the different centres. If we plot size against distance to the nearest self-governing town, we can visualise how these two are related.[104] The cities of the Balearic Islands have been omitted from this analysis as nearest neighbour analysis cannot be applied to insular cities. The average distance for all self-governing communities is 22.39 km, with a median of 20.50 km. The largest distance between a city and its nearest neighbour is that between *Olisipo* and *Scallabis,* 59.05 km. The smallest distance is that between *Villona* and *Carula* with only 1.20 km. This is expected for the region of the Guadalquivir, which was densely populated from pre-Roman times. To further analyse the relation between distances to nearest neighbour and size the variables can be displayed in a scatter diagram (fig. VI.19). If larger towns had larger territories, these parameters should be systematically related.

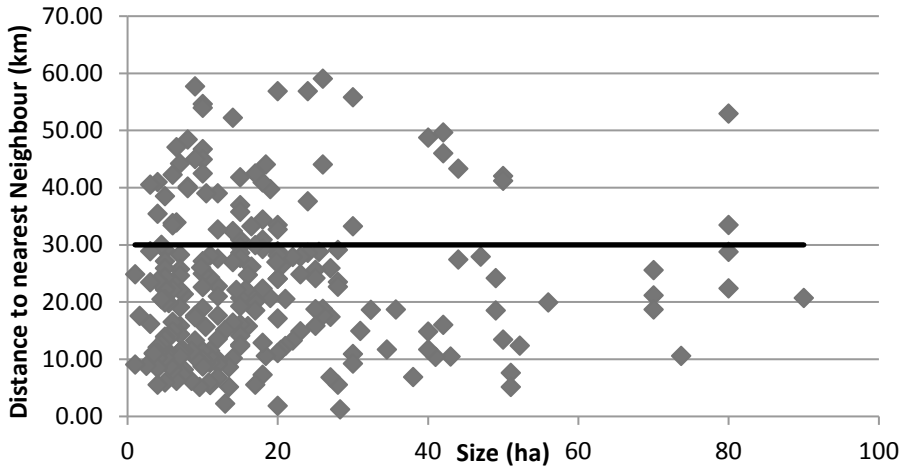

Fig. VI.19 Nearest neighbour vs size (line at 30 kilometres, cf. Bintliff (2002))

[104] Millett (1995) 'Strategies for Roman small towns.' In: Brown (ed.), *Roman Small Towns in Eastern England and Beyond*, 29-38: 31.

When looking at the graph, we observe a clear cluster of smaller settlements below the stated 30 kilometres. In addition, we observe that the larger cities indeed tend to be located further from other places, possibly indicating a larger territory. However, the outliers on the y-axis are still found in all the size brackets, showing that small cities could also have large territories.

The average distance separating the largest cities from their nearest neighbour is significantly more than the average distances for the other size categories, but within the former group large variations can be observed (fig. VI.20). Looking at the distances within this group, we find that *Corduba* has the smallest inter-city distance for the 5 largest cities at 20.70 km, which is logical as it is located within the Guadalquivir valley where we find a rather dense urban pattern. Similarly, we find *Gades* as the second smallest intercity distance in the highest size category ay 22.35 km, even though it is located on an island. The intercity distances are smallest in the whole Guadalquivir valley and estuary. As a result of the high fertility and economic activity of this area, it supported large and concentrated populations.

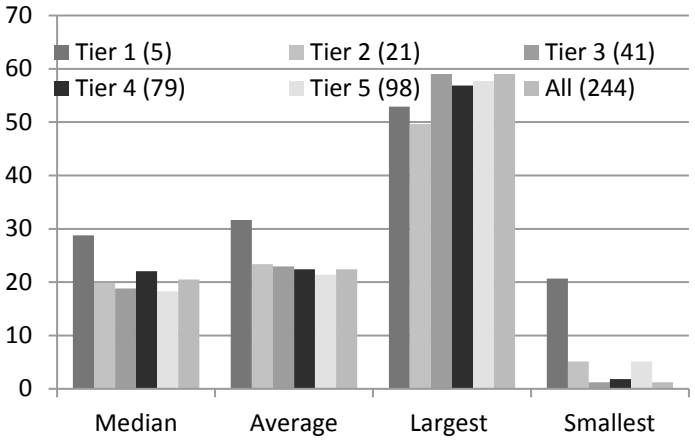

Fig. VI.20 Median, average, largest and smallest per tier for Nearest Neighbour

The smaller settlements with large intercity distances also represent an interesting phenomenon. Calculating the actual intercity distance of the 381 centres that have been located (leaving out the Balearic centres), we observe a mean intercity distance of 21.75 km. However, this mean intercity distance based on Nearest Neighbour is misleading as clusters of centres account for the relatively low mean intercity distance (visible in fig. VI. 21 & 25). The distances between clusters are well over the 30 kilometre range proposed by Bintliff.[105] Therefore, another approach is needed to circumvent the problems with Nearest Neighbour posed by clustering.

Another way of analysing the geographical distribution of cities is to look at relationships between the size of cities and the size of their territories. Unfortunately, the territories of the cities in Roman times are often unknown. Several attempts have been made to reconstruct the territories of single cities and even regions. Some of

[105] Bintliff (2002) 242.

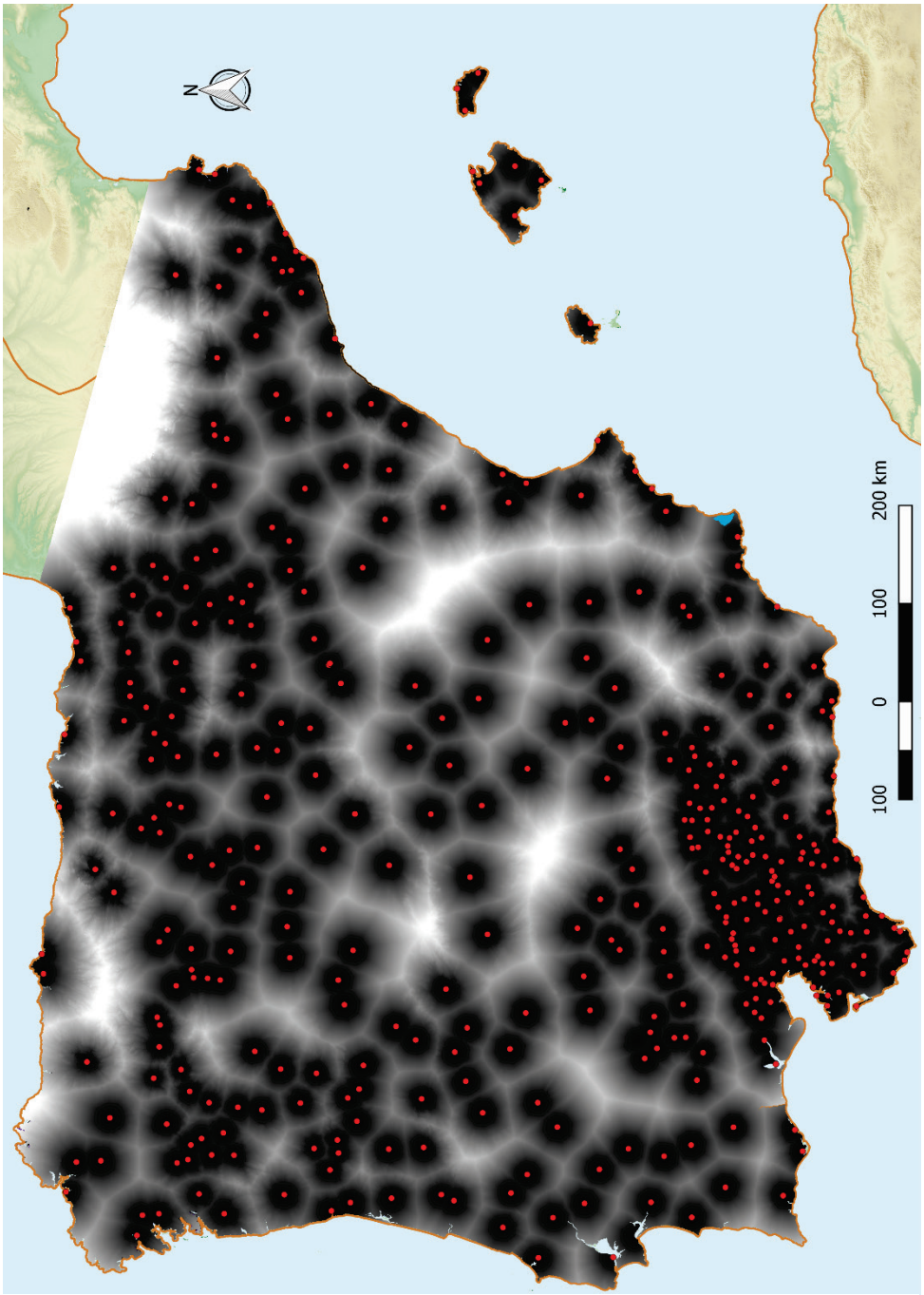

Fig. VI.21 All located self-govering communities with allocated territories based on equidistant least-cost paths based on walking time.

these have already been disputed or corrected by new insights. In the absence of reliable evidence, several options are available. First there are the Thiessen polygons. This simple spatial analysis divides geographical spaces by placing the borders equidistantly between points. A mayor weakness of using unweighted Thiessen polygons is that this method ignores the variations between cities and geography.[106]

As a variation on Thiessen polygons, there are weighted Thiessen polygons, which take account of differences in city size, based on the assumption that larger cities needed larger territories. However, this does not allow for the inclusion of other factors leading to larger territories, such as political or religious functions.

Another problem we encounter when attempting an analysis based on Thiessen polygons is the fact that we have an incomplete dataset. Creating Thiessen polygons for the whole Iberian Peninsula would lead to strangely large territories for some communities, simply because many self-governing communities are missing. Within this study, possible territories have been allocated based on least-cost paths between settlements.[107] Using this approach, we can create a map on which cities are allocated territories based on the equidistance using walking speed on the terrain (fig. VI. 21).

Figure VI.21 shows the distance from the centre in shades of grey; the lighter the colour, the further we are from the centre. We can immediately identify those areas where self-governing settlements were separated by large distances. Not surprisingly, the provincial capitals have larger territories on this map.

6.4.2 Territory of *Cordoba*

When looking at walking distances from *Corduba,* we observe that *Ategua* is located to the south at a distance of only 20.70 kilometres. To the south of *Corduba* is the densely populated Guadalquivir valley. The smallest intercity distances are found in this area. The distances between *Corduba* and its western and eastern neighbours - *Carbula* at 23 and *Onuba* at 25 kilometres - are larger. To the north of *Corduba* we enter the Sierra Morena, a less densely occupied region. In this area the distances separating *Corduba* from its nearest neighbours exceed 70 kilometres. It is clear that *Corduba* controlled a large territory in *Baetica* compared to other cities in the same region.

[106] Ducke and Kroefges (2008) 'From Points to Areas: Constructing Territories from Archaeological Site Patterns Using an Enhanced Xtent Model.' In: Posluschny, Lambers and Herzog (eds.), *Layers of Perception. Proceedings of the 35th International Conference on Computer Applications and Quantitative Methods in Archaeology (CAA)*, 245-51: 247.

[107] For the walking distances I am greatly indebted to P. Kloeg, who was so kind as to write and run these analyses. The walking distances are based on a least-cost path analysis and the DEM for the Iberian Peninsula in Antiquity derived from the AWMC.

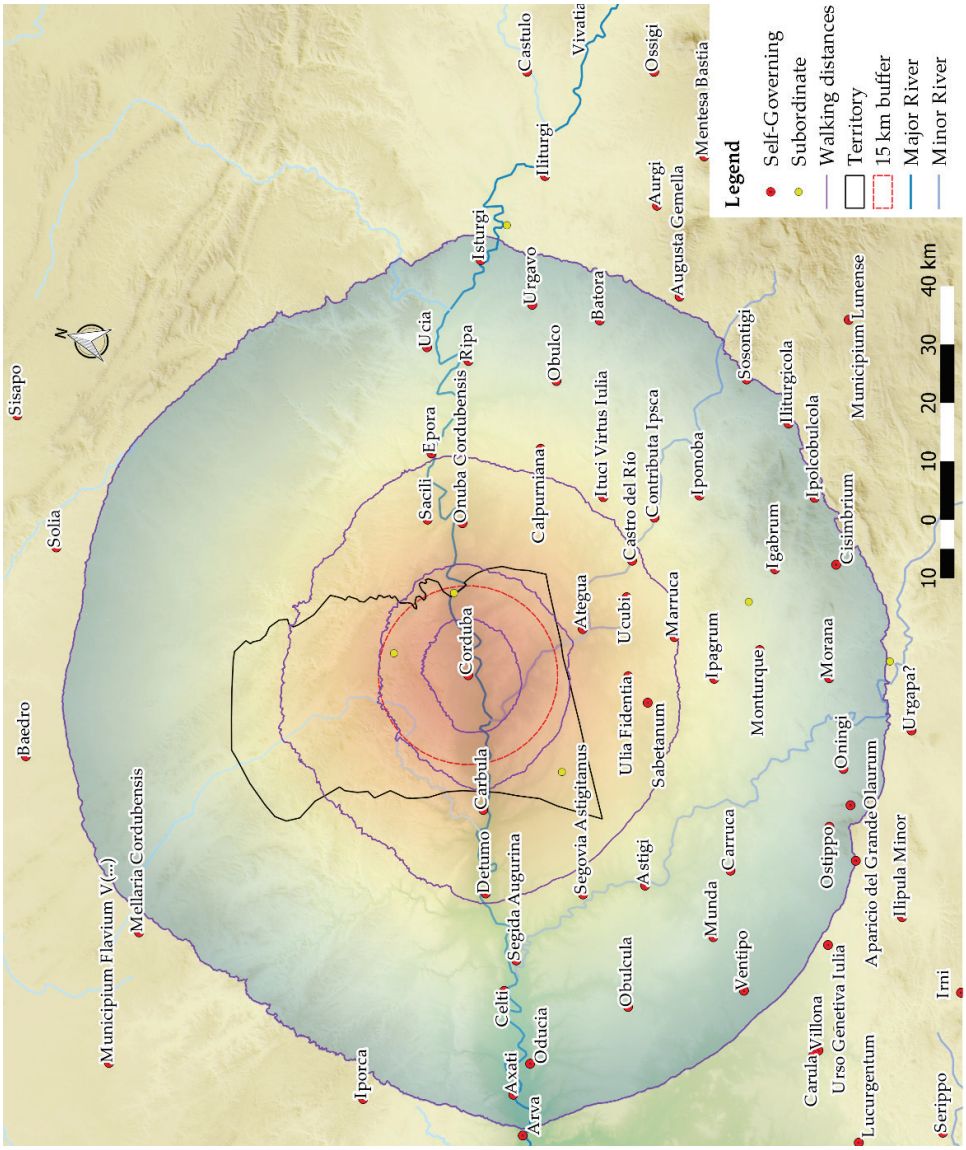

Fig. VI.22: Walking distance from Corduba (contour lines at 2h, 4h, 8h, and 16h).

The reconstructed territory of *Corduba* measures about 2000 km². However, a large proportion of this territory is mountainous and contains little fertile land.[108] When looking at the land in the direct vicinity of *Corduba*, within a 15-kilometre

[108] Melchor Gil (2004) 'El territorio.' In: Dupré i Raventós (ed.), *Córdoba: Colonia Patricia Corduba*, 105-17: 105ss. & lamina VIII.

radius, we observe that it had 80,000 hectares of arable land available for agriculture.[109] Using estimates of the carrying capacity of the land, it can be calculated that this territory could have supported between 90,000 and 280,000 people (Table VI.2).[110]

	Urban	Carrying capacity (3h)	%
Carreras (2014)	ca. 21,000	90,000-280,000	ca. 7.5 - 23
Keay (2011)	19,500-12,500	90,000-280,000	4.5 - 21.7

Table VI.2 Estimated population for Corduba

In calculating the urban population, we are relying on the 2014 article by Carreras and a recent article by Keay and Earl.[111] Although these calculations are largely hypothetical, they clearly show that the urban population of *Corduba* could easily be sustained by the city's territory.

6.4.3 Territory of *Tarraco*

The largest intercity distance in the highest size category is between *Tarraco* and *Subur*, at 52.92 kilometres. *Subur* is one of the *parva oppida* mentioned by Mela. On this basis, its size may be estimated at circa 10 hectares, based on the known size of the *parvum oppidum Barcino*, following Taracena and Carreras.[112] Traditionally, *Subur* is located at Sitges.[113] The next town would be *Dertosa* at 72 kilometres, fitting the distances found to the north of *Corduba*. In the case of *Tarraco,* most of its neighbours were located at more than 16 hours walking distance. Only *Subur*, the location of which is uncertain, and *Dertosa* are located within the radius. These observations suggest that *Tarraco* had an extensive territory.

	Maximum population	Minimum population
Engels (1990)	66,212	21,548
de Angelis (2000)	31,667	23,750

Table VI. 3 Estimated carrying capacity for the arable land within a three-hours walking distance from Tarraco

[109] Plin. *NH* III 2.1.

[110] Willet (2012) 'Whirlwind of numbers - Demographic experiments from Roman Corinth.' *Ancient Society* Vol. 42, 127-58: 128ss. Cf. Engels (1990) *Roman Corinth: An Alternative Model for the Classical City*: 203; Angelis (2000) 'Estimating the Agricultural Base of Greek Sicily.' *Papers of the British School at Rome* Vol. 68, 111-48: 118ss.

[111] Carreras Monfort (2014): 64; Keay and Earl (2011): 304.
Carreras gives 233 inhabitant per hectare as the density for cities. Keay and Earl only give a range for number of inhabitants per hectare, based on Hassan 1981.

[112] Mela II 90; Taracena (2007 [1949]): 427; Carreras Monfort (1996): 104.

[113] Cepas Palanca *et al.* (1997): 148; Tovar (1989): 434, C-567.

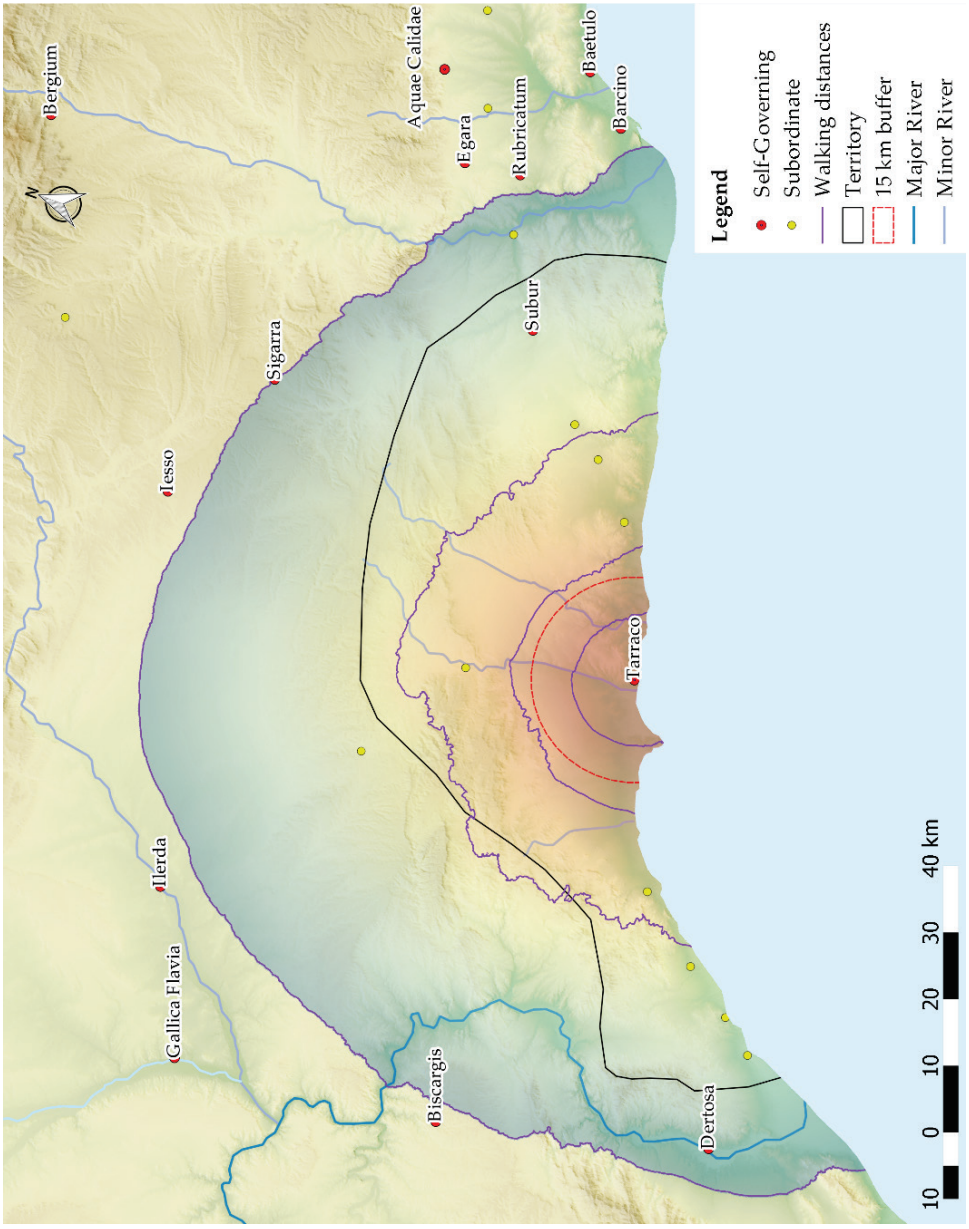

Fig. VI.23: Walking distance from Tarraco (contour lines at 2h, 4h, 8h, and 16h).

The total reconstructed territory of *Tarraco* measures 3,750 km², of which 300 km² was centuriated.[114] Only 190 km² of the centuriated land was located within a three-hour walking radius. When calculating the possible production of the centuriated land in the direct vicinity of *Tarraco,* we can establish that at least circa 23,000 people could be supported (Table VI.3).

Since *Tarraco* must have had approximately the same number of inhabitants as *Corduba* (c. 12,500-21,000) this area was barely large enough to sustain the urban population. However, the centuriated land goes well beyond the three-hour walking distance. If we take this into account, the number of people that could be sustained by the centuriated territory increases to *c.* 35,000 (Table VI.4).

	Urban	Carrying capacity	%
Carreras (2014)	ca. 21,000	34,000 -105,000	20 - 61.8
Keay (2011)	19,500 -12,500	34,000 -105,000	18.6 - 57.4

Table VI.4 Estimated population for Tarraco based on centuriated land

It appears that the centuriated territory of *Tarraco* could support the urban population if the lower estimates are applied. At the same time it is clear that the urban population *Tarraco* had to rely on the entire centuriated territory for its sustenance, and probably needed additional foodstuffs produced in the remainder of its territory, which contained some 700 km² of non-centuriated arable land. By any account, the agricultural land of *Tarraco* must have been sufficient for the population of *Tarraco*. This is demonstrated by the fact some of the land was used to produce wine, some of which was traded beyond the Iberian Peninsula.[115]

6.4.4 Territory of *Augusta Emerita*

The last provincial capital, *Augusta Emerita,* was separated from its nearest neighbour *Metellinum* by a distance of 35 kilometres. However, other cities are located at 60 kilometres. There can be no doubt that *Emerita* had a massive and very complicated territory measuring as much as 8,500 square kilometres.[116] In addition to its continuous territory, *Emerita* also had three *praefecturae* (enclaves in the territory of other *civitates*): the *praefectura Turgaliensis*, the *praefectura Mullicenses* and a third of

[114] Orengo *et al.* (2011) 'Restitución 3D de la Topografía de la Antigua Ciudad de Tarraco en un Entorno SIG: Propuestas Metodológicas y Primeros Resultados.' *Anejos del Archivo Español de Arqueología* Vol. 59, 61-8.

[115] Martín i Oliveras *et al.* (2017) 'The wine economy in Roman Hispania. Archaeological data and modellization.' In: Remesal Rodríguez (ed.), *Economía romana. Nuevas perspectivas / The Roman economy. New perspectives.*, 189-237: 196.

[116] Front. *De Contr.* La. 22, 6-8 = Th. 9, 10-12; *De Contr. Arg.* La. 51, 20-52,4 = Th. 44, 5-15; Hyg. Grom. *De Lim. Const.* La. 171, 1 = Th. 135, 18. Cf. Cortés Bárcena (2013): 64; Ramírez Sábada (1994): 131; Cordero Ruiz (2010): 160.

which the name is unknown.[117] Since the boundaries of these *praefecturae* remain undetermined, it is difficult to establish the extent of the territory of *Emerita*.[118]

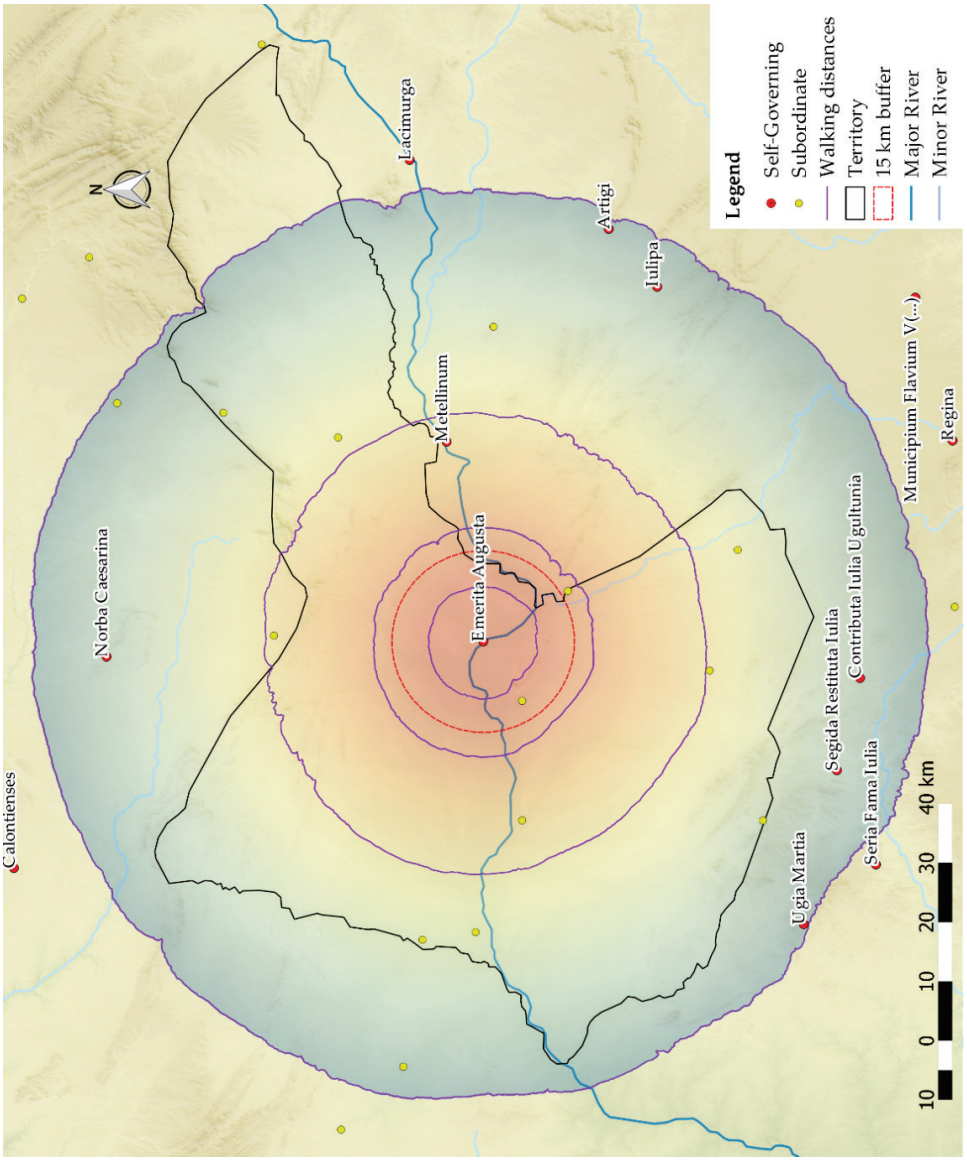

Fig. VI.24: The territorium Emeritense as proposed by Cordero & Franco (2010) and walking distance (contour lines at 2h, 4h, 8h, and 16h)

The carrying capacity of the continuous territory of *Augusta Emerita* was definitely sufficient for the city, especially in view of its location in the fertile Guadiana

[117] Hyg. Grom. *De Lim. Const.* La. 171, 6-10 = Th. 136, 3-7; Ramírez Sábada (1994): 131.
[118] Cordero Ruiz (2010): 155.

valley. In addition, we can try to establish whether or not the area in the direct vicinity of the city was sufficient to support the community. Unfortunately, we do not know the centuriations around *Augusta Emerita*, although there is evidence that the lands in this region were centuriated.[119]

	Maximum population	Minimum population
Engels (1990)	191,667	62,377
de Angelis (2000)	91,667	68,750

Table VI.5 Estimated carrying capacity for the arable land within a three-hour walking distance from Augusta Emerita

The carrying capacity of the area within a three-hour walking distance from *Emerita* is much higher than that of *Tarraco.* The obvious explanation for this is the fact that *Tarraco* is located on the coast and therefore has only half the area available to *Augusta Emerita*. Since *Augusta Emerita* was slightly smaller than *Tarraco,* it is immediately clear that the city could rely on the lands in its vicinity. The arable land in the direct vicinity of *Augusta Emerita* had a carrying capacity of at least 62,000 inhabitants. Clearly, this could have supported the population of the city, which may have had between 11,000 and 19,000 inhabitants.

	Urban	Carrying capacity (3h)	%
Carreras (2014)	ca. 19,000	62,000 -190,000	9.9 - 30.6
Keay (2011)	17,250 -11,000	62,000 -190,000	9.0 - 27.8

Table VI.6 Estimated population for Augusta Emerita

When mapping the known locations of smaller self-governing communities with a buffer based on the three-hour walking distance, we observe that the majority of these cities are separated by relatively large distances (see fig. VI. 25). We also observe several clusters, leading to lower intercity distances. As has already been stated, we have to bear in mind that only 399 of the 513 *civitates* mentioned by Pliny have been located.[120] In addition, Pliny states that there were an unknown number of *civitates contributae*. Furthermore, as has already been argued, there is the possibility of the dispersed *civitas*, a *civitas* centred on multiple town-like settlements rather than on a single city. Unfortunately, these elements cannot be included in this analysis as we have no data on them.

[119] AE 1993, 1018a-d. For a proposed centuriation see Cordero Ruiz (2010): 154.

[120] Of the total of 430 *civitates* recognized in the different sources, 31 could not be located at all. Some have been roughly located to be able to draw these maps, although their position is not certain, they have been placed within the region where they are thought to be located.

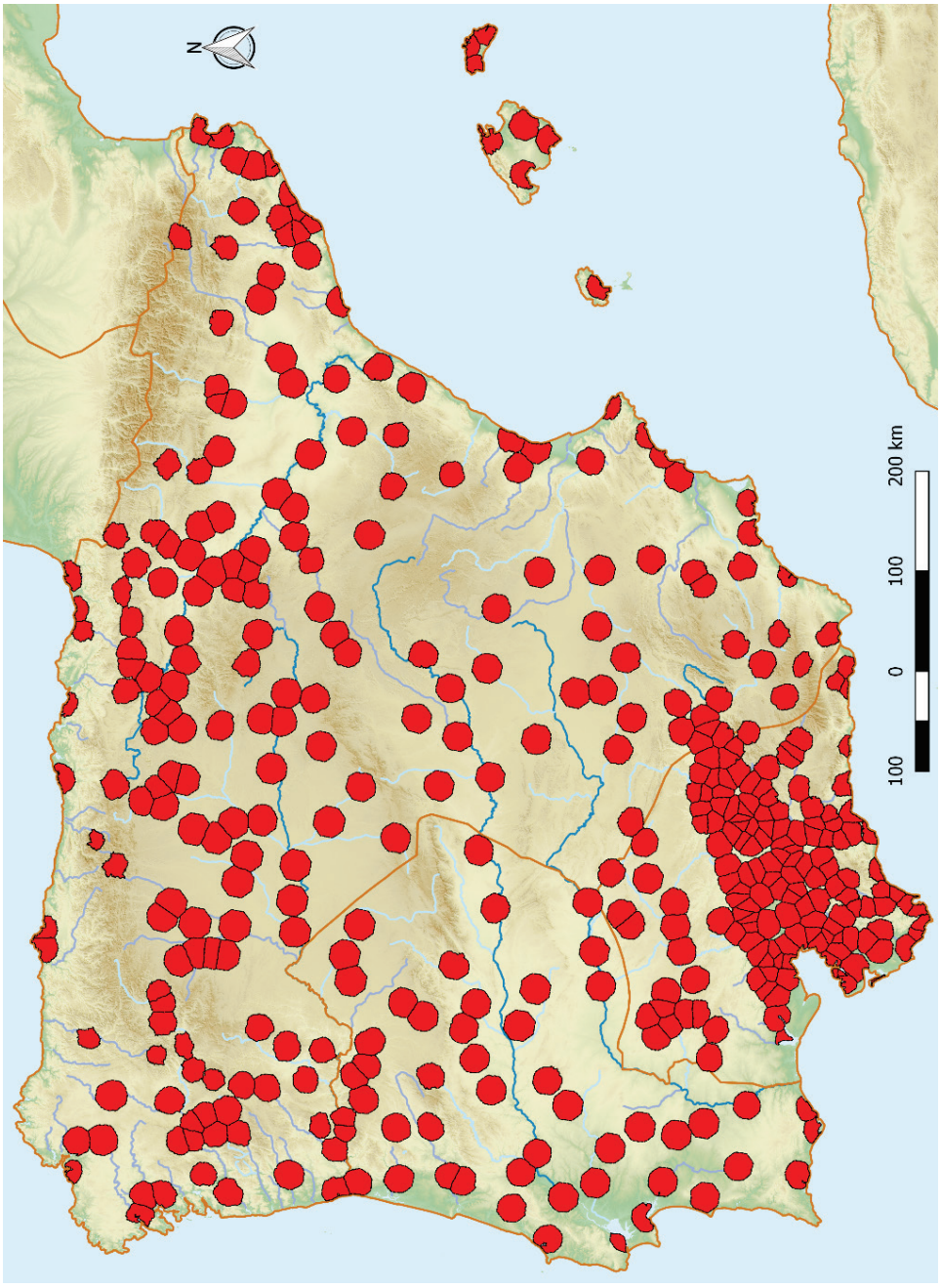

Fig. VI 25: All located self-govering communities with a 3-hour walking buffer

6.5 Geographical overview and the problem of missing sites

Despite the deficiencies of our data set, it is still worth exploring to what extent the patterns revealed by our maps might reflect the operation of geographical and climatological factors. This analysis will be carried out by creating a series of maps for four different factors; namely precipitation, height levels, Terrain Ruggedness Index and fertility of the land. The maps will show all the self-governing communities as before, but all settlements occupying less than 10 hectares and of unknown size are shown with the same dot. It is most likely that all unknown sizes all fall within the lowest category.

6.5.1 Precipitation

My first analysis focuses on the relation between precipitation and urban density. The rationale behind this approach is the idea that areas with less rainfall will not be able to support large urban centres, as they cannot rely on rainfall for agriculture. Precipitation levels in the Roman period have been modelled using the long-term precipitation averages from the WorldClim website.[121] This web-based dataset contains

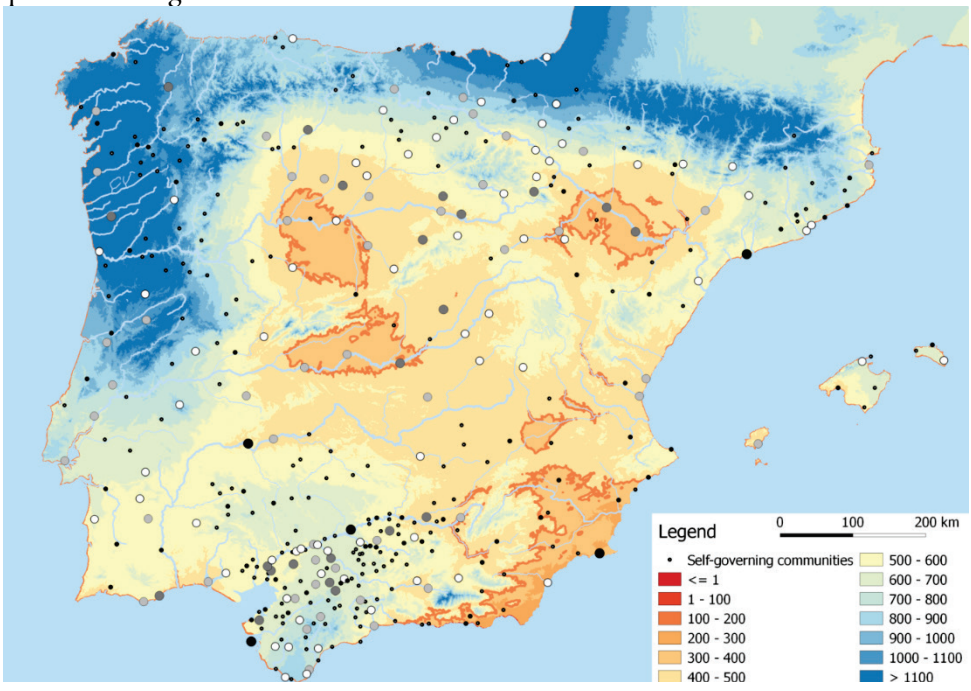

Fig. VI.26 Precipitation map based on the average annual rainfall 1960-1990 with the 400 ml isohyet

[121] http://www.worldclim.org/ (last visited 31-05-2017) For this the regions 15 and 16 (east and west of the Greenwich line) have been used.

rainfall data for the period between 1960 and 1990 at a 1-km spatial resolution.[122] There may have been a difference in climate between the Roman period and now, but since the pattern of rainfall is determined by the geography of the mountainous areas, it cannot be substantial. Even if amounts of rainfall were higher or lower in Roman times, the regional differences highlighted by the modern data must also have existed in Antiquity.

An initial glance at the map shows we can already establish that the areas with a lower level of precipitation were less densely urbanised. When comparing the number of self-governing communities against the precipitation in a bar chart, we can observe the distribution in a more precise way (see fig. VI.26). We see a steep drop between 400 and 300 ml per annum, which is the limit for normal agricultural production that relies on rainfall.[123] The few cities that existed in regions with less than 400 ml per annum (orange line on the map) were all located along rivers.

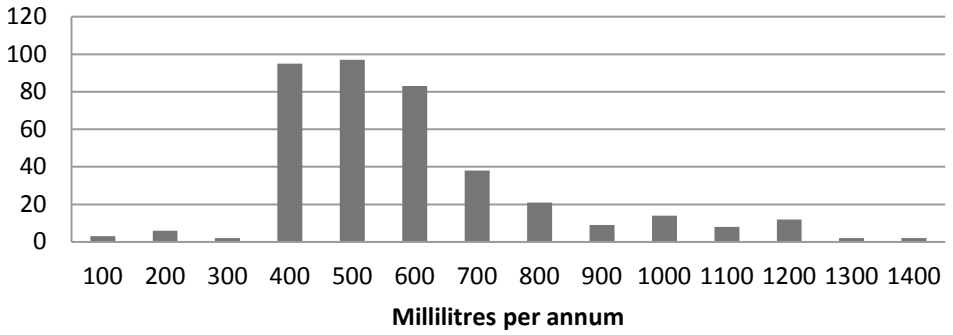

Fig. VI.27 Point sample percipitation per self-governing community

The concentration of settlements in these areas must reflect the use of irrigation schemes.[124] It is interesting that the number of settlements below the 400 ml isohyet drops significantly. Nonetheless, the vast majority of settlements were situated in areas with a higher annual rainfall. Most cities are found in zones that received between 400 and 600 millimetres of precipitation; above this we see a decline in the number of places. There are two possible explanations for this: areas with high precipitation rates were rather small. Secondly, high precipitation often is a result of mountains, because rain falls on the rainfall side of a mountain range. In mountainous regions we expect to find a lower urban density.

[122] Hijmans *et al.* (2005) 'Very high resolution interpolated climate surfaces for global land areas.' *International Journal of Climatology* Vol. 25, 1965-78: 1966.
[123] Wilkes (2005) 'Provinces and fronties.' In: Bowman, Garnsey and Cameron (eds.), *The Crisis of the Empire A.D. 193-337*, 212-68: 217; Halsall (2007) 'Barbarian Migrations and the Roman West, 376-568.' 93.
[124] Butzer *et al.* (1985) 'Irrigation Agrosystems in Eastern Spain: Roman or Islamic Origins?' *Annals of the Association of American Geographers* Vol. 75, N° 4, 479-509; Cf. Bintliff (2014) 'Prosperity, sustainability, and poverty in the Late Antique world: Mediterranean case studies.' In: Jacobs (ed.), *Production and prosperity in the Theodosian Period*, 319-83: 322.

6.5.2 Altitude

As a next step I will look at altitude (see fig. VI. 29), which, in the case of the Iberian Peninsula, is an important variable. To the north we find the Pyrenees with mountains reaching well above 3,000 metres, and the Cantabrian Mountains where we find the Picos de Europa, a group of mountains rising to 2,600 metres. The Central Meseta at the heart of the Iberian Peninsula has an average altitude of 650 metres. To the north, east and south it is bordered by mountain ranges, namely the Cantabrian Mountains, the Sistema Ibérico and the Sierra Morena. It is divided into two different plains by the Sistema Central, with peaks reaching 2,400 and even 2,592 metres (Pico Almanzor). To the west it slopes down to the Portuguese coastal lands.

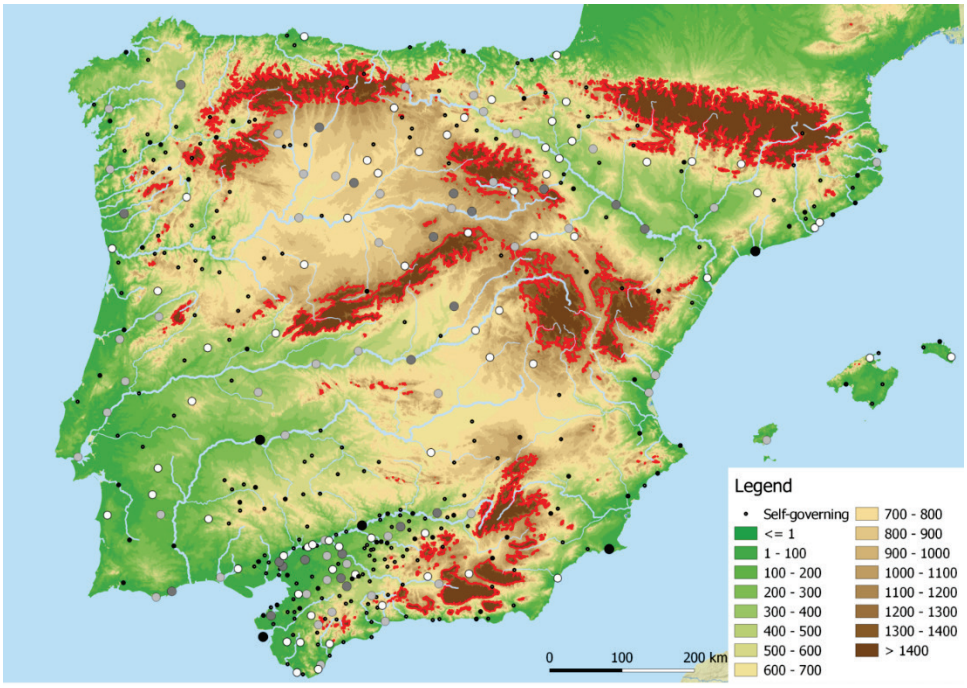

Fig. VI.28: Altitude map with polygons indicating areas above 1200 m

When looking at the distribution of areas with different altitudes, we can observe a concentration of cities in the lowest category. Some 92 are found below 100 metres above sea level. These places are all located along the coast or in the Guadalquivir valley. We also find a large number of settlements that are situated between 300 and 700 metres above sea level. This makes sense because the majority of the Peninsula is composed of Meseta plains with an average height of 650 metres.

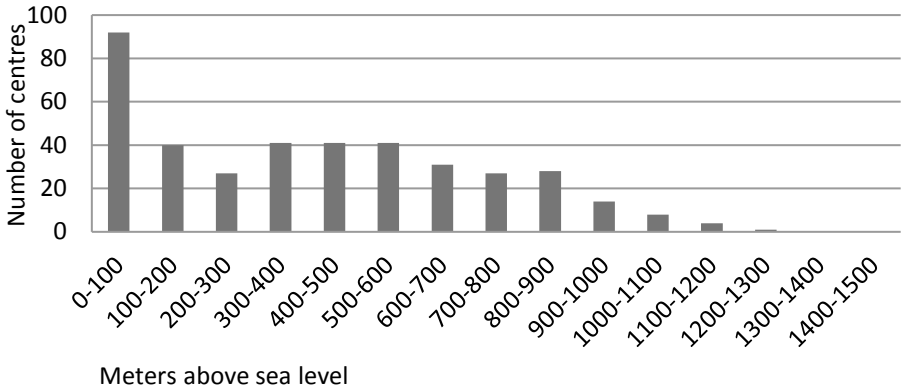

Fig. VI.29 Point sample altitude per self-governing community

For the higher altitudes the numbers start to decrease. This can be explained in two ways. Firstly, land at higher altitudes accounted for a relatively low proportion of all land. Secondly, and more importantly, at higher altitudes it is more difficult to find land suitable for agriculture. Above 1,200 metres we find only one settlement: *Iulia Libica* that was located high up in a valley of the Pyrenees at about 1,220 metres. This was a small settlement whose size has been estimated at only 3 hectares.

6.5.3 Terrain Ruggedness Index

Another geographical aspect, related to altitude, that has to be taken into account is the so-called Terrain Ruggedness Index (TRI). This is a quantitative measurement based on the change in elevation between points within the geographical area. The higher the index, the steeper the slope of the area.[125] This index allows for the recognition of level areas in mountainous areas, as well as for the identification of slopes, or rugged terrain, in low areas. In the case of TRI, point samples are not very useful because even in rugged terrain settlements will be positioned in level areas. For this reason a buffer of 10 kilometres will be used to determine the mean TRI for the region around the settlements.

[125] Riley *et al.* (1999) 'A Terrain Ruggedness Index That Quantifies Topographic Heterogeneity.' *Intermountain Journal of Sciences* Vol. 5, N° 1-4, 23-7.

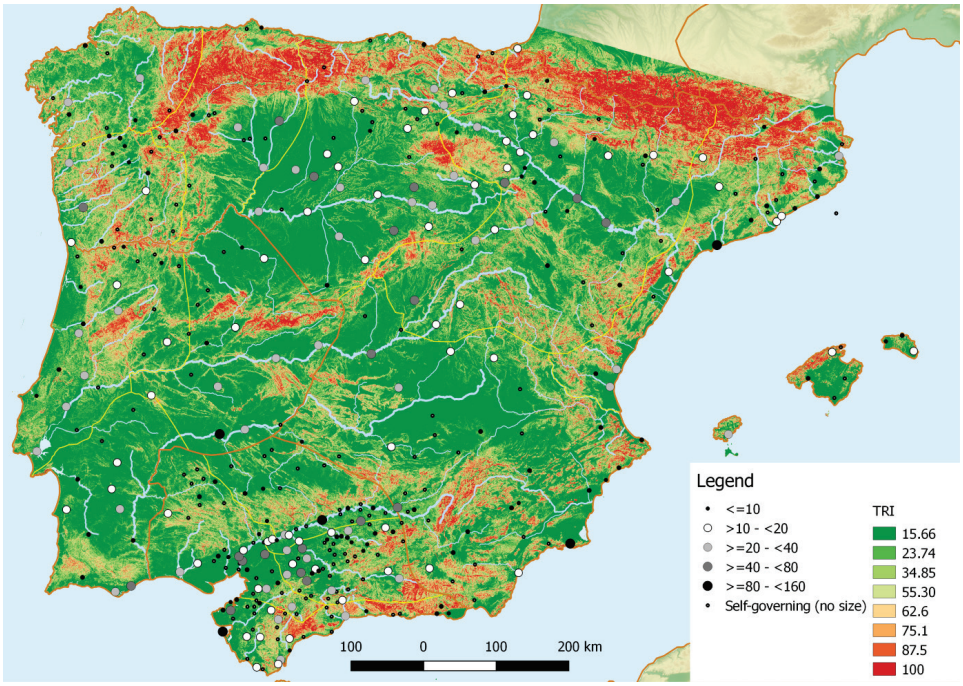

Fig. VI.30: Terrain Ruggednes Index map

The TRI values within the buffers range from 0 to 789.2, and the values for about 5,000 points were established in each buffer. The means for all the buffers a range of between 4.74 and 114.76. Looking at the graph based on the mean value for the buffers, we can immediately observe a concentration of settlements below an index of 40. The upper limit of the third quartile, is 34.86, meaning that 75% of all settlements occupied areas whose TRI did not exceed that value. The first 95% of all settlements were located in areas with a TRI lower than 55.3. The colouring of the map with the TRI is based on these statistics (see fig. VI.31).

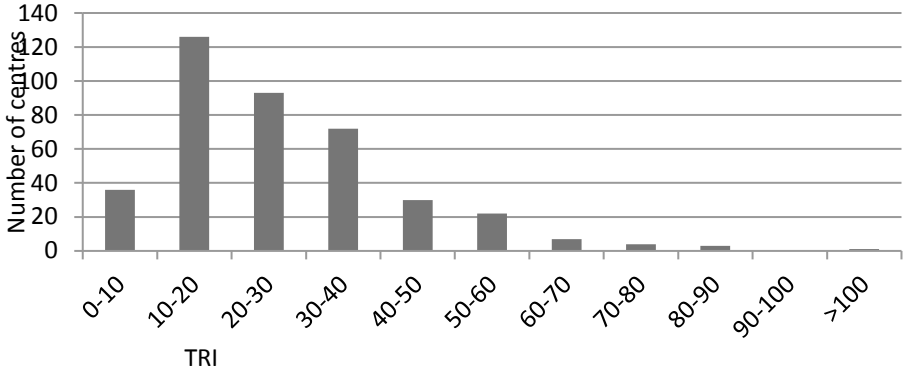

Fig. VI 31: Buffer sample mean TRI per self-governing community

6.5.4 Cultivable land

While the three geographical aspects discussed so far clearly delimit areas for urbanisation, they still do not take into account the agricultural output necessary to sustain urbanism. For this data we have turned to the Global Agro-Ecological Zones web database.[126] This dataset allows for the calculation of production capacity of land with different techniques based again on a thirty-year average (1961-1990). While average production has been calculated for the modern period, the database allows recalculations for arable cultivation without the use of chemical fertilizers or modern irrigation equipment.[127] The resulting map takes into account all land that is in theory available for cultivation (see fig. VI. 32). In addition, the areas have a resolution of approximately 60 square kilometres. Despite these disadvantages, the map can be used as a tool for identifying fertile and less fertile areas, thereby allowing us to identify areas where urbanisation is less likely.

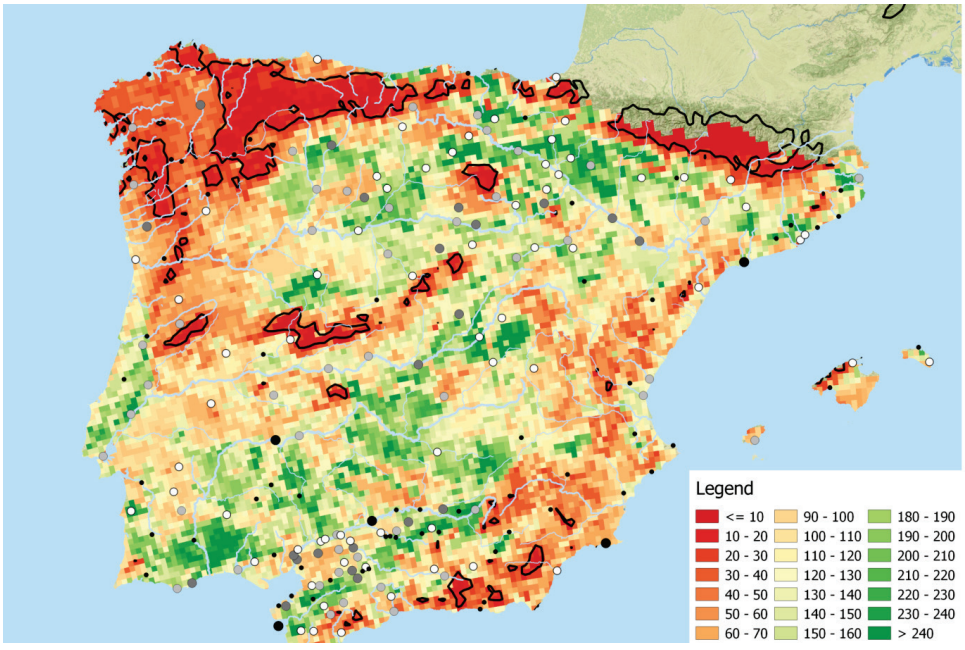

Fig. VI.32: Crop yield based on the long-term average (1961-1990) in kg dry weight (DW) per hectare

A glance at the map clearly reveals that the areas with a yield below 30 kilograms dry weight (DW) per hectare are virtually non-urbanised (see fig. VI.33). We find three places within a yield of 20 kg DW/hectare and three places with a yield of 10 kg

[126] FAO/IIASA (2011-2012) *Global Agro-ecological Zones (GAEZ v3.0)* FAO Rome, Italy and IIASA, Luxemburg -Austria: http://gaez.fao.org/Main.html#_Map based on data available on the website at 27/07/2013.

[127] Clearly, there were forms of irrigation in antiquity, as well as forms of fertilisation, see Butzer *et al.* (1985): 481. Obviously, these were on a completely different scale from modern-day irrigation and fertilisation, hence the choice has been made to show the map without these techniques.

DW/hectare In all cases we are dealing with areas in which 'urbanism' took the form of the dispersed *civitas*. Rather than having a centralised urban core, these *civitates* had a more dispersed organisation, leading to the absence of a central city. In these areas, the non-agrarian population was spread over a larger area and depended less on large pockets of farmlands.

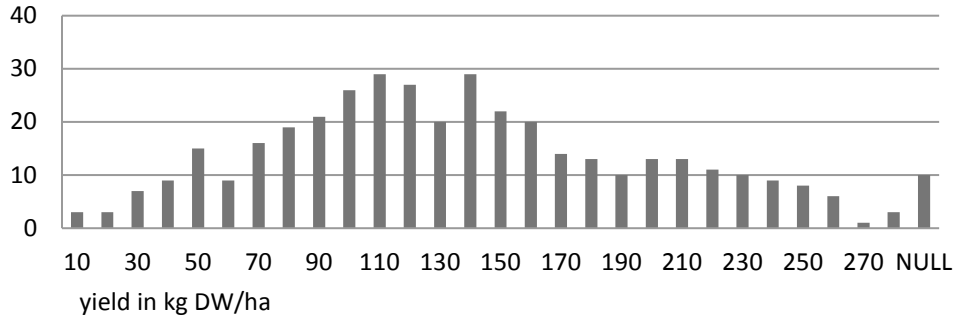

Fig. VI.33 Point sample of yield per self-governing community

6.5.5 The problem of missing sites

When we combine these approaches into one map, it becomes possible to draw some general conclusions concerning the relationship between geographical and climatological environments and the existence of possible urban centres (See fig. VI.34). It is clear that a geographical deterministic approach cannot fully explain the low density areas. Nonetheless, there are clear preferences for certain regions, especially in the case of precipitation, where a steep drop outside the 400+ millimetre per annum zone can be observed. In addition, we can observe that most areas with suboptimal conditions were indeed avoided. As the data to determine the suboptibal conditions is based on the whole range of self-governing communities, from the largest to the smallest self-governing settlements, I suspect that the existence of 'town-like' settlements in the areas with suboptimal conditions is an exception.

When the map showing the self-governing settlements with three-hour walking distance buffers is superimposed on the map showing the unfavourable areas to urbanism, we still observe some areas without urban coverage (fig. VI.34). Some of these empty areas might have been covered by self-governing cities whose locations remain unknown but a detailed investigation of the problem shows that large part of the Iberian Peninsula would remain uncovered even if all of these missing cities could be added to our maps.

In the case of *Baetica* the locations of 25 *oppida* referred to by Pliny cannot be determined. At first sight, it is tempting to assign a large proportion of these cities to *Baeturia,* the northern region of *Baetica*, where few self-governing cities have been identified on the ground. However, the study by Berrocal Rangel has shown that this

region was a mining region.[128] A comparison with other mining regions, such as Galicia, suggests that *Baeturia* was neither densely populated nor dotted with self-governing cities. More likely this was a region with only a few small towns. It follows from this that the majority of the 25 unlocated *oppida* must have been located in the already densely urbanized Guadalquivir valley, thereby not changing the overall pattern of urbanization within the province of *Baetica*.

Based on Pliny's account of *Citerior* we may posit the existence of 94 unlocated *civitates* (the total number of *civitates* in this province being 293). The total area favourable to urbanism but not covered by self-governing cities which appear on our maps can be estimated as about 114,150 km². If each of the missing 94 central places of *civitates* is assigned a buffer zone with a radius of 15 km, the maximum area covered by these missing centres would have been 66,458 km². This would have left a vast area of 47,692 km² uncovered by the 293 self-governing cities of *Citerior*. In reality the size of the uncovered area must have been considerably larger because the buffers of several of these cities must have overlapped.

The questions raised by incomplete urban coverage are even more acute in the case of *Lusitania*. As we have seen in previous chapters, the self-governing cities of this province were dispersed over a large area, leaving huge gaps in terms of market coverage. Pliny mentions 45 *populi* in his survey of *Lusitania* and based on other sources a further eight self-governing communities can be identified. Bringing the total number of self-governing cities or communities to 53. The central places of 51 of these communities have been identified on the ground, with varying degrees of confidence. This leaves only 2 unlocated central places of self-governing communities whose 15 km buffer zones would have covered an aggregate area of 1,414 km². The total area favourable to urbanism but not covered by self-governing cities in *Lusitania* can be estimated as about 14,350 km². Subtracting the area possibly covered by the two centres of the unlocated self-governing communities results in an uncovered area favourable to urbanism of 12,936 km².

It is may not be a coincidence that the two provinces with limited market coverage are those which appear in Pliny with *populi* rather than with *oppida*. Many of the *populi* of *Citerior* and *Lusitania* might have been poly-centric *civitates* of the 'dispersed' type and have had much larger territories than most *oppida* in *Baetica*.

The inhabitable areas of *Citerior* and *Lusitania* which were devoid of urban centres must have supported some habitation, and the populations of these areas are likely to have visited markets, for instance because they had to sell some of their surpluses in order to pay taxes or simply because they wanted to buy certain goods which were not locally available. On general grounds it seems therefore reasonable to posit the existence of a considerable number of secondary agglomerations which served as

[128] Berrocal-Rangel *La Baeturia: Un territorio prerromano en la baja Extremadura*: 51.

market centres for the inhabitants of the surrounding districts.[129] However, the almost complete lack of research into the secondary agglomerations of Roman Spain and Portugal makes it impossible to go beyond such general observations. I call upon other scholars to investigate the secondary agglomerations of the Iberian Peninsula in order to advance our understanding of the different levels of urbanization in the Iberian Peninsula during the High Empire.

[129] The total area on the map that could have supported urban or "town-like" settlements but where no evidence of the existence of town-like places has been detected is roughly 192,000 km². If we subtract 67,872 km², which is the sum of the areas that might have been served by unlocated self-governing cities of *Lusitania* and *Citerior,* we are left with an area of 124,128 km². Full market coverage of this area would have required the existence of at least 176 "town-like" secondary agglomerations if each of these agglomerations is credited with a buffer zone with a radius of 15 km (707 km²). Of course periodic markets could also be held in uninhabited places.

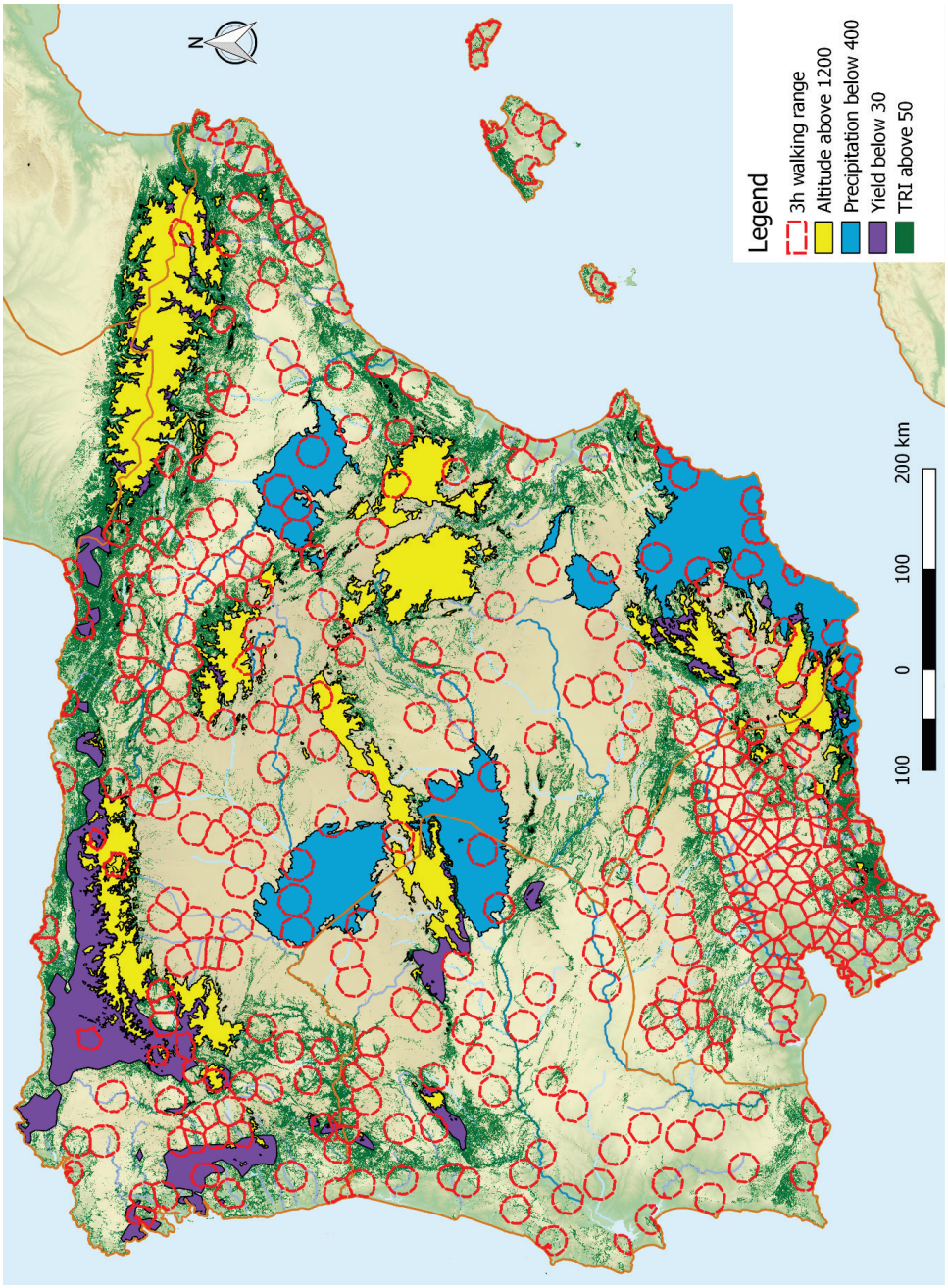

Fig. VI.34 Overview of geographical and climatological environments in relation to a three-hour walking range