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A GIS Study on the Spatial Development of Coastal Catalunya

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Abstract

GIS and multivariate statistical analysis were used to study the development of the Roman settlement pattern in the region of Tarragona and the Maresme in Spain. Though these two areas are geographically similar and almost neighbouring, the Roman settlement pattern varied considerably between the two throughout the time in which Spain was under Roman rule. The data clearly shows the effect the foundation of the town of Tarraco (Tarragona) had on the Roman rural settlement, while the lack of a strong centre in the Maresme caused the rural organisation of the area not to change significantly after the rural settlement was first established. The influence of the pre-existing Iberian settlement on the Roman settlement pattern was also investigated. Correspondence Analysis was also used to study the distribution of different pottery types in the two areas and assess which pottery types were associated with sites with certain characteristics and with the main communication routes. The GIS and CA study clearly shows that despite the geographical proximity of the two areas, the rural settlement pattern was shaped by different factors at play in the two territories.

1 Introduction

The study presented here used GIS as the main means to analyse the development of the two neighbouring areas of the Maresme and the region of Tarragona under the Romans, from the first large-scale Roman settlement to the Late Empire. The information used was obtained from the archives of the Generalitat de Catalunya and supplemented with information from published sources.

1.1 The region of Tarragona

In 197 BC the Romans divided Iberia into two separate provinces, Hispania Ulterior and Hispania Citerior, with Tarraco being the main military base of the latter province. In the middle of the 2nd century BC the defensive walls of the garrison at Tarraco were extended to include the Iberian settlement and provided with towers at 50m intervals and by the end of the century Tarraco had also become the focus of an important road network, which linked it to the lower Ebro Valley, the Vallès and the Maresme (Keay 1990, 128). By 5 BC the province of Hispania Citerior had been enlarged with the additions of inland territories and had been renamed Hispania Tarraconensis. Between 45 and 27 BC Caesar founded a colonia at Tarraco (Keay 1990, 137; Alföldy 1978, V.1.a), after the town had already been a centre of Roman power for 200 years. Augustus designated Tarraco as capital of Hispania Tarraconensis and the town kept this role until the Visigothic period (Keay 1991, 79).

In the 3rd century AD Tarraco had ceased to develop and expand and several large early imperial mansions along the river Francolí were abandoned. By AD 262 a body of Frankish tribesmen crossed into north-east Tarraconensis from southern Narbonensis, sacked Tarraco and then crossed over to north Africa by sea (Keay 1988, 177).

The region considered in this study consists of the ancient Ager Tarraconensis. This is divided into two parts by the Francolì river, which runs north to south almost perpendicular to the coast line. The half of the Ager Tarraconensis to the west of the Francolì contains the most Roman and pre-Roman sites, while only a few are found in the eastern part. The western part consists of a flat area with low mountains to the north west, while the eastern part is dominated by hills, with the Francolì running along the foot of these. Despite the fact that 90% of the whole area lies below 200m above sea level, the slope can be quite steep in places and can be a serious hindrance to movement.

1.2 The Maresme

The Maresme is the area found along the coast of Catalunya north of Barcelona. Before Romanisation, the Iberian settlement pattern consisted of small nucleated villages or hamlets, found on the peaks and flanks of the major hills and ridges. The available evidence suggests that the arrival of the Romans in this area was rather peaceful, as no Iberian site suffered violent destruction at the beginning of the

2nd century BC (Miret et al. 1991, 47-50). Two Roman towns existed in this area: Baetulo (modern Badalona), which was founded towards the end of the 2nd or the beginning of the 1st century BC, and Iluro (modern Mataró), probably founded at roughly the same time (Prevosti Monclús 1991, 135). Excavations carried out at these two sites have shown that both towns were effectively abandoned by the late 3rd century, by which time their administrative role had been taken over by Barcino (modern Barcelona, see Keay 1988, 176).

The Maresme comprises the coastal strip running north from Barcelona and is defined to the north-west by a chain of low and highly eroded granite hills running parallel to the coast known as the Serralada Litoral. The hills flanking the thin coastal strip are characterised by a number of small valleys created by the action of the several streams which run to the sea from the highlands. It differs somewhat from the nearby region of Tarragona in that a larger proportion of the land is found above 100m above sea level, causing the coastal strip to be rather thin and favouring a pattern of settlement constrained between the foothills and the coast. The Maresme is separated from the region of Tarragona by the Garraf massif, which effectively splits Catalunya into two distinct zones distinguished by climate, geology and vegetation (Solé Sabarís 1958-68).

1.3 The system and the data

The information about the site contents and coordinates was stored in a dBase III+ file. The GIS package used was Idrisi for Windows 1. The (2 and Kolmogorov-Smirnov tests (Note 1) were carried out using custom produced programs in dBase III+ language, while the Correspondence Analysis was obtained using WinBASP.

The archaeological data was made available from the Generalitat de Catalunya and consists of a database of rural Roman sites found in the region of Tarragona and the Maresme. The information contained in the database consists of a site list, with information about the different pottery types found in each site and the site coordinates. GIS background data consists of a DEM for each of the two areas, the position of the Roman roads, the hydrology and the coastline.

2 The relationship between the Roman towns and the rural landscape

2.1 The rural landscape of the region of Tarragona

The distance calculation facilities in Idrisi were used to calculate the cost distance from ancient Tarraco using a friction surface derived from the slope map of the region. The cost surface was then reclassified into 11 bands whose width corresponds to the cost of moving 5 km over a completely non-friction surface (Note 2). Notice that since the increment in the cost surface units is not the same as the linear units, the cost limit value was calculated for each distance band (i.e. 10 km, 15 km etc.), rather than calculating a cost limit value for the 5 km band and multiplying it by the required value.

The relationship between the position of the rural sites and Roman Tarraco was tested by means of the Kolmogorov-Smirnov one-sample test, using the area of each cost distance band as the hypothetical distribution against which to compare the number of rural sites occurring on each band. Of the 11 distance bands, only the area covered by the six nearest to Roman Tarraco had been surveyed, therefore only these were used in the Kolmogorov-Smirnov test. This was done to limit the error introduced in the analysis by the parts of the region for which data was not available. A Kolmogorov-Smirnov test was carried out for each period identified in the database, the Republic, the reign of Augustus, the Early Empire, the Third century and the Late Empire. The results of the Kolmogorov-Smirnov tests, at the 5% level of significance, show that there is a significant relationship between the position of the Roman rural sites and the Roman town of Tarraco in all periods except from the Late Empire, for which the test proved not significant. This relationship can be further investigated by looking at the way the distribution of rural sites with respect to the position of Tarraco changed in time.

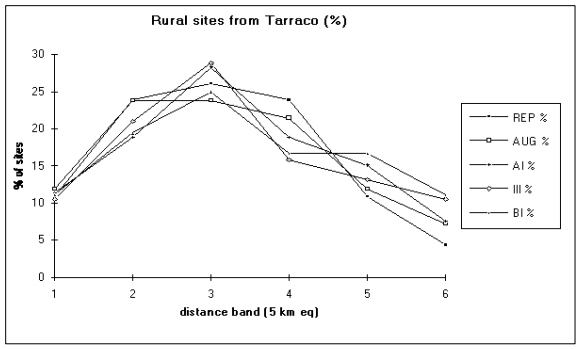

Figure 1. The percentage of rural sites on cost distance bands (5 km eq) from Roman Tarraco.

Figure 1 shows the percentages of sites from each period on the 5 km eq. distance bands from Roman Tarraco. The two lines detailing the percentage of rural sites dating from the Republic and the reign of Augustus on cost distance bands from Roman Tarraco are similar in shape. The three lines of the percentages of rural sites dating from the Early Empire, the 3rd century and the Late Empire are also similar to each other, but different from the other two. This graph suggests that the pattern of distribution of rural sites around Tarraco changed in the middle of the 1st century AD. This transformation in the settlement pattern might be explained by a reorganisation of the countryside following the founding of the colonia at Tarraco.

The distribution of rural sites in existence during the Republic and the reign of Augustus shows that the majority of the sites tend to occur in the cost distance bands closest to Tarraco. In the Early Empire this pattern changes and the largest concentrations of rural sites are further away from Tarraco, in the distance band corresponding to 10-15 km eq, with another peak in band 5, corresponding to 20-25 km eq. The line of percentage of rural sites dating from the Late Empire shows that by this time the focus of the rural settlement had shifted away from Tarraco. This is consistent with the decrease in importance and power of Tarraco itself clearly visible after the 3rd century (Keay 1988, 175). The decrease in the total number of rural sites in the Late Empire also suggests that the remaining sites turned into larger estates controlling larger areas. These results contradict Millett (1992, 179), who argues that the rural sites were not originally centred on Tarraco but came closer to the town in later periods.

Despite the fact that quarries in the eastern part of the Ager Tarraconensis had been exploited since before the arrival of the Romans, other quarries further away from Tarraco came into use in the Early Empire, suggesting an increased need of stone for the creation of new rural sites and for the urban development of Tarraco. These quarries continued in use into the Middle Ages, when new ones even further away from Tarraco started being exploited.

Tarraco was founded as a military settlement and it is likely that in the very early period the first Roman settlement occurred quite close to the town for reasons of protection. This pattern was maintained until the colony was founded by Caesar, which involved a reorganisation of the countryside around the town itself, visible from the Early Empire onwards.

In the medieval period, new sites were founded further away from Tarraco, reaching as far as distance band 8 (40 km eq). This pattern continues the trend already evident in the Late Empire of movement away from Tarraco, probably as a consequence of a loss of power of the town itself, together with a reorganisation of the countryside brought about by the end of the Roman rule.

2.2 The rural landscape of the Maresme

During the Roman period two main towns existed in the Maresme, Baetulo (modern Badalona) to the west, and Iluro (modern Mataró) to the east. In the Republican period both towns had the status of oppida civium Romanorum, and were later given the status of municipia (Prevosti Monclús 1991, 135). The ceramic evidence shows that Baetulo was very probably founded at the end of the 2nd or beginning of the 1st century BC (Guitart 1976), and it is very likely that Iluro was founded at roughly the same time, though it has not been studied so well as Baetulo. The similar date of foundation of the two towns is suggested by the similar topographical situation along the coast and the identical status attributed to the two towns by the Latin sources (Prevosti Monclús 1991, 135).

The distribution of rural sites in relation to the position of Baetulo and Iluro was studied by creating a cost distance surface starting from the two towns and using a friction surface derived from the slope map. The resulting image was then divided into a series of distance bands corresponding to 5 km eq and the number of rural sites dating to each period (Iberian, Republic, the reign of Augustus, the Early Empire, the 3rd century and the Late Empire) was used to calculate a series of Kolmogorov-Smirnov one-sample tests. The test was significant in all cases at the 5% level of significance except for the Iberian

rural site distribution, showing that the new rural sites founded after Romanisation were centred on the two towns rather than having a dispersed pattern in the countryside, as was the case in the Iberian period.

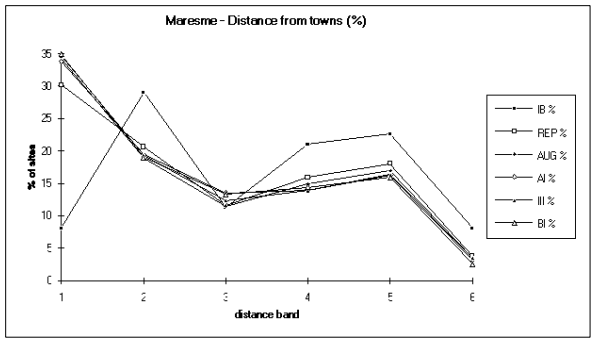

Figure 2. The distribution of rural sites on 5 km eq cost distance bands from the Roman towns.

Figure 2 shows the graph of the percentages of rural sites on 5 km eq distance bands from the towns for each chronological band considered in the analysis. The shape of the lines after Romanisation shows that the distribution of rural sites in relation to the towns stayed pretty much the same until the Late Empire. The Iberian pattern present before Romanisation, on the other hand, is markedly different from the pattern for the Roman periods, showing a much smaller number of sites close to the towns and a more dispersed pattern away from the town (or rather, the location where the Roman towns were to be built). This suggests that the two Roman towns were not built over pre-existing important Iberian settlement or locations that were of high importance to the Iberian organisation of the landscape. This pattern is consistent with the hypothesis that a large number of new rural sites were created in the Maresme at the time of the foundation of the two towns.

2.3 Comparison between the two areas

The results obtained for the Maresme differ from the picture which had emerged for the region of Tarragona, where a clear shift in the organisation of the countryside immediately following the reign of Augustus was visible from both the results of the Kolmogorov-Smirnov significance tests and the detailed study of the graphs of the distribution of proportion of sites on distance from Tarragona at different times. This is consistent with the view that Tarragona was an important centre and the development of its countryside reflected the fortune of the town, which became a conventus capitalis, while the Maresme was a marginal area which received input right at the time of the first large scale Roman settlement in the area but then froze and no transformation occurred in its countryside over the different periods of Roman rule. It is possible that the different development of the countryside of Tarragona was linked to the fact that the town was created over the site of a pre-existing important Iberian site and the organisation of the countryside until the mid 1st century AD still reflected the Iberian organisation of the land, while this does not appear to be the case in the Maresme.

3 The rural sites on elevation

3.1 The rural sites of the region of Tarragona on elevation

The few Iberian sites known from the Ager Tarraconensis were located in protected locations, often on high points, though in no case at points higher than 200m above sea level. Archaeological evidence has shown that most hill-top settlements were gradually abandoned from the 2nd century BC onwards (Keay 1990, 130). When new Roman sites appeared during the Republic, the majority of these were created on lower land than the Iberian settlement, probably to exploit the agriculturally better low lands, determining the shift in the settlement pattern visible in the graph in Figure 3.

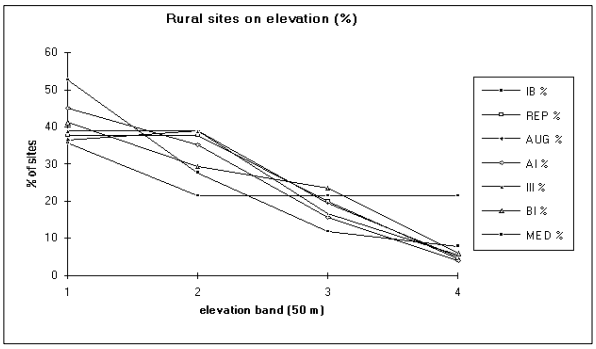

Figure 3. The proportion of rural sites on elevation bands (50 metres).

The relationship between the rural sites and the elevation they occur on was tested by dividing the altitude into a series of bands 50m wide. The sites occurring on each elevation band were counted and this information was used to carry out a series of Kolmogorov-Smirnov one-sample tests, comparing the distribution of sites on each band to a hypothetical distribution derived from the area of the elevation band. Of all the bands, only the first 4 (0 to 50m, 50 to 100m, 100 to 150m and 150 to 200m) contained rural sites, therefore the others were excluded from the analysis to try and reduce the bias

introduced by the archaeologically empty large proportion of the study area.

The results of the Kolmogorov-Smirnov tests showed a significant relationship between the elevation above sea level and the distribution of rural sites dating to the Republic, the Early Empire, the 3rd century and the Middle Ages, while the relationship between the elevation and the distribution of rural sites dating to the Iberian period, the reign of Augustus and the Late Empire was not significant.

Figure 3 shows the proportion of rural sites on 50m elevation bands for all periods. The graph shows that in the Iberian period more sites existed on high ground than was the case in the Roman period, while the largest proportion of sites in the first band (0 to 50m above sea level) dates from the Middle Ages.

During the Early Empire several new sites were created and the line for this period shows that these were located preferentially on low ground. This is consistent with the reorganisation of the land following the creation of the colonia at Tarraco, as the new sites were located on the better soils of the lowlands. The line for the Late Empire shows that at this time the proportion of sites on high ground increased compared to the earlier periods, suggesting that a movement of sites towards high ground occurred. Less sites existed in the Late Empire than in the Early Empire and in the 3rd century, so it seems that sites disappeared from low ground, rather than new sites being created on high ground. This fact might be linked to the incursion of the Frankish tribesmen who sacked Tarraco (Keay 1988, 177). It is also possible that the higher proportion of sites on high ground is linked to the distributed pattern of rural sites already noticed in the study of the relationship between rural sites and ancient Tarraco (section 2.1). If this pattern was due to the appearance of large estates controlling larger areas, the main rural site (a `villa') would no longer be required to be close to the territory it exploited, but could be located on higher ground to offer better protection against incursions and to give a better view over the Francolì valley.

Despite the fact that very few Iberian sites are present in the database, the pattern of distribution of rural sites in the Iberian period is markedly different from the pattern of distribution of rural sites in all of the Roman and Medieval periods (see Fig. 3). The new Roman rural sites were created preferentially on lower ground, possibly for agricultural reasons. The test for the period of the reign of Augustus was not significant and in fact a careful study of the sites which ceased to be used in this period shows that these were mainly those on the lower ground, possibly due to a reorganisation of the land following the creation of the colony at Tarraco. In the Early Empire, the new foundations occur again preferentially on lower ground. In the 3rd century, sites started to be abandoned and a shift towards a higher concentration of sites on higher ground than in the preceding period is visible. The 3rd century shows the beginning of a generalised transformation in the settlement pattern, which might be linked with incursions in the Ager Tarraconensis such as that of the Frankish tribesmen. Fewer sites existed in the Late Empire than in the other Roman periods but, while a few lowland sites disappeared altogether, new foundations tended to occur preferentially on higher ground, reversing the trend which had existed in the Republic and Early Empire.

3.2 The rural sites of the Maresme on elevation

The Maresme has higher hills than those found in the region of Tarragona. While there is a marginally higher proportion of land on higher ground in the Maresme, (83% of the land lies below 200m above sea level), a number of sites are found at higher elevation than this. Prevosti Monclús (1981, 264) concludes from the study of her data that the majority of the `villae' (her definition of rural sites) in her study area occur around 100m above sea level, with a group of `villae' occurring on much lower ground along the coast.

The elevation map was divided into bands of 50m and a Kolmogorov-Smirnov one-sample test was carried out to test whether there is a significant relationship between the rural sites in existence at any one period and the altitude they are found at. In all cases the Kolmogorov-Smirnov test was significant at the 5% level of significance, but this was expected as fewer sites were built on higher ground which was less easily accessible due to the steep slopes, and most of the settlement occurs in the thin coastal strip at the foot of the mountains. Figure 4 shows the proportion of rural sites on 50m elevation bands at different times. The graph shows that in Iberian times there was a smaller proportion of sites on low ground and a higher proportion of sites on higher ground than in the Roman period, though very few rural sites were found above elevation band 5 (200 to 250m above sea level). The graph also shows that the proportion of rural sites dating from the Roman period on elevation differs from that of the Iberian

sites. In Roman times a higher proportion of sites is found on low ground than in the earlier period. There does not appear to be any variation in the proportion of sites on elevation throughout the Roman period from the Republic to the Late Empire, despite the fact that some sites disappeared and others came into existence at different times.

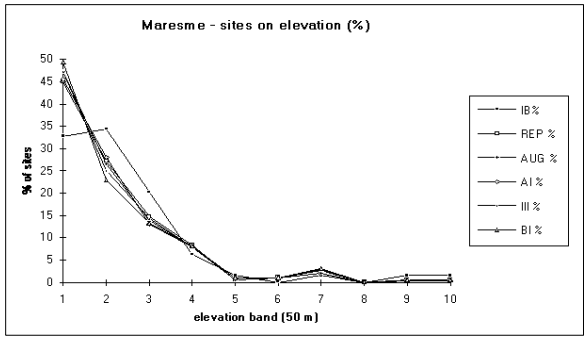

Figure 4. The percentage of sites dating from different periods on 50 metres elevation bands. IB = Iberian period, REP = Republic, = AUG = the reign of Augustus, AI = Early Empire, III = the 3rd century, BI = Late Empire.

Prevosti Monclús (1981, 264) states that the preferred location for villae in Roman times was around 100m above sea level with a few luxurious villae located by the seaside. Prevosti's idea is contradicted by the results of this analysis. The graph shows that in Roman times the largest concentration of rural sites was on elevation band 1 (0 to 50m above sea level) with 45% to 50% of the cases in all the Roman periods. Around 25% of the sites from each of the Roman period are found on band 2 (50 to 100m), while over 35% of the Iberian sites are found at this elevation.

Figure 5 shows the elevation (the real elevation, not divided in bands) at which sites occur in each period (each dot represents a site). To make the eventual pattern easier to see, only the sites occurring below 250m above sea level were included in the graph. There does not appear to be a preference for the rural sites to occur around 100m or at sea level, as Prevosti Monclús states: in fact, the cut-off point seems to be around 200m. Above this elevation only a few sites existed, as can be seen in Figure 6, which also shows that despite the fact that the proportion of Iberian sites on high ground (Figure 4, bands 9 and 10) is higher than in Roman times, when the actual count of sites is checked, more Roman than Iberian sites existed on high ground. The number of rural sites found at higher elevation than 250m above sea level shows that in a few cases some high locations where especially selected for settlement and continued in occupation until the Late Empire. These sites on higher ground had very limited access to good agricultural land, so it is possible that they had a different function from the lowland sites. As all of the highland sites occur on crests and ridges, it appears that the sites were located to have a good visibility of the surrounding area. This might be linked with reasons of security, or to control the maritime traffic along the Catalan coast. If this is the case, however, it is odd that similarly located sites were not found in the region of Tarragona.

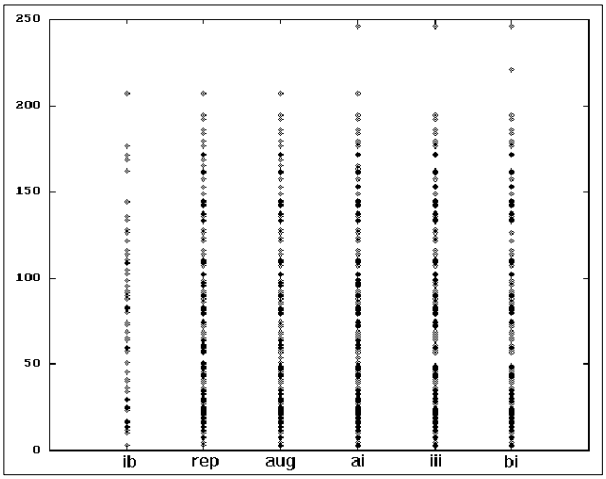

Figure 5. The distribution of rural sites on elevation, up to 250 metres above sea level (IB = Iberian, REP = Republic, AUG = the reign of Augustus, AI = Early Empire, III = 3rd century, BI = Late Empire).

4 The relationship between the Roman roads and the rural landscape

4.1 The Roman roads in the region of Tarragona

The main communication route in the region of Tarragona was the Via Augusta, which ran parallel to the coast, connecting the Maresme, over the Garraf massif to the north, to the south of Spain (Pallí Aguilera 1985, 207), eventually leading to Hispalis (Seville). The other important road in the area was the one leading north to Ilerda and Caesaraugusta from Tarraco (Keay 1990, 139).

These two roads were used as starting points to calculate a cost distance map, which was then reclassified into a number of 2 km eq cost distance bands and used to perform a series of Kolmogorov-Smirnov tests for each of the periods the site data are

dated to. Since rural sites are only found in the first 6 cost distance bands away from the roads, the bands with no sites on them were excluded from the analysis. The results of the tests were significant in all cases at the 5% level of significance except for the dataset from the Late Empire.

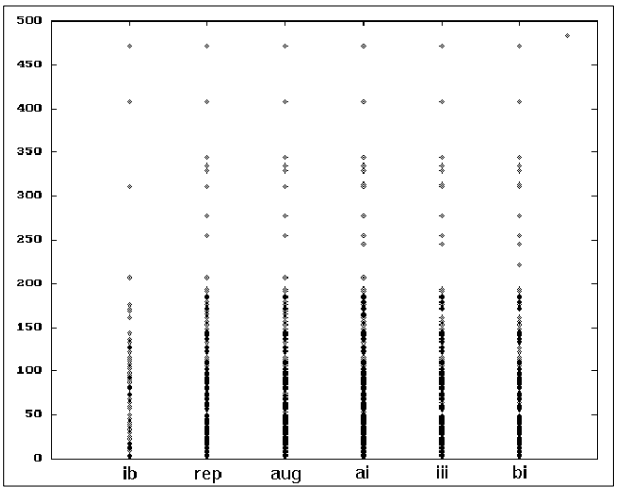

Figure 6. The distribution of rural sites on elevation (IB = Iberian, REP = Republic, AUG = the reign of Augustus, AI = Early Empire, III = the 3rd century, BI = Late Empire). The scale on the vertical axis is the elevation in metres above sea level.

Further insights can be gained by studying the graph of the percentages of sites occurring on each distance band (Figure 7). The line of the proportion of rural sites dating from the Republic shows that a lower proportion of sites existed very close to the roads (in band 1) than in later periods. The proportion of sites dating to the Republic in the second band, however, is higher than in the following periods. This suggests a site pattern already centred around the roads in the early period of Romanisation, though at this time the communication routes had less influence on settlement than in the later periods. The pattern of site distribution around the roads stayed the same until the Late Empire when the proportion of sites away from the roads (in band 4) increased. At the same time the proportion of sites in bands 2 and 3 decreased and the proportion of sites in band 1, very close to the roads, stayed the same as the preceding periods.

These variations in the way rural sites were distributed along the communications routes at different times suggest that in the first period of Roman settlement it was important to locate the new sites near the roads, but it was not so important as it was in the following periods, possibly because import/export was not such an important feature as it later became. It is also possible that some of the new Roman sites were continuations of pre-existing Iberian farms, so that the Republican site distribution pattern reflects in part the pre-Roman settlement pattern. In the following periods, new sites were created along the roads to minimise the effort of reaching the communication and commercial routes (the Via Augusta led to Tarragona, which was the main port of the region), showing that trade had become more important. In the Late Empire the proportion of sites away from the roads increased suddenly, perhaps as a consequence of the decline of the large-scale exchange system which had played such an important role in the area, so that sites no longer needed to be located within easy access of the communication routes.

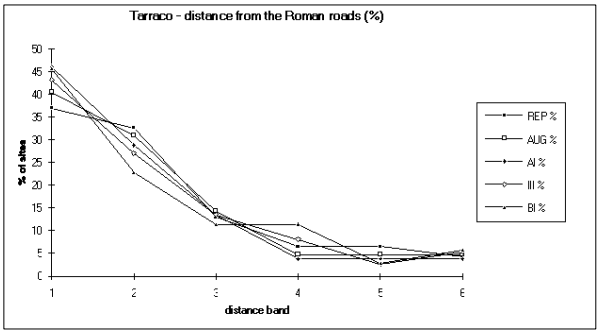

Figure 7. The proportion of rural sites on 2 km eq distance bands from the Roman roads.

4.2 The Roman roads in the Maresme

In the Maresme the Via Augusta ran parallel to the coast from north to south (Pallí Aguilera 1985). The importance of the Via Augusta to the placement of rural sites at different times was tested by creating a cost distance surface using a friction surface derived from the slope gradient map and using a digitised map of the Via Augusta as a starting point. The cost distance surface was then reclassified into a number of cost distance bands 1 km eq wide and the number of rural sites occurring on each band in every one period counted. These data were used to carry out a series of Kolmogorov-Smirnov tests to see whether there is a significant relationship between the position of the Via Augusta and the rural sites at any one time. The tests for all periods were significant at the 5% level of significance, showing that the rural sites were distributed in relation to the position of the Via Augusta.

These results, however, must be treated with some caution, as almost the whole of the Roman settlement in the Maresme is found in the thin and long coastal strip, which was also followed by the Via Augusta. The fact that the Iberian rural site distribution tested significant as well can be interpreted in two ways:

The Via Augusta ran along the track of an ancient path which was used well before the arrival of the Romans.

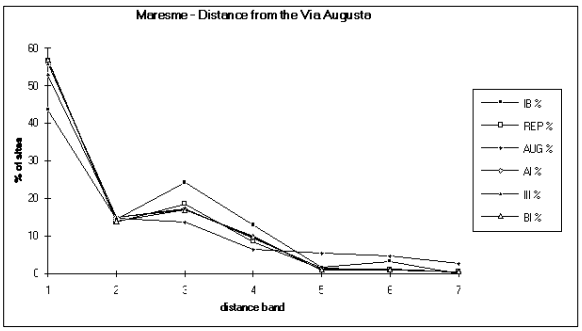

Figure 8. The distribution of rural sites on 1 km eq cost distance bands from the Via Augusta.

The Iberian sites were distributed along the coast, like the Roman ones, and the results of the Kolmogorov-Smirnov tests are biased by the land form, which influences both where the road could go and where the sites could be located.

It is very likely that a road existed along the track of the Via Augusta before the arrival of the Romans, as coastal Maresme represents the ideal corridor along which a road connecting the north to the south would run, keeping in mind that Cissis (Tarraco), to the south of the Garraf massif, was an important Iberian site and was located along the course of the Via Augusta. It is therefore likely that a combination of the two elements listed above would be the best explanation for the results of the Kolmogorov-Smirnov tests. The graph in Figure 8 shows the lines of the proportions of rural sites on distance bands from the Via Augusta. Apart from the fact that a slightly smaller proportion of Iberian sites appear to be close to the Via Augusta and a higher proportion away from it than it is the case for the Roman sites of all periods, very little variation seems to occur overall.

5 The multivariate analysis of the ceramic assemblages

5.1 The ceramic assemblage of the region of Tarragona

The wares most commonly found in the sites of the region of Tarragona, after unspecified local common pottery, are Spanish Terra Sigillata and South Gaulish Terra Sigillata, followed closely by Terra Sigillata Chiara A. Black Glazed pottery is found in 35% of the sites while Arretine Terra Sigillata and Terra Sigillata Chiara D are found in only 12% of the sites.

Ware	Number of sites	Percentage of sites
ANF	11	16.9
ANF_I	44	67.7
ANF_IB	33	50.8
ANF_A	12	18.5
CA	23	35.4
COM	41	63.1
TSA	8	12.3
TSH	33	50.8
TSSG	33	50.8
TS	7	10.8
TSC_A	31	47.7
TSC_C	4	6.2
TSC_D	8	12.3
PFINE	7	10.8

Table 1. Total number and percentage of sites containing a specific ware. ANF = generic amphora, ANF_I = Italian amphora, ANF_IB = Iberic amphora, ANF_A = African amphora, CA = Black Glazed pottery, COM = common pottery (local coarse ware), TSA = Arretine Terra Sigillata, TSH = Spanish Terra Sigillata, TSSG = South Gaulish Terra Sigillata, TS = generic Terra Sigillata, TSC_A = Terra Sigillata Chiara A, TSC_C = Terra Sigillata Chiara C, TSC_D = Terra Sigillata Chiara D, PFINE = Thin Walled ware.

Despite the fact that Common local pottery was found in over 63% of the sites, this category encompasses several different types of local coarse wares which were not better identified and is therefore very difficult to use for any sort of meaningful analysis. A table of the number of sites in which each ware was found is presented below. The percentage in the table was calculated out of the number of sites in the database for which the presence/absence of the wares was recorded, not the total number of sites.

5.2 Correspondence Analysis of the site assemblages

A study of the distribution of pottery types was carried out by means of Correspondence Analysis, which is one of the few multivariate statistical methods to allow analysis of presence/absence data (Baxter 1994, 104-107). This type of analysis is not

as powerful as that applied to quantified data, but it can nonetheless be used to observe general trends in data. A table of the presence/absence of different pottery types was produced, indicating the presence of a specific pottery type in a site with a 1 and its absence with a 0. Of all the sites in the database, only 65 had at least one pottery type and were included in the analysis. It was decided to exclude from the analysis the ANF (generic amphorae), TS (generic Terra Sigillata) and COM (common ware) types because these three groups were miscellaneous collection of pottery types which had not been better identified and could have biased the analysis.

Component	Iterations	Norm	Eigenvalue	% Inertia	Cumulative
i	57	0.072	0.316546	24.0	24.0
ii	37	0.098	0.258100	19.6	43.6
iii	31	0.078	0.194179	14.7	58.4

Table 2. The Correspondence Analysis information for the analysis of the pottery assemblage of the rural sites in the region of Tarragona.

Table 2 contains the percentages of inertia and other information for the first three components. A study of the components loadings shows that the first three components are strongly influenced by Arretine Terra Sigillata, Terra Sigillata Chiara C and Thin Walled Ware. The variable plot (see Fig. 9) confirms this pattern: Arretine Terra Sigillata dominates the top left quadrant, Terra Sigillata Chiara C the top right quadrat and Thin-Walled ware the bottom left one, while all the other wares tend to cluster towards the centre of the plot.

The separation of Arretine Terra Sigillata from the other wares is interesting. Another trend which can be noticed is that the imported wares tend to be in the top half of the graph, while Thin-Walled ware, a local production, and Iberian amphorae are in the bottom half of the graph, with Spanish Terra Sigillata in the centre of the graph, close to South Gaulish Terra Sigillata which it was an imitation of. It seems that the second component explains the variation between local and imported wares. The three Terra Sigillata Chiara subtypes occur in the same quadrant of the graph, showing that their patterns of occurrence in sites are not very different, while they are definitely separated from the pattern of occurrence of Thin-Walled ware and of Arretine Terra Sigillata.

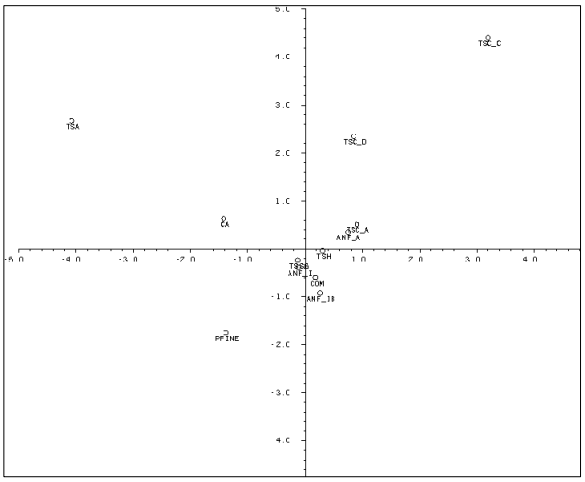

Figure 9. The object plot of the Correspondence Analysis on the pottery presence/absence in sites. Component i on the horizontal axis, Component ii on the vertical axis.

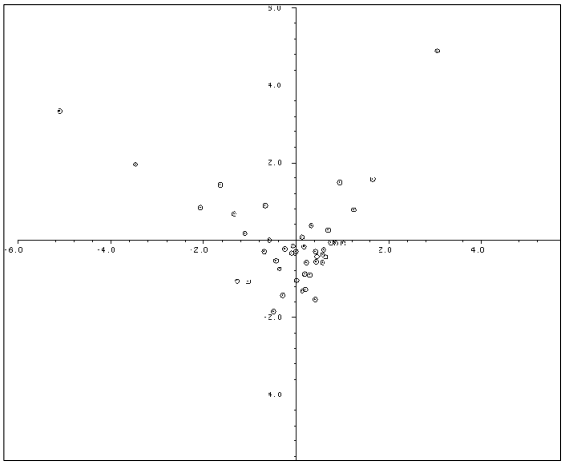

Figure 10. The variable plot of the Correspondence Analysis of pottery presence/absence of the sites. Component i on horizontal axis, Component ii on vertical axis.

The plot of sites on the first two components of the Correspondence Analysis (see Fig. 10) shows a concentration of sites in the centre of the graph, where most of the wares also cluster in the variable plot. Almost all the sites which are separated from the central cluster and are in the quadrant of the plot where Arretine Terra Sigillata dominates are very close to the Roman road leading from Tarragona to Ilerda. These sites also contain Black-Glaze pottery, which is nonetheless found in other locations as well. This trend suggests that Arretine Terra Sigillata had a less widespread distribution in the Ager Tarraconensis than the other wares. There also appears to be a tendency for sites which were further away from the Roman roads to be in the same area of

the graph as imported Terra Sigillata Chiara D and C, while sites closer to the Roman roads (both the Via Augusta and the road leading to Ilerda) are in the area of the graph where the Iberian amphorae and Thin-Walled ware occur. The sites closest to the roads are equally likely to occur in the areas of the graph where imported or local productions are.

The horse-shoe shape of the object graph is very often associated with seriation of the objects, however, the sites in the Tarragona data set do not seem to be ordered chronologically as a result of the Correspondence Analysis. The only clear chronological pattern visible in the Correspondence Analysis plots is that the sites in the centre of the plot, corresponding to the main concentration of pottery types, were in occupation longer than those found in the top right corner (close to Terra Sigillata Chiara C and D), which were all occupied only between the Early Empire and the Late Empire.

The widespread distribution of Black-Glaze pottery is in contrast to the distribution of Arretine Terra Sigillata, which features strongly in the assemblages of the sites close to the road from Tarraco to Ilerda. While this fact suggests that this type of pottery arrived at Tarraco and was then carried to Ilerda along the Roman road, it seems that the same was not true for Black-Glaze pottery, which was imported until the 1st century BC. Imported pottery types immediately later than Arretine Terra Sigillata, such as South Gaulish Terra Sigillata and Terra Sigillata Chiara A are found more widely distributed than Arretine Terra Sigillata and do not appear to have a strong influence on the assemblage of the sites near the road to Ilerda. Spanish Terra Sigillata, a local ware imitating Arretine Terra Sigillata and South Gaulish Terra Sigillata, follows a similar distribution as South Gaulish Terra Sigillata and it tends to be found at the same sites as this ware, but has a rather separate distribution from Arretine Terra Sigillata. Both Terra Sigillata Chiara C and D have influence on the assemblage of sites quite far away from Tarraco, as well as close to it.

The Iberian and Italian amphorae are found towards the centre of the graph, near South Gaulish Terra Sigillata and Spanish Terra Sigillata. Interestingly the Iberian Amphorae variable is the type closest to Thin-Walled ware, a local production, while the African amphorae variable is close to Terra Sigillata Chiara A, which was being produced in Tunisia like the African amphorae. Idrisi was used to compare the distribution of the sites with the three different types of amphorae. The Iberian and Italian amphorae are found in sites which are quite evenly distributed around the Ager Tarraconensis, while the sites with African amphorae tend to be found more distant from the coast and have a similar distribution to the sites containing Terra Sigillata Chiara C and D. Whilst an Idrisi plot of the sites is required to look in detail at the distribution of the types occurring in the centre of the object plot because they are close to each other, the subtle difference between the Italian and Iberian amphorae, with the Iberian amphorae being closer to the local Thin-Walled ware, can only be picked up by the Correspondence Analysis.

5.3 The ceramic assemblage of the Maresme

Table 3 shows the total count of sites containing a given pottery type in the Maresme. These data are derived from Prevosti Monclús (Note 3) (only those sites included in Prevosti Monclús' map considered) and from the records of the Generalitat de Catalunya.

Pottery type	Number of sites
CA	73
TSA	50
TSH	80
TSSG	75
TSC_A	60
TSC_C	21
TSC_D	42
PFINE	26

Table 3. The count of sites where a certain pottery type was found. CA = Black Glaze, TSA = Terra Sigillata Aretina, TSH = Spanish Terra Sigillata, TSSG = South Gaulish Terra Sigillata, TSC_A = Terra Sigillata Chiara A, TSC_C = Terra Sigillata Chiara C, TSC_D = Terra Sigillata Chiara D, PFINE = Thin-Walled ware.

It is immediately evident that the number of sites with Terra Sigillata Chiara A is higher than the number of sites with Terra Sigillata Chiara D, as was the case in the region of Tarragona, but not in other parts of Spain (see for example Massagrande 1995).

Component	Iterations	Norm	Eigenvalue	% Inertia	Cumulative
i	76	0.085	0.186162	23.2	23.2
ii	39	0.078	0.165210	20.6	43.8
iii	53	0.075	0.127085	15.8	59.6

Table 4. The Correspondence Analysis information for the analysis of the pottery assemblage of the rural sites in the Maresme.

The information about pottery types was used to create a binary presence/absence table of pottery

types in sites. This table was then used to perform a Correspondence Analysis. Table 4 contains the percentages of inertia and other information about the analysis of the assemblages of the rural sites of the Maresme. Figure 9 shows the variable plot for the presence/absence pottery data on the first two components. Spanish Terra Sigillata and South Gaulish Terra Sigillata are close together in the plot, while Arretine Terra Sigillata is away from them, as was the case in the Correspondence Analysis of the data from Tarragona. This indicates that despite the fact that Spanish Terra Sigillata was a local imitation of both Arretine Terra Sigillata and South Gaulish Terra Sigillata, the Spanish Terra Sigillata found in the Maresme is distributed in a way similar to the South Gaulish Terra Sigillata, rather than the Arretine Terra Sigillata. This pattern is also visible in the Correspondence Analysis of the pottery data from the region of Tarragona, indicating that a similar process of distribution of pottery types was at work in the two areas. The other feature emerging from the analysis of the variables on the first two components is that the Thin-Walled ware is separate from all the other pottery types in terms of its distribution. This feature is consistent with the results of the Correspondence Analysis carried out on the datasets from the region of Tarragona as well as data from other parts of Spain (Massagrande 1995, 1996), showing that in Spain the locally produced Thin-Walled ware tends to have different distribution from the other (both imported and local) pottery types. The three Terra Sigillata Chiara subgroups are found in the same area of the graph, though subgroups C and D are closer together than they are to subgroup A. This pattern, again, is similar to the one observed in the region of Tarragona.

The plot of objects on the first two components (see Fig. 12) does not suggest any direct relationship between the location of the sites and the type of pottery assemblage they contain. The distribution of the pottery types in the Maresme appears to be uniform, without specific concentrations in any place. This pattern of no variation ties in very well with the results of the analysis of the relationship of rural sites to elevation, distance from the Via Augusta and from the Roman towns, which showed a uniform settlement pattern throughout the Roman periods. Though there appears to be some sort of covariation between certain pottery types within the assemblages, such as South Gaulish Terra Sigillata and Spanish Terra Sigillata or Terra Sigillata Chiara C and Terra Sigillata Chiara D, the sites containing the assemblages with these characteristics do not appear to be located in specific positions with regards to elements such as the towns and the main communication and import/export route.

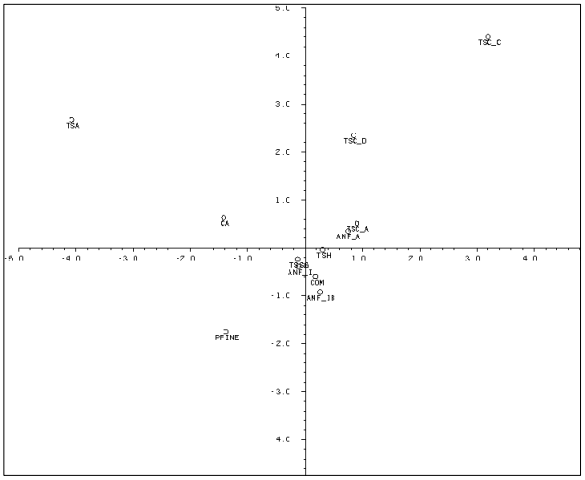

Figure 11. The variable plot (pottery types) of the Correspondence Analysis carried out on the assemblage data of the rural sites in the Maresme. Component i is on the horizontal axis, Component ii on the vertical axis.

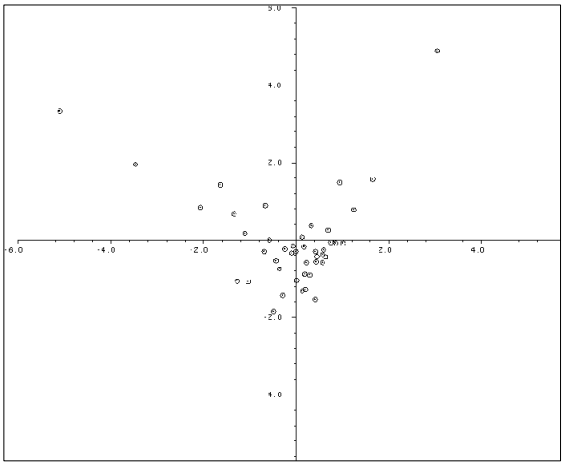

Figure 12. The object plot (sites) of the Correspondence Analysis carried out on the rural sites from the Maresme. Component i is on the horizontal axis, Component ii on the vertical axis.

6 Conclusions

6.1 Comparison between the region of Tarragon and the Maresme

Miret et al. (1991) state that the Garraf massif does not just divide Catalunya into two separate geographical parts, but into two separate cultural units as well, with visible different characteristics before Romanisation occurred. To the south of the Garraf massif (the region of Tarragona) was the land of the Cessetani, with capital Kesse (or Cissis), on the immediate small area of which Tarraco was founded, while to the north of the massif (the Maresme) was the land of the Laietani. One of the main differences between the two areas noticed by Miret et al. (1991) is that Iberian villages occur at much higher elevation in the Maresme than in the region of Tarragona, despite the fact that the difference in the proportion of high land in the two areas is marginal. This pattern of sites on high elevation continued in the Roman period, with Iberian sites on high ground surviving and new ones (though very few) being created under the Romans.

In both areas the creation of the Roman towns implies a reorganisation of the rural territory with respect to the pre-existing Iberian pattern, though it does appear that the indigenous use of the landscape did have some influence on the resulting distribution of Roman rural sites. In both cases the rural sites which existed during the Republic were concentrated near the towns but, while this pattern stayed unchanged throughout the periods in the Maresme, in the region of Tarragona the creation of the colonia brought about a reorganisation of the rural landscape, clearly visible from the data.

The main difference between the two areas is that in the Maresme the settlement pattern does not show any variation after the 3rd century AD, when both Baetulo and Iluro lost their administrative role to Barcino (Barcelona), to the south-west. In the region of Tarragona, after the decline of the town, the Late Empire is characterised by the appearance of a more widespread pattern of rural settlement, though still based on the pattern from the preceding period, while no such thing seems to occur in the Maresme. The creation of a colonia involved in most cases the division of the land into allotments for the colonists (centuriation), while this was very rarely the case when a municipium was created (Keay 1988, 68) and Baetulo and Iluro only ever reached the status of municipia.

The overall evidence indicates that the role of the towns in influencing the organisation of the landscape always was very marginal in the Maresme. Tarragona was a more important Roman centre than either Baetulo or Iluro and its decline was more likely to have an influence on its hinterland than would be the case for the two towns in the Maresme.

A difference between the two areas exists in the fact that significantly more sites are found on high ground in the Maresme than in the region of Tarragona. These sites are always found on crest sand ridges in the Maresme, suggesting a greater need for keeping a lookout than in the region of Tarragona.

Notes

1 For an introduction to the Kolmogorov-Smirnov one-sample test see Hodder and Orton (1976, 226-229)

2 The cost distance units equivalent to the cost of moving over a km in linear distance are referred to as km equivalent (km eq), therefore the bands are said to be 5 km eq wide. A description of the method used to calculate km eq can be found in Massagrande (1995).

3 This information was derived from the tables in Prevosti Monclús (1981, 285-289).

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