OXFORD STUDIES ON THE ROMAN ECONOMY

SETTLEMENT, URBANIZATION, AND POPULATION

EDITED BY

Alan Bowman and Andrew Wilson

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General Editors

Alan Bowman   Andrew Wilson

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This innovative monograph series reflects a vigorous revival of interest in the ancient economy, focusing on the Mediterranean world under Roman rule (*c.* 100 BC to AD 350). Carefully quantified archaeological and documentary data will be integrated to help ancient historians, economic historians, and archaeologists think about economic behaviour collectively rather than from separate perspectives. The volumes will include a substantial comparative element and thus be of interest to historians of other periods and places.

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Edited by
ALAN BOWMAN
and
ANDREW WILSON

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Preface

This volume is the second to be published in the series Oxford Studies on the Roman Economy, and, likewise, the second originating in the research programme entitled *The Economy of the Roman Empire: Integration, Growth and Decline,* funded by the Arts and Humanities Research Council in 2005–10 and directed by the Series Editors. Its predecessor, *Quantifying the Roman Economy: Methods and Problems* (ed. A. K. Bowman and A. I. Wilson, 2009) included in its Preface an account of the general aims and character of the research programme that is applicable to the present volume and therefore need not be repeated here. This volume focuses on settlement, population, and urbanization. Earlier versions of most of the chapters were delivered as papers at a conference held in Oxford in September 2007. Simon Keay, Graeme Earl, Peter Attema and Tymon de Haas were not able to attend that conference but we are very grateful to them and John Hanson for supplying written texts for inclusion in this volume. For this volume, we have not thought it appropriate to include texts of responses made to the papers at the conference, but we encouraged authors to take those comments into account in preparing their final version; we hope that the introduction also reflects the reaction to the papers as presented at the conference.

We are grateful to the AHRC for its financial support of the research programme, to the staff of the Stelios Ioannou Centre for Research in Classical and Byzantine Studies, where the conference was held, and to all those who contributed to the discussion at the conference. The task of converting the proceedings into a monograph has also benefited from the interest and support of Baron Lorne Thyssen, which have enabled us to carry forward the research programme for a substantial period beyond that funded by the AHRC. Both the organization of the conference and the completion of the volume owe a very great deal to the post-doctoral research assistants who worked on the project, Drs Myrto Malouta, Annalisa Marzano, Dario Nappo, and Hannah Friedman, as also to the project administrative assistant Gareth Hughes. Dr Miko Flohr, Assistant Director of The Oxford Roman Economy Project, has helped to steer the volume into its final stages of publication and we are very grateful to him for that.

Alan Bowman
Andrew Wilson
January 2011

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Homer to Alexander (Oxford, 1990), and wrote, with Peter Thonemann, *The Birth of Classical Europe: A History from Troy to Augustine* (London, 2010). He also worked on The Sphakia Survey (SW Crete), publishing a website (http://sphakia.classics.ox.ac.uk) and numerous articles. This survey work developed an early interest in ancient demography, from which arose the chapter in this volume.

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Introduction

Alan Bowman and Andrew Wilson

SETTLEMENT, POPULATION, AND URBANIZATION IN THE ROMAN ECONOMY

The chapters in this volume have their origin in a colloquium held in Oxford on 10–11 September 2007 as part of the research programme of the Oxford Roman Economy Project (OXREP). Some of them (those by Bowman, Marzano, Wilson, Mattingly, Morley, Price, and Witcher) were delivered as papers and discussed at the colloquium; others (those by Attema and De Haas, Hanson, and Keay and Earl) were contributed subsequently by invitation, specifically in order to cover topics or geographical areas that had not been discussed at the colloquium but seemed central to the topic. Even so, the geographical coverage of the areas under Roman sway in the period *c.* 100 BC to AD 350 is not and could hardly have been complete, but is (we hope) broad enough to offer a significant survey of the subject with which this volume is concerned: Italy, Greece, Egypt, North Africa, Spain, Britain, and Asia Minor are all represented and offer a reasonable enough range of differences in topography and settlement patterns to be useful for our purposes.

As to those purposes, in accordance with the strategy outlined in the previous volume of the series,[1] we are here concerned with population and settlement. The introductory chapter in that volume dealt in some detail with methods and approaches to the demography of the Roman empire, acknowledging the value of the analysis offered

[1] Bowman and Wilson 2009.

in the recent *Cambridge Economic History of the Greco-Roman World*, particularly on the macro-demographic issues, which have also been discussed by Maddison.[2] It is therefore unnecessary to go into that in great detail here. Maddison's comparisons of the calculations of Beloch, Goldsmith, and Hopkins, together with his own estimates or modifications of their figures, show that there remains a good deal of subjectivity in the debates, a reliance on assumptions about major issues (such as supposed population decline in later antiquity) and a tendency to drift to compromises within the existing parameters. Such analyses are often intended to provoke challenge and debate in order to stimulate improvement. One disadvantage, from our point of view, is that they tend to be static and to mask regional or chronological variation and change except in the broadest terms (as for example with the slave population of Italy on the one hand and Egypt on the other). Another lies in the fragility of large-scale demographic estimates as a basis for the assessment and quantification of economic performance. It seems obvious to us that it would be unwise to base calculations about the economy on the platform of an overall estimate for the population of the empire in the mid-second century AD that might be as low as 55 million or as high as 75 million, with figures for individual provinces that in some cases look like compromises or averages. We have therefore adopted a conservative or cautious approach to such macro-estimates. We would, of course, be more positive if such estimates were more robust, but we must work with what we have that is reasonably secure. We have thus concentrated on the physical sizes of urban settlements and, where possible, their populations (at least relative size if evidence for absolute size is lacking). This approach is underpinned by the ongoing collection of evidence, archaeological, literary, and documentary, that will eventually be presented in a database recording information of this kind for a wide range of regions in the Roman empire.[3] Evidence for the size of urban settlements can, in turn, be brought into relation with such evidence as we have for the size of cities' territories, and the nature of rural settlement. This will illustrate the range of relationships between city and hinterland, the economic and social functions of urban settlements, the role of villages and villas as economic units.

[2] Scheidel *et al.* 2007: 45–9; Maddison 2007: 32–40.
[3] To be made available on the OXREP website: http://oxrep.classics.ox.ac.uk/.

Such an approach will inevitably not immediately produce a few 'big' answers to 'big' questions, nor, in particular at this stage, are we able to track general trends over time, but we hope that it will serve to move forward the debate about the character of the Roman economy by substituting a framework that is at once more nuanced and more varied than one that relies, for example, on the oversimplified model of a productive agrarian sector supporting consumer cities.[4] We believe that this is not only desirable but essential for understanding an empire composed of so many large and diverse regions with different patterns and anatomies of settlement dictated by topography, ecology, and previous 'political' experience over a period of around half a millennium.

We should also emphasize that our approach to the evidence for these different areas and different aspects of economic experience, which essentially aims to open up new questions and areas for debate, has to be both incremental and recursive. It is incremental in that we have chosen to approach the wider subject of the economy thematically rather than regionally or chronologically, dealing consecutively with settlement, agriculture, trade and commerce, and metal and money supply; hence the evidence here assembled for settlement and urbanization patterns will be augmented and enhanced in future volumes by evidence for the other activities and sectors. It would be premature to attempt to bring this evidence to bear on the agricultural economy here and now. This compartmentalization is inevitably an obstacle to stressing the interdependence of the different themes, but we hope that this will emerge more clearly and usefully as the work progresses. It is recursive in the sense that future work will require revision or modification of the views and perspectives (if not the actual evidence) of the individual contributors. Few of them, we guess, would wish to claim their contributions as definitive.

The attempt to impose a degree of coherence on a multi-author volume—especially one on topics where the methodological questions are a subject for such lively debate—without being unduly *dirigiste* has its own problems. We have tried to do this by clearly identifying the issues that we wished to address: size and relationship of settlements; the role of urbanization and urban communities in the context of wider settlement patterns; methods of estimating sizes (relative or

[4] Morley, Chapter 6, this volume.

absolute) of populations or units of population (city, village, household, and so on). There remain significant differences of approach and treatment, as also of types of evidence, between our contributors that it would have been impossible and indeed undesirable to eradicate. The volume thus includes a variety of perspectives, which we hope are representative of the current state of debate. Even though the evidence is patchy and sometimes uncertain or ambiguous to interpret, we have encouraged authors to attempt to indicate the physical sizes of sites and settlements. With such evidence as is available, some have chosen to work with more or less hypothetical figures for population densities in order to derive estimates for population sizes or at least parameters, while others are less confident of the utility of this approach (which might indeed vary between regions). We note, for example, that the average population densities derived for the Roman provinces in the *Cambridge Economic History* are all below 50 per km^2, with the exception of Egypt, which is 167–200![5] Such an exercise may have its uses, but averaging over such diverse provinces that will have very different proportions of habitable or cultivable land seems to us very unhelpful from a macro-economic point of view.[6] Since urbanization bulks large in the volume, it is not surprising that two of the chapters (Marzano, Hanson) address the configuration of urban settlements in different regions with the familiar tool of rank-size analysis, even though there remains a debate as to precisely what such analysis can tell us in the ancient context. We must surely reckon with the likelihood that there are significant regional differences between Spain, Britain, Asia Minor, and Egypt (not least because of topography), but believe it will be useful from an economic point of view to help determine the relationships between very large or medium-to-large urban centres and villages that range in size from a few thousand to a few hundred or fewer. Those relationships will obviously not be determined by size alone. Location, distance, and complexity of 'administrative' facilities also have an important role: modelling spatial relationships in detail may offer some interesting insights, even if some recent attempts have not proved very convincing.[7] Overall, it is our impression that the

[5] Scheidel *et al.* 2007: 48.

[6] It might, of course, be useful from the point of view of estimating the costs of trading or moving goods over distance.

[7] Müller 2003a; 2003b.

'traditional' concept of city and *territorium* with dependent villages, which central place theory would articulate in more sophisticated terms,[8] has tenaciously persisted in influencing our approach to settlement patterns in many parts of the ancient Mediterranean. It may involve gross oversimplification and underestimate the self-sufficiency of village communities (which does not mean isolation from or independence of the major urban centres).

On the basis of the volume of recent scholarship on Roman economic history both in its own context and in comparative perspective, it would be possible to review the issues and the debates at very great length with little prospect of definitive conclusions. Given the focus of this volume, however, it seems most useful to add some brief remarks about methodology in relation to population and urban/rural settlement patterns, bearing in mind particularly the fact that we have asserted our view that urbanization is a proxy for economic growth and prosperity. Although it would be possible to choose many others, our points of departure can be those raised by Morley in this volume and by Ziche in a recent contribution that focuses on late antiquity. For Morley, 'What is clear is that the traditional view, that Rome was a world of cities and that is significant for our evaluation of its economy, is entirely correct, even if the definition and interpretation of that significance needs further work.'[9] And for Ziche, 'Our attempts of understanding [*sic*] the interrelations between city, countryside and trade cannot be dissociated from an explicit model of the late imperial socio-economic, political and even cultural background.'[10]

Given the apparent impossibility, present and future, of addressing some of the key macro-demographic questions with robust data, we resort to asking how best to analyse the economic issues with the data we have. Given the practical constraints of data collection (when, where, how?), we need to ask rigorous questions in relation to our sampling and make no prejudicial assumptions about comparability and contrast. The analyses offered here highlight the issues of regional and temporal variation: Italy, Spain, Britain, Egypt, Crete, Asia Minor from classical Greece to the early Byzantine period. It is our

[8] Christaller 1933.
[9] Below, p. 158.
[10] Ziche 2006: 274, save for his concentration on trade (reserved for a future volume) and the late period.

basic contention that it is only on the basis of an understanding of exactly how the differences played out in detail in a number of scenarios (where we have the evidence) that we can begin to analyse the major trends and patterns in economic behaviour; and that this understanding is hindered rather than enhanced by exclusive concentration on the need to produce estimates on a macro-economic scale. For the present, although they are by no means exhaustive, the contributions to this volume sketch out the varied landscapes in which the many general issues raised need to be further analysed. The relationship between urban settlements and their environs and the economy of rural settlements in or beyond those environs is crucial, and we suggest particular aspects that might repay analysis: in particular the physical size of settlements and the relationship between size, location, and distribution.[11]

On the one hand, it can be argued that our method of identifying and counting 'cities' is inevitably crude (we are hardly nearer to establishing definitive and universally accepted criteria than we were half a century ago).[12] Attempts to base a count on a minimum population size are bound to falter for lack of robust statistical data. It is in any case perhaps more useful to set aside the relatively very few enormous conurbations and think in terms of a functional approach. In a comparative perspective, what counts as 'city' in Britain or Dalmatia might be only the size of a 'large village' in Egypt or Syria. Thus, in a given region what is significant is the number of comparatively large and more functionally complex settlements. And there will be a hierarchy of complexity, exemplified by the fact that many 'large villages' in the East had administrative, social, and economic institutions beyond the level appropriate to what might crudely be characterized as subsistence agricultural communities. If, then, for the sake of argument, there is urban decline or contraction in the later period, at what level of economic efficiency and growth (or not) can such villages function? Might their populations increase at the expense of the declining and shrinking cities, or is it inevitable that if urban populations shrink, rural population must also? How do we compare different areas in the context of the costs of the 'technologies' that cities support with revenues derived to a significant extent from the rural economy? There might, for example, be landscapes in

[11] Prominent in Bintliff and Sbonias 1999 and in several other recent works.
[12] Hanson, Chapter 9, this volume; cf. also Maddison 2007: 40–3.

which it becomes more viable to support those technologies in nuclei that are smaller than conurbations but large enough to achieve the required functional complexity in a rural environment. That, we suggest, is a proposition that could perhaps only be tested for the later empire in the East. If that were possible, it might also lead us to consider the balance between the effects of Malthusian population controls and violent 'shocks' (such as plague or earthquake) on changing patterns of settlement. Behind these extremely complex and challenging questions, which would take us beyond the chronological horizons of our present project, must lie a robust scenario of overall population increase and urbanization in the 'high empire' and, at least in some areas, a decline in urbanization in the later period.[13] Until the end of the fourth century, economic vigour and prosperity is evident in many areas, certainly in the sweep from Asia Minor around the southern Mediterranean to the Straits of Gibraltar and arguably also in much of Spain, Gaul, and Italy.

Clearly, however, there are changes in the third and fourth centuries, and if these are not simply a matter of straightforward 'decline' or a shrinking economy, any closer analysis will have to identify and address the functional relationships between urban and rural communities that are now recognized to be much more complex than the balance between rural production and urban consumption. The implication of the quotation from Ziche is that urban communities provide administrative facilities, technology, media of information exchange, markets, and social 'norms' that are essential to economic growth and prosperity (and he sees this as implicit in the way in which cities are characterized in literary sources). Further extrapolation will lead us to consider hierarchies of settlement in the characteristic classical pattern of city plus territory, the way in which those entities are defined, from the highest to the lowest level: the empire as 'city of Rome plus territory'; regional and local hierarchies; and then more precisely the identity and the nature of the 'instruments' that enable them to function in economic cohesion (which essentially leads us on to topics in future volumes). It is our impression that the application of useful but limited analytical tools such as central place theory, Thiessen polygons, and rank-size analysis, which are used explicitly or implicitly by some of our contributors, do not take

[13] But perhaps far from universal and not beginning in earnest until after AD 400 (cf. Ward-Perkins 2005).

us as far as we would wish to go. We might, for example, think of ways in which different classifications and agglomerations of evidence for port sizes and facilities and the exchanges of goods and services that they enable illuminate patterns of economic behaviour on a local and inter-regional level.[14]

The chapters in this volume fall into two main groups, the first dealing with the evidence for rural settlement as revealed by archaeological field surveys, and the attendant methodological problems of extrapolating from that evidence to a view of population; and the second with city populations and the phenomenon of urbanization.

In the first group, the chapters by Witcher, Mattingly, and Attema and De Haas respond to the approach set out by Fentress in the earlier volume.[15] These are preceded by Price's chapter, analysing the potential contribution of field survey to demographic reconstruction using data on site sizes from the Sphakia survey on Crete. Although there are more than occasional glances at the Roman period, many of the data that he discusses derive from the Greek and Hellenistic periods and thus may seem to sit somewhat uneasily in a volume on the Roman economy. There are, however, good reasons for including it, particularly from a methodological point of view. The relationship between size of site and size of population is central to analysis of this and other areas of interest in the Roman period, as are the estimates of sizes of house and household; both of these issues are discussed elsewhere in the volume in relation to other parts of the Mediterranean. Furthermore, it places the Cretan settlements in the context of a *longue durée* on the basis of newly collected data that are suggestive of change from the classical Greek into the Hellenistic and Roman periods and beyond. Price points out, for example, that *comparanda* from Ottoman census records in the same area suggest that population densities below 100/ha, perhaps in the range 40–60/ha, are more likely for villages and small Cretan *poleis* than the ranges of 100–150/ha more commonly assumed by field surveys in Greece. However, planned towns or larger sites may have had higher densities and we need to consider whether these are more characteristic of the post-classical period and may be compared with developments in other areas such as Egypt and Asia. And further thought is needed about the best use of population *density* estimates. These clearly vary

[14] Schörle 2011. [15] Fentress 2009.

greatly across time and space, dependent (among other factors) on the nature of the terrain. This analysis will help us to address key questions about possible changes in patterns of economic behaviour over these periods. Witcher emphasizes the need to consider site recovery rates—that is, how effective a survey has been in identifying sites—and take into account the fact that these are affected not only by the post-depositional factors more usually discussed, but also by behavioural factors in antiquity, such as whether or not the inhabitants of sites had access to the kinds of diagnostic pottery, usually finewares, that help us assign sites to particular date parameters. He then uses two alternative models to examine the effects of different site recovery rates on the question of a high or low count for the population of Roman Italy in the early imperial period, arguing that if we want to believe that survey evidence suggests a low population count (because of a high site recovery rate), then that population was well integrated into pottery supply networks that make them archaeologically visible; if we wish to believe that the population was larger, we need to assume a lower site recovery rate and the corollary is that the rural population had less access to diagnostic finewares, suggesting that they were less well integrated into economic networks. This does, however, assume that ancient behavioural factors (use of finewares) are more important than post-depositional factors (erosion, alluviation, landscape change, surface visibility) in determining site recovery rates. Mattingly's chapter, by contrast, demonstrates the potential impact of the latter—he compares the results of population extrapolations from arid-zone surveys, where visibility is good and site recovery rates should be high, with those from plough-zone surveys. They produce, on the face of it, similar population densities, but as it is implausible that arid pre-desert zones were as densely settled as fertile Mediterranean landscapes this suggests that the plough-zone surveys are probably recovering a much lower fraction of the total number of sites, and that overall population densities were probably higher in these regions. Attema and De Haas then attempt a population extrapolation for the Pontine region around Antium, using Fentress's methodology as refined by Witcher.[16] One of the important points that they demonstrate is the variable recovery rates for different types of sites achieved by three surveys of differing

[16] Fentress 2009; Witcher, Chapter 3, this volume.

intensity in the region (two one-person surveys in the 1970s, and a more intensive recent survey in the 1990s but after substantial urbanization in the intervening years); and since the areas of some of these surveys overlapped, some assessment can be made of maximum recovery rates by the different surveys. They estimate a population density for the region of *c.* 55–60 people/km^2 in the early imperial period, a figure matching that suggested by Witcher for the extended *suburbium* of Rome. These are much higher density figures than for the early and middle Republic, suggesting the scale of population increase in central western Italy in the last centuries BC, fuelled perhaps by improved trade and communications connections to Rome through Nero's harbour at Antium.

The remaining chapters address the issue of urbanization. Morley sets out some of the theoretical debate about urbanization in the Roman world and its possible relationship to the economy, reminding us in particular of the city's importance as a location of demand and of the concentration of political power; Wilson's contribution looks at some of the physical evidence for Roman towns to see how we might establish the parameters of the plausible in estimating population densities for Roman cities in different regions, and therefore creating a set of possible estimates for population sizes of towns whose physical extent can be measured. A rough estimate is then presented for how the aggregate total of the urban population living in centres of 5,000 people or more in the mid-second century AD might relate to guesses about the total size of the population of the Roman empire. Marzano's chapter applies a rank-size analysis to datasets of physical areas for cities in Britain and the Iberian Peninsula, with results suggesting that the urban systems of these areas show a high degree of interaction with the outside world. Within the Iberian Peninsula, the urban system of Lusitania appears more self-contained than those of the provinces of Hispania, where the deviation from the expected rank-size distribution suggests that we are not in fact looking at a complete urban system within the province, but at an urban system integrated into wider Mediterranean connections and whose primate city is Rome. Hanson extends this approach to Asia Minor, showing both that the population estimates for some of the major cities of the region (Ephesus, Pergamon, Miletus, etc.) have been considerably exaggerated in previous literature, and that the model suggests that the region as a whole was closely integrated into a wider urban system focused on the Mediterranean.

The analysis of urban territories is clearly important in the assessment of the economic role of urban systems, but is even less straightforward than the analysis of cities. Is a large territory indicative of a large city and lots of resources, or of a large but not very fertile area that is thinly populated (as some of the notional territories suggested by Hanson's Voronoi diagram analysis for eastern Asia Minor)? In other words, is territory size really a measure of city importance (as Tacoma's study for Egypt assumed),[17] or sometimes inversely correlated? Keay and Earl's chapter on cities and city territories in Baetica addresses the problem using multiple criteria and approaches to the definition of territories, thus enabling the attribution of a hierarchy of urban settlements to the territories of top-level settlements, something a simple Voronoi diagram or calculation of Thiessen polygons is unable to do.

Bowman reviews the evidence for the population of Roman Egypt and its distribution among different kinds and sizes of settlement; possibly 20 per cent of a (high count) population of 7.5 million lived in (large) cities; and indeed, settlements in Roman Egypt were remarkably large by comparison with those elsewhere, some villages apparently being larger than major towns in other provinces. There is good evidence for population increase from the Ptolemaic period through to the mid-second century, when the Antonine Plague seems to have had an important impact, but there appears to have been some recovery by the third century; the evidence for what follows is far from conclusive and whether it is to be regarded as recovery, stagnation, or decline is still open to debate. Given the claim (now commonly accepted) that Egypt was very heavily populated by Roman standards, further claims about its broader significance in the context of the Roman Mediterranean highlight the counterpoint of regional idiosyncrasy versus generic patterns and need to be carefully formulated. In an empire composed of very diverse regions, the concept of 'typicality' is elusive and probably illusory, but the position here adopted is that analysis of Egypt's population structure and the economic relationships between 'units' of population (cities, villages, households) is significant for patterns of human behaviour in the eastern Mediterranean in classical antiquity.

[17] Tacoma 2006.

The variation in approach and the ongoing debates between some of the chapters might suggest that we need to be cautious about drawing any major conclusions from these diverse contributions. However, the juxtaposition in this volume of studies attempting to extrapolate rural and urban populations throws up some interesting points. For example, urban population studies assume between five and six people per household, while rural population studies assume five per farm. Is this last figure large enough; do rural farms contain no more people, or even fewer, than urban houses? Nevertheless, a number of points emerge. Both the field survey evidence from Italy and the documentary evidence from Egypt support the impression of population growth from the late Republican period to the mid-second century AD, accompanied by intense urbanization, especially in the west, from the Augustan period through to the middle of the second century. There are good reasons to believe that the Antonine plague caused a sudden and severe population drop in many areas, but also that some recovery had taken place by the middle of the third century. After the middle of the third century, however, decline is not certain and in some areas demonstrably untrue.

The contributions by both Price and Witcher suggest a very high urbanization rate—*c.* 50 per cent—for the ancient Greek world, but this is achieved by including the population of all *poleis*, many of which were very small, instead of setting a population threshold (as other studies in this volume have done, usually with a threshold of 5,000). Moreover, not only were many Greek *poleis* physically small but if their population density was—as argued by Price—in the region of 40–60/ha, then they were substantially less thickly populated than were planned Greek or Roman towns (where this can be checked by house counts, as at Olynthos, Pompeii, Sabratha, and Timgad), and were in the same density range as Rathbone proposes for many Egyptian villages, and which might be thought likely for Roman villages elsewhere. This may in fact reflect the nature of those *polis* settlements; they were chiefly *agrovilles* in which a considerable proportion of the population farmed surrounding fields, and this helps explain the apparently high urbanization rate. This is a very different kind of urbanization from the pattern in much of the Roman world, where towns were frequently much larger and a smaller proportion cultivated adjoining land; Roman city populations much more often exceeded the amount that could be supported within the radius of a daily commute to fields.

Roman-period cities in the empire as a whole, by contrast, are typically much larger than *poleis* of classical Greece; and, in different ways, both smaller and larger than we might have expected. Smaller, because closer scrutiny of the evidence for some larger cities of Asia Minor cuts them down from 100,000–225,000 to closer to 40,000–90,000 (Hanson, Chapter 9, this volume); larger because there are a surprisingly high number of middling to large cities by pre-industrial standards (5,000–50,000). The urbanization rate at a threshold of 5,000 in the mid-second century is comparable to seventeenth- or eighteenth-century northern European economies; many provinces boasted several towns of 10,000 or more, equivalent to late medieval York and larger than the capital of the Republic of Ragusa. In some regions especially, notably Egypt, the size of both urban and non-urban settlements is much larger than expected—Egypt had a remarkable number of cities whose population probably exceeded 30,000, and the physical extent of Egyptian villages is striking, with a number exceeding the physical size of cities like Sabratha and even Pompeii, even if population density cannot have been as high. There is also a remarkable number of large cities in the eastern provinces more generally. And cities even of under 5,000 people built an impressive amount of monumental structures, ranging from the overtly utilitarian, religious, ideological, and ornamental—eloquent testimony to their role as a concentrated locus of political power and social theatre. We are still at the beginning of trying to form a picture of the urban system of the Roman empire as a whole, but it is clear that an empire-wide view is necessary as the rank-size analyses of urban size in individual provinces suggest that provincial urban systems are not entirely contained within provincial boundaries but that the phenomenon of urbanism is an empire-wide development resulting from integration into a pan-Mediterranean system focused on Rome (as one might expect).

The studies in this volume thus emphasize something of the considerable regional diversity and different paces of development evident from studies of population and settlement across the empire, which clearly means that we need to be careful about making generalized statements. Nevertheless, they provide a foundation on which it may be possible to base certain generalized claims, and even more importantly, many of them set out the evidence for regional and in some cases chronological variation that is indispensable if we are to develop both a larger and a more nuanced picture. In attempting that development for specific sectors in future volumes, we emphasize that the aim of the present collection is not to answer 'big' demographic questions that have so far resisted definitive solution, but to see how we can best use the imperfect available data to quantify economic behaviour and activity.

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Part I

Survey method and data

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2

Estimating Ancient Greek Populations

The Evidence of Field Survey

Simon Price

Back in 1990, Lucia Nixon and I explored the value of the Athenian Tribute Lists as a source of systematic information about 200 or more city-states in the Athenian empire.[1] We were sceptical about the use of these data for demographic purposes, especially for states paying one talent or more in tribute. Instead, we argued that the Tribute Lists should be used as an index of the variations in local resources in the Aegean world. This chapter explores the value of another source of systematic information, namely archaeological field surveys, and argues that this source does offer a basis for estimating the populations of ancient Greek (and perhaps other) states.

It is rare to have census data for antiquity. Classical or Hellenistic Greek states had some sense of how many men would in principle turn up if the *polis* sought to fight at full strength (*pandemei*). Such counts as were made in the classical period were made at moments of military crisis, to assess manpower.[2] We have no synoptic sets of figures, notional though they may have been. Instead, we have isolated claims in ancient writers about individual places, and, when we do have these figures, we have to guess what proportion of the population they represent. What we cannot get from these sorts of figures is a general pattern.

[1] Nixon and Price 1990: 137–70. See now Tenger 1995: 139–60; Hansen 2006a: 7–10.

[2] Megalopolis 318 BC (against Polyperchon: Diodorus Siculus 18.70.1); Rhodes 305 BC (against Demetrios, Diodorus 20.84.2–3).

In Egypt, the Ptolemies introduced a regular census (building on Pharaonic precedent), for fiscal purposes. The Romans, too, began to have regular censuses, but the data that survive from them are unsatisfactory. For the republican period, we have numbers of Roman citizens, but their distribution between Rome and towns in Italy is not known; then we have Augustan censuses, although their data seem not to be comparable with the republican data; and the numbers of recipients of the corn dole in Rome, although the exact composition of this group is debatable. The upshot is that scholars guess that early imperial Rome had a population that, at times, approached one million persons (which would make it the largest pre-industrial city in Europe, apart from London and Istanbul).

Furthermore, how large was the population of other towns in the empire?[3] It is customary to say that Alexandria had a population of half a million, and that places like Carthage, Pergamon, and Ephesus were in the next tier, with populations of maybe 200,000.[4] It used to be believed on the basis of an inscription (*Inschriften von Ephesos* 951) that the number of Ephesian citizens was 40,000; from this scholars inferred a total population of maybe 200,000. However, as Warden and Bagnall pointed out, the Greek of the inscription (referring to the number of citizens in receipt of a benefaction) had been universally mistranslated: *χειλίους τεσσαράκοντα* has to mean not 40,000, but 1,040.[5] This is a large number to be in receipt of a benefaction, but no basis for an estimate of the total citizen body of Ephesus. A better bet is the census held in Syria under Quirinius in AD 6: the tombstone of a soldier who died in Syria (probably in Beirut), recorded that 'I also on the order of Quirinius took the census at the *civitas* of Apamea with 117,000 citizen people'.[6] The phrase 'citizen people' is problematic, but probably refers to the entire free population (male, female, and children), of course not for the city of Apamea, but for the *civitas*, the city and its very large territory. So there are some reliable numbers,

[3] Figures for towns in the Roman empire have to be obtained indirectly: Duncan-Jones 1982: 259–87; Mitchell 1993: 1. 243–4.

[4] Alexandria: Bagnall and Frier 1994: 54; Clarysse and Thompson 2006: II. 101–2. I note that Bagnall and Frier accept a very high population density, 400 persons/ha, the same as that for Alexandria in 1798.

[5] Warden and Bagnall 1988: 220–3.

[6] *ILS* 2683 (= EJ 231): *idem iussu Quirini censum egi Apamenae civitatis millium homin. civium CXVII*, with Kennedy 2006: 109–24. Cf. on problems of Luke: Schürer 1973 vol. 1: 399–427; Millar 1993: 46–8.

but they are patchy, in both space and in time. What we need are proxy data, which might permit a broader set of inferences.

Graves have been used for this purpose in archaic and classical Greek history: estimates of the changing population sizes of Lefkandi, Pithecusae, Attica, or Argos have been made on the basis of excavated graves.[7] For example, the population of Attica is said to have increased annually by 4 per cent in the eighth century BC. However, such claims are poorly founded because we do not know the relationship between the excavated graves and the original universe of graves. The subset of excavated graves with grave goods (which we can date) is the product of social and not demographic factors, and we do not know the relationship between this datable subset of graves and the total number of graves at any one time. This sort of quantification, therefore, does not work. However, some impressionistic claims must be true: the overall amount of excavated material must mean that there were more people alive in 400 BC than in 800 BC. In any case, the changing fashions of burial mean that, for later periods of antiquity, one could not even begin to play the quantification game on the basis of excavated graves.

Size of territories is a second type of proxy data that might be used to establish population sizes. In this case, the data are widespread and quite secure. For about three-quarters of the locatable *poleis* in Hansen's *Inventory* (635 out of 869 states), the size of the territory is determinable for the archaic or classical periods.[8] About 60 per cent of them had territories of 100 km^2 or less, and nearly 80 per cent had territories of a maximum of 200 km^2. Therefore, as Ruschenbusch argued over twenty years ago, most *polis* territories were quite small (for example, Asea in south-west Arcadia, had a territory of *c.* 55–60 km^2). A territory of 100 km^2 would (if circular, just to simplify the sums) have a radius of only 5.6 km, and one of 200 km^2 would have a radius of only 8 km. In either case, the size of the territory has obvious implications for the distribution of settlements within the territory. For 80 per cent of *poleis* (like Asea) with territories of less than 200 km^2, even the outer limits of the territory were a possible, even an easy, day's commute from the centre.[9] Equally, this intimate picture is

7 Snodgrass 1980: 22–5. For criticism, see Morris 1987; Morris 1992: 27, 78–81; Scheidel 2003: 120–40.

8 Hansen and Nielsen 2004: 71. Cf. Ruschenbusch 1985: 253–63.

9 Morgan and Coulton 1997: 125–6: normal maximum walking time 2 hours (or *c.* 10 km) in twentieth-century Greece.

not true for the 10 per cent of *poleis* whose territories were between 200 and 500 km^2 in size; let alone the further 10 per cent of *poleis* whose territories exceeded 500 km^2 in size, where subsidiary nucleated settlements would be expected. Of course, it is in those larger states that subsidiary places are attested (for example, the extraordinary richness of Argive village names employed in fourth-century financial documents[10]).

The inferences that can be drawn about population levels on the basis of territory size are, however, limited. Some extremes can be eliminated. It cannot be true, as Athenaeus (372d) claims on the basis of Aristotle (fr. 475.1 Rose), that Aegina had 470,000 slaves; the island, with an area of 86 km^2 (and little of its own water), would have had a slave population density of 5,500 slaves/km^2 (even if some of the slaves were hired out to work in the Attic mines; for comparison, the Netherlands today, the most densely populated European country, has a population density of 375 persons/km^2).[11] However, that sort of exaggerated statement aside, the use of size of territory is more problematic. One suggestion is to use ratios between early modern populations and the area of the territory of individual villages,[12] but this idea depends too much on environmental uniformity to be viable. Some scholars have attempted to argue about the 'carrying capacity' of individual territories (the territory of Asea can support around 2,000–3,000 people), but such arguments are not very helpful.[13] They are based upon data from modern, or early modern, censuses for that territory, which are then taken to be the carrying capacity of the area. Even if distortions created by nineteenth- and twentieth-century economic developments can be dealt with (for example, by use of earlier, Venetian, or Ottoman, data), the point remains that later census data show only what population an area *might* support, not what it *did* support in antiquity.[14] Arguments about carrying capacity do have some use, in that they suggest that ancient maximal populations should not be (say) more than double or treble the levels attested in the early modern period, but they do not show what the population actually was in any period of antiquity.

[10] Kritsas 2006: 426–30 (40 new village names attested).

[11] Hansen 2006b, who also rejects the slave figure, calculates a population whose density is still rather high, at 235 persons/km^2.

[12] Laiou[-Thomadakis] 1977: 37–46 (Byzantine villages of northern Greece).

[13] Forsén and Forsén 2003: 270 for Asea. Cf. Sanders 1984, on Melosa.

[14] So too Hansen 2006a: 12–14, 77–91.

The sort of proxy data that is more promising, and on which I want to focus here, is that of settlements. I do not mean the simple *number* of settlements and their changes from period to period: changes in number can always be the result of changes in preferences for nucleation or non-nucleation. Rather, I mean to focus on the areas of settlements. As Hansen has shown, it is possible to draw demographic inferences from the areas of settlements known from excavation or from study of the standing remains.[15] To this type of data, I wish to add the evidence of the areas of surface scatters of pottery as recorded by archaeological field surveys. Together, these two sources offer uniquely comprehensive sets of data, across both space and time. If they can be used in a reliable fashion as the basis for population estimates, then we have gained an enormous amount. This potential gain perhaps meets the negative view of some that field surveys, once they have put lots of dots on maps, have done all that they possibly can do, and that scholars should therefore move on or back to other data.[16] Sites that have been fully excavated, or that have fully visible standing remains, are of course unusual, and the challenge is to establish a reliable way of analysing the surface pottery scatters, which are typically what field surveys recover. Others have already made use of survey data for this purpose, but the argument of this chapter is that the population densities that they assume are often much too high.

The obvious place to start is with the excavation of ancient sites or the study of their standing remains. For some places, the area of domestic housing and the average area of houses is known: for example, classical Halieis, Delos, or Metaponto in south Italy. I think that one should assume five persons per house. This multiplier of five per house has its critics (Hoepfner and Schwander use twelve per house[17]), but the multiplier of around five is supported by the census data from Hellenistic and from Roman Egypt.[18] If one does assume five persons per house, then the population of the place can be calculated. On the basis of five per house, the calculation produces 156 persons/ha for Delos, 215 persons/ha for Metaponto, and 250 persons/ha for Halieis.[19] Those figures are fairly secure for those places and times, but I wish to argue

15 Hansen 2006a: 35–63; Hansen 2008.
16 E.g. Bowden and Lavan 2004: xii.
17 Hoepfner and Schwandner 1994: 72.
18 Clarysse and Thompson 2006: II. 314–15; Bagnall and Frier 1994: 67–9.
19 Jameson, Runnels, and Andel 1994: 549–50; Cherry, Davis, and Mantzourani 1991: 280; Carter 2006: 209.

that they cannot be extrapolated to the rest of the Greek world, let alone more widely. I want to argue that figures above 150 persons/ha are exceptional in the Greek world,[20] and the 125 persons/ha figure popularized by the Argolid Survey is too high for most places.

The planned towns of Metaponto or Halieis, or the confined site of Delos, where houses were put very close to each other, had much higher population densities than many towns. Note that even the planned town of Olynthus in the late fifth century, with 600 houses, has a density of only 110 persons/ha.[21] Even then there are unplanned towns. Metaponto, Olynthus, and Halieis are likely to have much higher densities than unplanned towns, which simply grew by agglomeration. This appears to be true of, for example, archaic–classical Corinth, Argos, and Thespiae; they all seem to be agglutinative conglomerations rather than dense settlements.[22] Estimating the populations of large, agglutinative sites on the basis of their areas is going to be difficult, and this matters because this type of site may be quite common.[23] There is good evidence that densities much lower than 110 persons/ha were common. I note here two sets of evidence that point in the same direction.

First, the splendid survey by Kolb in central Lycia of Kyaneai and its territory has recorded a series of ancient settlements of different sizes: Kyaneai itself, eight large settlements, around seventy hamlets, and no fewer than 430 farms.[24] As walls survive at most of the sites, it is possible to estimate the precise number of houses: 110 for Kyaneai, 25 or 30 for villages, and 3 to 15 for hamlets. I have calculated population densities from these amazing data: 80 persons/ha for Kyaneai, 30 or 40 persons/ha for villages, and an average of 40 persons/ha for the hamlets. These data give the demographic conclusions for Kyaneai and its territory in the Roman imperial period (see Table 2.1).

Strikingly, the table shows that only about 15 per cent of the population lived in the main settlement. The data for Kyaneai diverge

[20] Aperghis 2001: 72–3 assumes 100–200 persons/ha in 'certain rural areas in the Middle East', with urban areas averaging *c.* 200 persons/ha. Hansen 1997: 27–8 estimates 200+ persons/ha for late fifth-century Plataeia, which seems on the high side.

[21] I recalculate the figures of Hansen 1997: 30.

[22] Morgan and Coulton 1997: 92–4.

[23] The other tactic, of assuming 10 m^2 of floor space per person, involves far too many culturally relative assumptions (cf. Whitelaw 2001: 15–17).

[24] Kolb and Thomsen 2004; Schuler 2004; Hailer and Şanli-Erler 2004; Şanli-Erler 2006.

Table 2.1. Population calculations for Kyaneai, villages, hamlets, and farms.

Kyaneai	550
Six villages	650
Seventy-one hamlets	1,500
215 farms	1,075
TOTAL	3,775

dramatically from the picture inferred by Hansen in part from field surveys on the Greek mainland, where he argues that a clear majority of the population lived in the *polis* centres.[25]

Second, the settlements in the territory of Eretria are a unique case study for central Greece in that there survives most of an early third-century BC census recording the citizens of Eretria deme by deme, and, in addition, the extensive field work conducted by Sylvian Fachard of the Swiss School has located all the major deme centres. Preliminary analysis of the epigraphic and archaeological evidence supports the argument of this chapter. In those places where we can identify deme centres on the ground, the census data give low population densities, of 40–60 persons/ha.[26]

The conjunction of these two pieces of new evidence shows that, whereas a planned town like Olynthos might have a density of 110 persons/ha, unplanned towns (which means the majority of ancient settlements) had much lower densities, in the region of 40–60 persons/ha.[27]

The second type of evidence that should be used is comparative evidence. I am strongly in favour of the use of this evidence, but it is particularly prone to abuse. Some have used the population densities of medieval European towns in order to argue for the densities of Greek and Roman towns,[28] but this is too crude a comparison to be useful. Others have used data from modern Near Eastern towns to argue for prehistoric Greek settlements and for Graeco-Roman

[25] Hansen 2006a: 64–76.

[26] Sylvian Fachard, Lucia Nixon, and I are planning to publish a more detailed analysis of this material. Our preliminary results are quite different from those of Hansen 2006b: 61–88.

[27] Hansen 2006a: 47–51 happens to include only planned cities as his base data, and thus gets a figure of 150 persons/ha.

[28] Pounds 1969: 142 has 150 persons/ha, which he thinks may be low.

villages.[29] Renfrew's pioneering book on the Cyclades and the Aegean in the third millennium BC estimated a density of 300 persons/ha for Bronze Age sites and 200 persons/ha for Neolithic sites, but this is based on a guess by Frankfort of 400 persons/ha for ancient Mesopotamian urban sites. The Argolid Survey, which estimated, as we have seen, 250 persons/ha for Halieis, estimated a figure for villages (125 persons/ha) on the basis of figures for modern Near Eastern villages, but those modern figures turn out, on close inspection, to rely merely on guesses made by British soldiers driving through the area in 1919. (This estimate of 125 persons/ha has proved rather popular with other surveys, which have used it as the basis for some of their own calculations.[30]) Obviously, one needs to get the comparative data right (although the frequency of error here shows that the point is not always obvious). More significantly, I would also suggest that the comparisons need to be drawn with greater care than is usually done. The Near East, with its quite different environment (especially in relation to water), is not a good source of *comparanda* for the purpose of establishing population sizes for the Aegean world. Comparisons are arbitrary if they do not take into account the organizational infrastructure of settlements, the variations of environment, and socially variable attitudes to conceptions of space. It is better to reduce the variables to a minimum by employing comparative data from the same sort of environment and within the same sort of technological constraints as the area and time under investigation. The best set of comparisons can be derived, I would suggest, from early modern data from the same places as one is investigating for antiquity. (This too must be done with care. The Minnesota Messenia Survey calculated a figure for modern villages in Messenia (112 persons/ha), and then without discussion picked a higher figure (130 persons/ha) for prehistoric villages in Messenia.[31])

[29] Renfrew 1972: 251 estimates 300 persons/ha for Bronze Age sites and 200 persons/ha for Neolithic sites, but this is based on a guess of 400 persons/ha for Mesopotamian urban sites. Jameson, Runnels, and Andel 1994: 542–3 estimate 125 persons/ha; they rely on Adams 1981: 69, 349 n. 6, 144, 349–50 n. 1, but his modern population data are mere estimates. Wilkinson 1999: 46–7 presents the extraordinary range of more recent Near Eastern estimates (15–25 persons/ha up to 248–1,205 persons/ha). Kennedy 2006: 117–19 argues that even for the Roman Near East estimates of 400–500 persons/ha are much too high.

[30] Hayden 2004: 49, 173; 296 notes that the Ottoman densities for this area are of the same order of magnitude as the Near Eastern parallels, and hence support their use, but this is to reverse the correct logic.

[31] McDonald and Rapp 1972: 128.

I turn now to Sphakia in south-west Crete. I am currently completing, with others, the final print publication of the field survey of this area.[32] For Sphakia we have good early modern data: both census data, village by village, for more than 200 years, and also estimates of the areas of individual villages (based on maps and sometimes on our own measurements).[33] The quality of the Ottoman censuses was extremely high: they were meticulously conducted, recording the names of each head of household, plus the number of unmarried adult males.[34] However, the use of these data, good though they are, requires some care. One option is to apply Model Life tables to them (as has been done in the Asea Survey). The Forséns argue that one should use a multiplier of 3.5 to heads of households, and then add the unmarried males. The alternative is simply to employ a multiplier to the heads of households, setting aside the unmarried males: a multiplier of 5 is commonly used, but I use a family multiplier of 4.42 (the ratio known for Sphakia in the census of 1881).

The ratio between the population of the villages and the areas of the sites can be estimated for various dates. We have omitted those villages whose population data are insecure because of seasonal population migrations. There are two uncertainties in the calculations: the population figures have a margin of error, and the areas, estimated from maps, may be larger than the extent of habitation in 1881 or 1900. In some cases we have been able to take account of the problem of the changing extent of a settlement. This problem of the area of habitation in the later nineteenth century arises because of the decline in the population of Sphakia after 1770 and again after 1828, when there were disastrously unsuccessful revolts.

The striking fact about the data presented in Table 2.2 is that the densities are so much lower than those used by most field surveys. Our data show that the 50–60 persons/ha range was normal for early modern Sphakia. By contrast, Boeotia uses 225 persons/ha of domestic occupation (or 126 persons/ha of whole site); Keos uses 150 persons/ha; Southern Argolid uses 250 persons/ha for walled towns, or 125 persons/ha for villages. Only two Greek survey publications, as

32 For an introduction to the Survey, see Nixon *et al.* 2000.

33 For more details, see Price *et al.* 2008: 69–99.

34 The great exponent of these data is Michael Kiel, who has contributed selflessly to the work of other projects. For some of his key articles, see: 1999a, 1999b, and 2007.

Table 2.2. Average density for the 13 villages in the area of modern Sphakia. Anopoli, Khora Sphakion, and Askyphou cumulate the areas of the separate hamlets.

Census year	1650	1655	1704	1881	1900
Av. persons/ha	53	60	58	43	50

far as I know, consistently use a range that comes down as low as ours (but without much supporting argumentation): Richard Catling in the Lakonia Survey suggests 50 persons/ha for hamlets, and 100 persons/ha for villages,[35] and the Western Mesara Survey suggests 30–50 persons/ha for smaller sites (up to 10 ha), and 50–100 persons/ha for large sites, over 10 ha.[36] The difference between the high figures used by most surveys and those of the Sphakia Survey might be due to environmental factors (Sphakia is a relatively resource-poor area), but it might also be because of lack of attention to detail by most other surveys. At the very least, I would like to see analysis of Venetian or Ottoman data for those areas as a control over the assumptions that they make.

The next crucial move to make in the analysis of survey data is to take into account the sizes of sites, not simply their number in any one period. Otherwise one is likely to be recording just changing patterns of nucleation or non-nucleation, rather than changing patterns of demography. This point applies especially to the analysis of small rural sites. Those surveys that operate with high village population densities (say 150 persons/ha) have tended, then, to have a single category 'farm' for all other sites. However, as Whitelaw has shown in a re-analysis of the Keos data, rural sites must also be taken to include groups of farmhouses, which considerably affects the total rural population.[37]

It is possible to calculate the areas of the 102 Graeco-Roman settlement sites in Sphakia in different periods of classical antiquity. The areas are known in some cases from the visible remains of buildings or stone tumble, and in others from the area of pottery

[35] Catling 2002: 206.

[36] Watrous, Hadzi-Vallianou, and Blitzer 2004: 24–5. Hayden 2004 sometimes (e.g. 48, 173, 352) uses the figure of 66 persons/ha (minus 20 per cent for non-living spaces), but this is based on Near Eastern parallels.

[37] Whitelaw 1998.

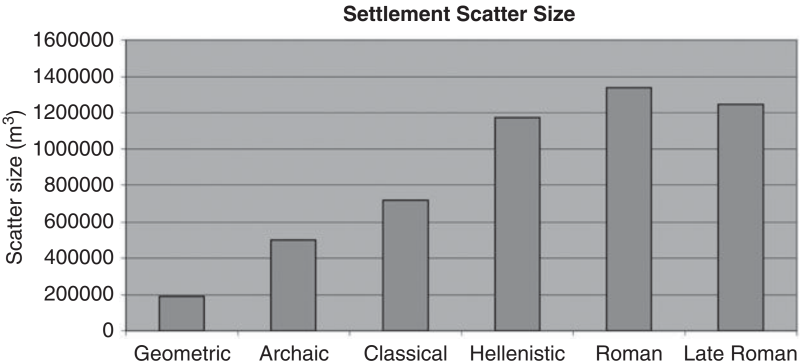

Fig. 2.1. Sphakia Survey: pottery scatters of settlement areas.

scatter. Areas of sites that existed for more than one period within the Graeco-Roman epoch are given equally for each period; our data do not permit us to give different areas for different periods of the same site. We also assume that all sites of a particular period existed contemporaneously, and that individual houses or groups of houses were permanent residences. For the major sites of Anopolis (4.21 ha), Phoinix-Loutro (5.11 ha), and Patsianos Kephala (8.30 ha), only the areas of housing are included.

Making an estimate, not only of changes in the extent of settlement in Sphakia, but also of absolute levels of population, is more speculative. Nonetheless, it is worth making the attempt, both to humanize the data and to enable one to make comparisons between Sphakia in this epoch and other places and periods. Figures have been calculated for each Graeco-Roman settlement site (not just for the pottery scatters). Actual figures for inhabited areas (of course much smaller than the extent of pottery scatters) were used wherever possible (see Fig. 2.1). Where tumble did not survive, an estimate of site type ('1 house', '2–9 houses', etc.), made on the basis of the extent of pottery scatter, was used.

The right multiplier then has to be applied to the area of settlement of any particular period. We think it helpful to use the data just established for early modern Sphakia. We do not assume that there are no differences between these epochs, but we are comparing like for like in terms of environment and (approximate) scale. We also insist on the need to recognize the uncertainties of the calculations by using a range of possible densities: the Turkish figures show a considerable range at any given time, and also show variations in density as the population increased and declined. The densities suggested by the Turkish data for Sphakia are much lower than those used by other scholars for the Graeco-Roman period, namely 40–60 persons/ha. They are compatible with cases where we can calculate figures independently. At Phoinix-Loutro (5.11C), the calculation by area gives a range from 36–54 persons/ha, while a calculation based on the number of identifiable houses (assuming five persons per house) gives 45 persons/ha. This figure comfortingly falls right in the middle of the range calculated from the area. For sites identified as single houses, we have assumed five persons. These calculations are obviously based on hypothetical assumptions, but they are likely to give results that are reliable within a reasonable order of magnitude. A total population range of 2,500–5,000 might be out by 20 per cent, but is unlikely to be out by 100 per cent.

The population figures calculated in this manner are similar to the graphs of the areas of pottery scatters in respect of the growth of population between Geometric and Hellenistic, but strikingly different in respect of the peak of population in the Hellenistic period (see Fig. 2.2). This peak fits into a pattern surmised on two circumstantial grounds for Crete as a whole. A general population increase on the island is likely because of the evidence for emigration from Crete and for mercenary service overseas, and because of the increased pressure on civic boundaries and the expansion of the major cities.[38] The evidence from Sphakia is the first detailed support for the hypothesized general increase in population.

The population figures for individual ancient *poleis* in the Hellenistic period can also be extracted from these data (see Fig. 2.3). To Tarrha we have attributed all sites in Region 1; to Araden all in Region 3 (omitting the mainly later site of Aradhena), plus adjacent sites in Region 5; to Anopolis all in Region 4, plus coastal sites in Region 5.

These figures can be compared to seventeenth- and nineteenth-century census data for villages in the same areas (Ag. Roumeli plus Samaria, Aradhena plus Ag. Ioannis and Anopoli). The ancient figures are high, but not impossible. If the calculations of the Hellenistic data are in fact acceptable, the size of the figures suggests that

[38] Chaniotis 1996: 25–8, 173–4.

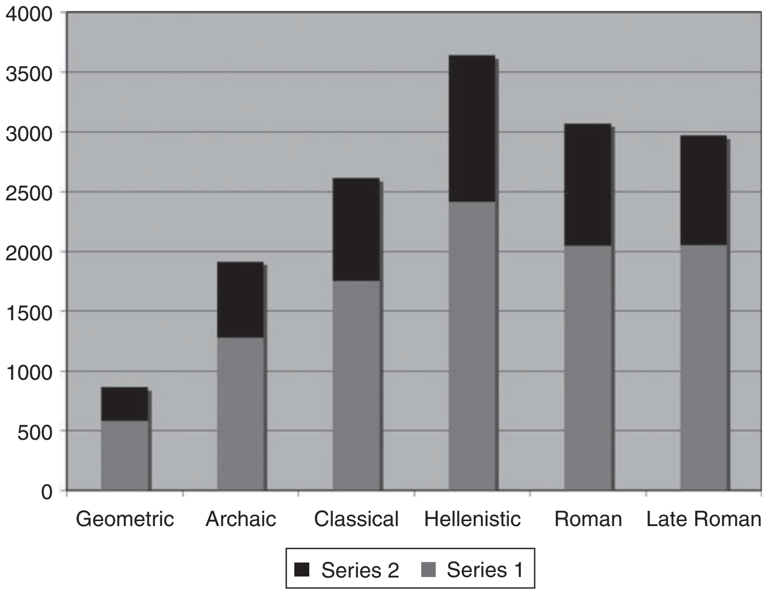

Fig. 2.2. Estimated population of Sphakia in antiquity. Series 1 assumes 40 pers./ha, and Series 2 assumes 60 pers./ha.

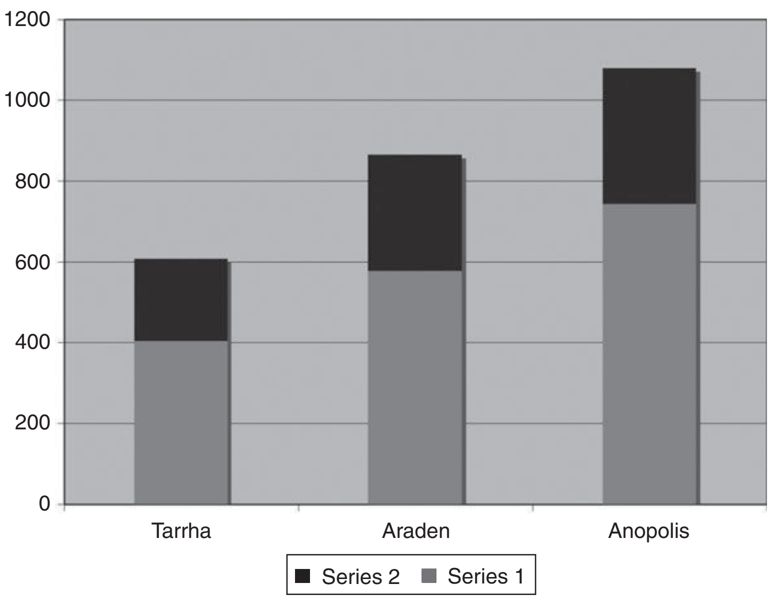

Fig. 2.3. Estimated populations of three Sphakiote *poleis* in the Hellenistic period. Series 1 assumes 40 pers./ha, and Series 2 assumes 60 per./ha.

the Hellenistic population was at or near the highest ever population of this area. If one wanted to talk in terms of carrying capacity of the land, then I would suggest that these (and not the early modern data) are what might provide it. The comparison between the Hellenistic and the early modern data also suggests by a sort of wigwam argument that we are right not to use the common population densities greater than 125 persons/ha, otherwise the Hellenistic data would drift even further from the later figures (see Table 2.3).

Comparison between these figures and those for other Cretan *poleis* in the classical and Hellenistic periods is instructive. There are almost no indications of the absolute population levels of other Cretan *poleis*,[39] but it is clear that the Sphakiote *poleis* fall at the bottom of the scale of Cretan *poleis.* At the top of the range, to judge from the extent of the central place, urban Gortyn or Khania/Kydonia will have had populations of 5,000 to 10,000 people (and more in their territories). By contrast, Anopolis, Araden, or Tarrha had maybe between 500 and 1,000 persons. They do have largish territories, but those territories are not rich in resources (see Table 2.4).

Table 2.3. Estimated Hellenistic population and early modern census data for the same three areas of Sphakia.

	Hellenistic	1650	1704	1834
Tarrha/Ag. Roumeli + Samaria	404–606	340	339	212
Araden/Aradhena + Ag. Ioannis	577–864	402	434	336
Anopolis/Anopoli	742–1079	717	655	508

Table 2.4. Hellenistic Cretan *poleis*: urban centres and extent of territories.

Name	Area of centre (ha)	Area of territory (km^2)
Gortyn	150	310
Kydonia	85	180
Phaistos	62	260
Aptera	45	295
Itanos	19	79
Anopolis	10	180
Araden	10	100
Apollonias	6	110
Tarrha	6	125

39 Chaniotis 1987: 194–5; Chaniotis 1996: 25.

CONCLUSIONS

So where does that leave us? I hope that the reader will agree that the potential of site size, as investigated by field surveys and excavations, should be more fully tapped, but tapped on a sounder basis than has hitherto often been the case. The evidence of settlements known from excavation and surface remains needs to be looked at much more carefully. In addition, comparative evidence (like the Ottoman censuses) needs to be more fully exploited. On the basis of both these types of evidence, lower rather than higher densities seem to be correct, 40–60 persons/ha rather than 125–250 persons/ha.[40] One might say that this sort of data is too fuzzy to be useful at all, but I do not think that is true. It offers order-of-magnitude figures, and these are perfectly helpful. This sort of data does not detect short-term blips, even if they are major (the Antonine Plague or the capture of part of the population by pirates). I have been concerned with long-term patterns, as is necessitated by the nature of the proxy archaeological data. One might also object that this particular sort of data is too patchy to be useful, too dependent on the vagaries of post-depositional history, but I do not think that is true. There is plenty of good evidence for rural settlements in flat plains like Metaponto or the Crimea; the problem of major loss of sites might apply only in areas where there has been major alluviation (e.g. large river deltas in northern Greece and Asia Minor), but it may be that those areas were avoided for habitation sites because of flooding and the associated problems of storing produce in damp conditions. Visibility rates for some parts of the Greek world are very good, better than those in northern plough-zone areas, and comparable to arid-zone visibility rates. I therefore remain convinced of the value of survey data as offering broad coverage of potential ancient settlements in many parts of the ancient world. My central argument is that we can make population estimates on the basis of settlement sizes, but that we should lower rather than raise estimates of population densities.

[40] If so, estimates for prehistoric settlements should also be revisited. Manfred Korfmann, for example, assumes 250–500 persons/ha for his estimated 5,000–10,000 population of Late Bronze Age Troy (Korfmann 1997–8: 371).

If this could be generally agreed, more secure estimates of ancient populations could be made. This would then feed into studies of other aspects of antiquity, political, social, and economic, but that, of course, is what this whole book is about.

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3

Missing persons? Models of Mediterranean Regional Survey and Ancient Populations

Robert Witcher

1. INTRODUCTION

The critical importance of demography for studies of the ancient world is widely recognized; for example, both the size and structure of populations are central to understanding the scale and organization of economies. The three principal sources of information derive from historical texts (e.g. manpower figures), comparative data (e.g. early modern societies), and archaeological evidence (e.g. the number and type of settlement sites). This chapter approaches the issue of demography primarily through the archaeological evidence for rural settlement, but inevitably touches upon textual and comparative data. The aim is to explore the potential and the problems of Mediterranean regional survey for demographic modelling drawing on case studies from Italy, Greece, and North Africa. Specifically, it addresses concerns about recovery rates, or the percentage of settlement sites and, indirectly, population identified by surface survey.

Discussion is structured into four main sections. The first reviews the general literature on recovery rates, particularly their variability, and leads to consideration of the situation in the ancient Mediterranean. The next section presents opposing models of recovery rates in the context of the early imperial population of Italy and explores the implications for economic organization. The third section tackles the issue of the Italian population from an alternative model-building approach using the results of the Liri Valley Survey. Finally, issues of recovery rates and demographic modelling in Greek and North African contexts are used to develop a comparative understanding of population and wider economic organization across the ancient Mediterranean.

2. RECOVERY RATES

Sites

Survey archaeologists have generated an extensive critical literature on the theory and method of archaeological field survey (see Barker and Mattingly 1999–2000). One particular area of concern is the degree to which patterns mapped by survey accurately reflect past settlement. In different circumstances, survey may either *over*estimate or *under*estimate the number of sites, with obvious implications for spatial analysis and the reconstruction of population. Archaeologists such as Dewar (1991) have drawn attention to the 'contemporaneity problem': the mobility of individual sites within any single archaeologically defined period may lead to 'double-counting' and thus overestimation of site numbers. In effect, the recovery rate may be more than 100 per cent. In the context of classical Greece, Osborne (2001) notes that site mobility may lead to exaggeration of the density—and significance—of rural population. Similarly, the misidentification of barns, seasonal shelters, and even burials, as permanently occupied settlement sites (e.g. Osborne 1992) may also effectively lead to recovery rates of more than 100 per cent. A further complication is that a site may change function over time. For example, Bintliff and Howard (1999) suggest that sites may evolve from farm to barn and back to a farm again. Each of these problems can be partly addressed with methodological refinements. Hence settlement mobility could be partially mitigated by defining shorter chronological phases, and the misidentification of non-settlement sites (or phases) could be addressed through closer analysis of assemblages (e.g. artefact function).

Second, theoretical and methodological studies have demonstrated that a large number of depositional, post-depositional, and sampling processes can lead to the *under*estimation of site density; indeed, the literature on reduced recovery rates is rather more extensive than that on exaggerated recovery rates (see Banning 2002: 39–74 for a summary of the former). By and large, attention has focused on: (a) those post-depositional processes such as alluviation and intensive agriculture that have 'degraded' settlement patterns; and (b) the inadequacies of sampling procedures, for example issues of surface visibility and variable fieldwalker efficiency. In each case, the effect is to reduce recovery rates to less than 100 per cent. Often these 'biases' have been subject to quantification in order to allow for the numerical correction of survey results and the reconstruction of the 'original' numbers of sites (e.g. Terrenato and Ammerman 1996).

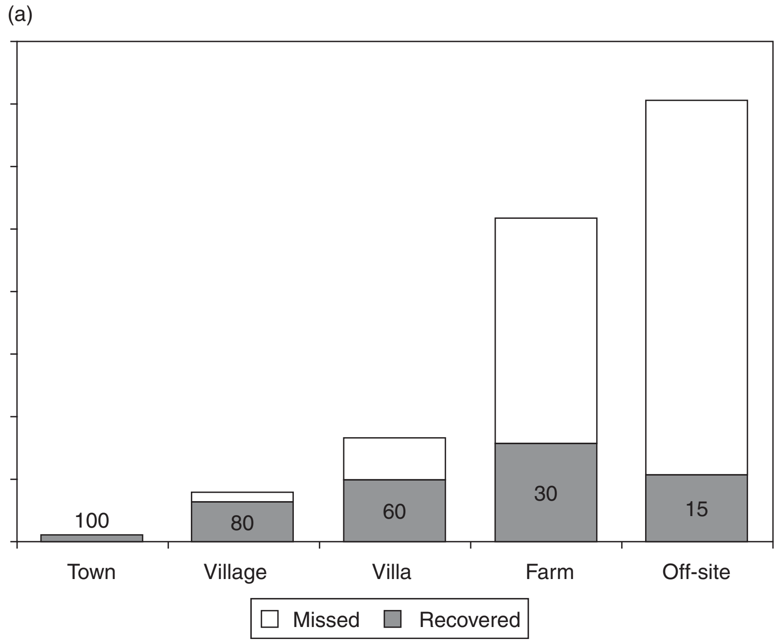
Such work has been invaluable for demonstrating the significant influence of post-depositional and sampling processes on recovery rates, but there is a danger that attempting to account for every possible bias in a quest for the 'ideal' distribution map risks reducing survey to the mechanistic application of method, with inadequate consideration of what the resultant 'perfect' map might mean. Such an approach seeks to empower the archaeologist in the present to control and understand the archaeological record, while systematically denying the very thing it claims to seek—the variability of past human behaviour (Witcher 2006a). For example, Banning's (2002) highly useful manual of archaeological survey attends carefully to recovery rates, but focuses almost entirely on post-depositional and sampling processes. Such issues are both important and fully worthy of study, but only indirectly touch upon the fundamental issue under consideration here: variability of recovery rates *as a result of past behavioural and depositional practices*. For example, for current purposes, I am not concerned with those sites missed because of geomorphological processes, but rather sites missed because they did not make use of finewares and are therefore more difficult to find and date.

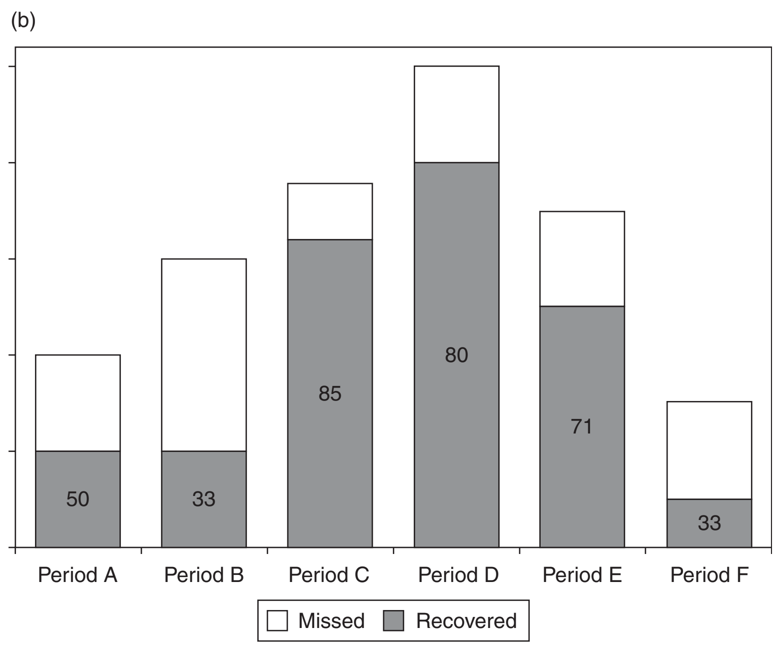
A number of archaeologists have called attention to the critical importance of such behavioural and depositional processes in the past and their influence on survey recovery rates. Pettegrew (2001) has argued that the process of site abandonment in classical Greece could have profound influence on recovery rates: if sites were systematically stripped of portable artefacts and even roof tiles, there might be little (durable) material culture to enter the archaeological record in the first place, making 100 per cent recovery of classical Greek farmsteads unlikely. Millett (1991) and Fentress *et al.* (2004) note significant variation in the supply and consumption of diagnostic finewares across time and space as a result of diverse social and economic processes. For example, reduction in the availability of African Red Slip pottery in Italy as a result of political or military disruption may have led to increased market price and hence reduced availability to some social groups. If African Red Slip is the only diagnostic material available with which to detect and date settlement sites, such social groups may become less archaeologically visible. Hence variation in the consumption and deposition of diagnostic material culture suggests that recovery rates are not only less than 100 per cent but are also uneven across time and space (Witcher 2006b: 45–9).

Again, some of these issues can be partially mitigated through methodological refinement: for example, the collection of coarsewares may assist the recognition of groups living outwith the fineware market. I argue the almost infinite variety of these behavioural and depositional processes means that they are intractable for those who seek to discipline the archaeological record and to recover the 'perfect' distribution map. However, these processes are not inconvenient 'biases', but rather the proper object of study. This chapter therefore steers a careful course. I am interested in the (in)completeness of the archaeological record; I seek to address the fundamental paradox of understanding what has been missed in order that I can understand what has been recovered. However, I approach this issue not in order to correct 'biases' in the archaeological record, but rather to reconceive (some of) these patterns as valid insights into past human behaviour that have implications for reconstructions of economy and demography. The aim is not to establish specific population densities, but rather to explore the significance of variable recovery rates for understanding ancient societies more generally.

Dimensions of variability

The normative assumption that underlies the analysis of settlement patterns is 'What You See Is What You Get' (WYSIWYG). Even when archaeologists acknowledge that recovery rates are less than 100 per cent, there is a widespread belief that mapped settlement patterns are reliable. However, recovery rates may vary in a number of ways that question this assumption and which make the expression of a single recovery rate meaningless. Fig. 3.1


(a)
100
80
60
30
15
Town
Village
Villa
Farm
Off-site
Missed
Recovered


(b)
50
33
85
80
71
33
Period A
Period B
Period C
Period D
Period E
Period F
Missed
Recovered

(c)

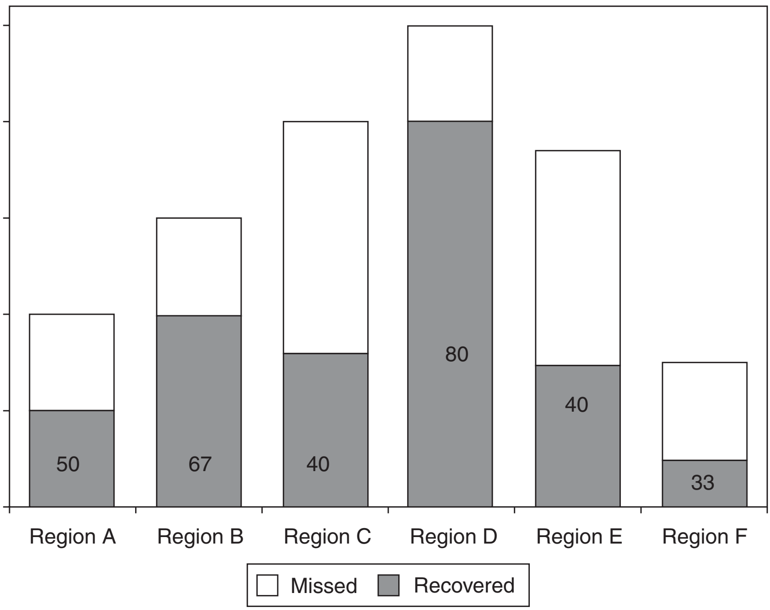


Fig. 3.1. Hypothetical variation in percentage recovery rates, (a) across settlement hierarchy, (b) over time, and (c) across space.

demonstrates three ways in which recovery rates might hypothetically vary; in each case, numbers of sites are deliberately excluded in order to focus attention on the percentage recovery rates. Sites successfully identified are indicated in solid grey; missed sites are indicated by hatching. Fig. 3.1a illustrates the effects of variable rates for different types of site, and consequently the effects on the overall shape of the settlement hierarchy. Both theoretical studies and field observation suggest that sites of different size and status are recovered at different rates. Banning (2002: 48–54, 69–72) summarizes research on the effects of site size and 'obtrusiveness'[1] on site recovery. Generally speaking, larger sites are likely to be better represented. Despite the wide acceptance of this phenomenon (e.g. Cherry 1983: 392–3),

[1] Some types of artefact and site are easier to detect than others (e.g. monumental architecture, denser concentrations of material); when combined with field method (e.g. transect spacing) and environment (e.g. background noise), measures of obtrusiveness can be used to determine variable recovery rates; see Schiffer 1987: 236, 347.

relatively few surveys explore the implications for settlement and population reconstruction.[2] In Fig. 3.1a, the sites successfully recovered indicate a rather steep settlement hierarchy. However, when a variable recovery rate declining from 100 per cent to 15 per cent is introduced, the settlement hierarchy changes shape dramatically; for example, the numerical relationship between farms and off-site scatters is reversed. Fig. 3.1b illustrates the effects of variable recovery rates over time. The sites successfully recovered suggest that Periods A and B had the same number of sites. However, when variable recovery rates are factored in, it becomes clear that a genuine increase in site numbers is disguised by a decline in recovery rate during Period B. In Period C, a modest increase in site numbers is exaggerated by a sharp rise in recovery rate. Finally, Fig. 3.1c illustrates the effects of variation in recovery rates over space (assuming each region to be equally sized). The sites successfully recovered suggest that Region D is much more densely occupied than Region C, but this is actually explained by a significantly lower recovery rate in the latter area.

In each case, relationships between site types, periods, and regions are modified, even reversed, by the effects of variable recovery rates. This variation across settlement hierarchies, over time, and across space presents potential difficulty for the use of survey data for spatial analysis and demographic modelling. It is difficult to estimate recovery rates even for a single area or chronological period; the problems rapidly multiply as we attempt to compare. Arguably, this situation lies behind the slow progress on comparative regional survey (generally, see Alcock and Cherry 2004; for examples of comparative demographic studies, see Bintliff 1997a; Wilkinson 2003). This is not, however, a counsel of despair. It may be impossible to define precise figures, but the implications of variable recovery rates can be worked through in order to evaluate the implications for interpretation.

Insights from prehistoric and medieval landscapes

Above, a simplistic distinction has been made between those processes leading to recovery rates of more than or less than 100 per cent

[2] E.g. Cambi's 1999 demographic model makes no distinction in the recovery of site types: House 1 and House 2. Wilson 2008: Tables 9–14 assumes the recovery of villages and villas to be 100 per cent, while assessing the effects of low farm recovery rates. For both these models, see below.

of sites. It is, of course, important to recognize that within any individual landscape, these processes may operate in tandem (Bintliff 1997b: 237–8; Chapman 1999): for example, a long period of high settlement mobility and socially restricted ceramic consumption may lead to double-counting of some sites and the failure to recognize others. However, in the context of the ancient Mediterranean world, it is arguably the underestimation of site numbers—or low recovery rates—that is the more significant. First, the intensity and duration of Mediterranean landscape use means that post-depositional processes are considerable (e.g. erosion, mechanized ploughing, urbanization, etc.); in turn, this can also make systematic archaeological sampling difficult. Second, classical, Hellenistic, and Roman pottery permit the definition of much shorter chronological phases in comparison with many prehistoric periods. As a result, the potential for over-counting is much reduced, although not necessarily removed altogether.

If site recovery is likely to be less than 100 per cent and variable, what estimates are available? It is useful to compare briefly the experience of other periods, for example, the late prehistoric or medieval. In both cases, there has been debate about the degree to which survey successfully recovers sites. In late antique and early medieval Italy, the sharp decline in settlement numbers has been taken to reflect historically attested 'crises' such as plague, and political, military, and economic instability (e.g. Hodges and Whitehouse 1983: 42); in other words, it is assumed that site recovery is high and that settlement patterns are reliable. Others have advanced less 'catastrophic' interpretations that argue that changing economic organization (e.g. production and exchange of pottery) and settlement location (e.g. hilltop nucleation) have depressed the number of sites located and exaggerated the impression of demographic decline; in other words, site recovery is comparatively low and unreliable (for summaries see Christie 2006: 412–28; Francovich and Hodges 2003).

In the context of prehistoric Greece, Bintliff *et al.* (1999) have argued that Neolithic and Bronze Age settlement in Boeotia may be 'hidden' for a variety of reasons, including the disintegration of friable pottery when incorporated into the plough-zone and because scarce prehistoric artefacts are swamped by the abundant material of later periods. They argue that whole prehistoric landscapes have been systematically overlooked; in other words, site recovery rates are (extremely) low. A number of scholars have critiqued various aspects of this model and have asserted greater confidence in the reliability of prehistoric settlement distributions (e.g. Cavanagh 2004; Davis 2004). However, while the belief that 'What You See Is What You Get' does not presuppose that recovery rates are high in absolute terms, it does assume that different site types are recovered in broadly equal proportion.

Finally, in Iron Age Salento (Italy), Burgers (1998) questions whether the sharp increase of sites during the eighth century BC was due to rapid demographic growth or to increased accessibility of matt-painted wares to previously 'invisible' sections of the population. In other words, a large pre-eighth-century BC population was already there, but is difficult to map because it did not use diagnostic pottery (i.e. low recovery rate), or survey has mapped a genuine increase in site numbers during the eighth century (i.e. high recovery rate). On the basis of a consistent relationship between matt-painted wares and *impasto* in excavated contexts, Burgers (1998: 189) assumes that the same situation holds universally and concludes that there was indeed a sharp increase in site numbers rather than an increase in access to matt-painted wares and therefore recovery rates; in turn, this decision shapes Burgers's model of social development in the immediately pre-colonial period.

These three examples demonstrate that there is little consensus on site recovery other than the belief that it is less than 100 per cent and likely to have to varied widely across settlement hierarchy, time, and space. Moreover, they demonstrate that recovery rates lie at the heart of profoundly different interpretations of the past (e.g. continuity versus catastrophe, uniformity versus variability). As survey has a virtual monopoly on the generation of long-term settlement and demographic data, it is incumbent upon archaeologists to pay close attention to recovery rates in order that their own and others' use of these data is more nuanced (Wilkinson 1999: 45).

What are the lessons for recovery rates in classical, Hellenistic, and Roman landscapes? If it is accepted that prehistoric and medieval pottery is comparatively rare and friable (a variety of opinions hold and it may be difficult to generalize; e.g. Cavanagh 2004), then its reduced ability to survive in the plough-zone should make this material a good indicator of recently disturbed archaeological deposits in the immediate vicinity. Conversely, the more abundant and durable ceramics of the classical, Hellenistic, and Roman periods may be rather less reliable for the detection of settlement sites as even sherds incorporated via manuring may survive. Ironically, the very abundance and durability of classical, Hellenistic, and Roman material culture may make it less useful for mapping settlement (as opposed to 'activity'). Indeed, Davis (2004: 22) explicitly questions the automatic assumption that prehistoric sites are harder to find than later sites.

One advantage over the prehistoric period, if not the medieval, is the existence of a number of independent 'checks' in the form of texts recounting numbers of colonists, military manpower, and census data. These sources have been used to work 'backwards' from 'known' population to site recovery rates. For example, in central western Italy, Cambi (1999) has compared historical texts concerning the numbers of colonists and archaeological settlement maps in order to estimate the recovery rate of dispersed rural settlement in the Albegna Valley. For the second century BC, he calculates that *c.* 20–33 per cent of farms have been recovered. Similar calculations based on the classical period settlement evidence from Boeotia (Greece) suggest that *c.* 57 per cent of small sites have been recovered (Bintliff and Snodgrass 1985: Table 5).[3]

Such independent 'checks' are useful, but are not unproblematic. First, few of them provide unambiguous population totals and usually require assumptions to be made: for example, records of military manpower require knowledge or estimates of family size and service liability. In the case of the Albegna Valley, Cambi (1999: 121) is obliged to make a number of assumptions, some of which might be contested: for example, he assumes that 20 per cent of colonists were located in urban centres and thus 80 per cent were in rural areas. Second, the vast majority of landscapes do not have any associated textual sources; the principal evidence available for most areas is archaeological. In short, the examples outlined so far have used 'known' population to estimate recovery rates; however, recovery rates are a means to an end. We are not interested in recovery rates *per se*; rather, we are interested in site and population totals. In other words, we really need to be able to work from recovery rates to *un*known population (see Section 4).

[3] More recently, Bintliff (1997b: 233–6) has increased the estimated population size of larger nucleated rural sites, calculating a recovery rate of *c.* 77 per cent, and removing the need to postulate a low recovery rate for small sites.

Population

So far, discussion has focused on the recovery of sites and the reconstruction of settlement patterns. What about the recovery and reconstruction of population? Wherever regional field survey is practised, demographic reconstruction is cited as one of its key aims (e.g. Mediterranean, Bintliff and Sbonias 1999; Levant/Near East, Wilkinson 2003; Mesoamerica, Feinman *et al.* 1985). One strategy used by Cambi (1999) is to equate the number of sites with the number of households; this method does not require him to define household composition. This approach usefully circumvents difficult questions concerning household size and the relationship of households to the extent of artefact scatters (see Osborne 2004; for alternative approaches to population using this particular dataset, see Fentress 2009; Perkins 1999). However, in demographic reconstruction, household size and composition become important when considering overall population figures, demographic structures, and economic organization.

There are several methodologies for converting numbers of sites into population figures. The most basic quantifies the number of site types (e.g. farms, villas) and multiplies these by standard site populations (e.g. five persons per farm). The process is repeated for each chronological period. Populations of nucleated settlements (e.g. villages) are often calculated by multiplying their area by standard densities (e.g. 100–250 persons/ha). Dispersed and nucleated populations are summed to calculate absolute populations and divided by survey area to calculate population density (e.g. Catling 1996a; Fentress 2009; Witcher 2005). (Other approaches include various assessments of carrying or productive capacity, e.g. Goodchild and Witcher 2009; Sallares 1991; Wilkinson 2003; or labour requirements, Ørsted 2000a.)

Although such models have not ignored the issue of site recovery rates, they have not placed great emphasis on them (e.g. Fentress 2009; Witcher 2005); discussion of confidence in site interpretation and site population has taken precedence. Scheidel (2008) has been critical of such models for their lack of attention to the issue (see Witcher 2008a for a response to Scheidel's comments on Witcher 2005). Undoubtedly, the explicit or implicit assumption of high site recovery can have important implications for the reconstruction of population figures and their interpretation. For example, in her discussion of the population the Albegna Valley, Fentress (2009) suggests that villas and large farms are 'very hard to miss', but accepts that smaller sites may have been less thoroughly identified (as a result of destruction rather than limited use of material culture). However, she notes that even if the number of small sites (Farm 1) were tripled in response to Cambi's (1999) suggestion of a 33 per cent recovery rate, the overall effect would be limited. The additional 8,000 persons represent a *c*. 26 per cent increase in population (Fentress 2009). To take these calculations to their logical conclusion, if the recovery of small sites were as low as 20 per cent (Cambi's lower figure), the additional 16,000 persons represent a *c*. 51 per cent increase. The point at which these additional individuals become sufficiently important to change interpretations is obviously a matter of judgement. Clearly, however, Fentress's assumption of high recovery rates in the Albegna Valley becomes significant in the context of her interpretation of the long-term history of the city of Cosa and its environs. In particular, she places explanatory weight on the demographic weakness of the region, resulting from warfare, colonization, and malaria (Fentress 2003: 143; also Sallares 2002: 192–200). If the Albegna Valley Survey achieved lower recovery rates, and rural population was rather higher than suggested, Fentress's explanation of Cosa's 'intermittent' occupation would need refining in order to explain the discrepancy between a healthier rural population and the repeated failure of the city's population.

The only attempt to explore Mediterranean survey recovery rates in a quantified manner is Wilson's (2008) exploration of the effects of hypothetical recovery rates in the Biferno Valley Survey (also, briefly, Witcher 2008*a*). Wilson notes that rural site density is very low and that consequently a very high percentage of the population appears to live in urban centres, a pattern quite different from other parts of central Italy (e.g. *suburbium*, Witcher 2005; cf. Greek surveys below). In order to reduce the high level of urbanization and bring overall densities into line with those suggested elsewhere in Italy, he suggests that recovery rates as low as 10–20 per cent are not implausible. Of course, the key problem of evaluating recovery rates is the issue of negative evidence. Are sites absent or simply invisible? Evidence of absence or absence of evidence? Correction factors can be applied to survey results. However, Davis (2004: 33) warns that 'real differences in empirical results [from survey] may be "massaged away" in order to make them conform to prior expectations'; Fentress (2009) makes the same point in direct relation to demographic modelling. Wilson

(2008: 245) observes that '[t]he sceptic may . . . feel that the conjuring of thousands of inhabitants . . . out of less than a hundred sites in each period is a dubious exercise'; however, he rightly asserts that the potential implications of recovery rates are such that it is important to consider them further.

3. DEMOGRAPHIC MODELS OF ROMAN ITALY: HIGH VERSUS LOW RECOVERY

The models presented by Cambi (1999) and Bintliff (1997b) start from 'known' population figures and work 'backwards' to define recovery rates. It is possible to apply a similar approach to the population of early imperial Italy using census figures. However, the most appropriate interpretation of these historical figures has generated intense debate (for a recent and comprehensive collection of views, see de Ligt and Northwood 2008). The details of this debate cannot be reviewed here (see Scheidel 2008 for an overview); for current purposes, it is sufficient to note that population estimates have polarized into the 'low count', broadly the consensus position, which posits an Augustan population of *c.* 6–7 million (e.g. Brunt 1971), and the revisionist 'high count', which argues for a population of *c.* 12–14 million (Lo Cascio 1994).[4]

In this section, a pair of models will be defined that take as their starting points the two competing figures for the early imperial population of Roman Italy. The intention is not to resolve the 'high/low count' debate (see Witcher 2008a and comments by Mattingly, Chapter 4 in this volume), but to evaluate what these population figures might mean in terms of field survey recovery rates. The two contrasting recovery rates thus revealed allow us to discern two very different visions of Roman Italy. The recasting of the 'high/low' population figures, via

[4] Scope for an intermediate figure has been systematically rejected by both 'high' and 'low' counters on philological grounds, but there is increasing interest in intermediate figures that are effectively modified versions of the 'high' or 'low' count (e.g. Launaro 2011). Here, the figures of 6–7 million and 12–14 million are used to frame two models and to explore the implications. Section 4 goes on to address the archaeological evidence without the framework provided by the census figures.

recovery rates, into a different vocabulary permits an alternative approach to the debate.

First, the 'low count' model. In order to reconcile a population of 6–7 million with the evidence of regional field survey, it is necessary to accept a relatively high rate of site recovery. The densities of sites directly attested by survey are already sufficient to reconstruct a population of several millions if extrapolated across Italy as a whole. As it would only be necessary to double roughly the number of known sites to approach a population figure of *c.* 6–7 million (i.e. a recovery rate of 50 per cent or higher), the 'low count' scenario requires us to believe that survey has identified a large percentage, perhaps the majority of sites. Settlement patterns should provide a reliable (if not complete) picture of settlement and population.

The 'high count' model starts with an early imperial population in the order of 12–14 million. In this case, the settlement patterns mapped by archaeological survey can only be reconciled with such high population by assuming that site recovery rates are low, far below 50 per cent, perhaps as low as 10 per cent. This is because there are simply too few 'dots on the map' to accommodate such a large population. For 'high counters', it is necessary to believe that survey fails to recognize the majority of sites and population; such a small sample would provide an inadequate basis for demographic modelling and is unlikely to give a reliable overview of settlement in general. (For more detailed discussion of these two models, see Witcher 2008a.)

Put simply, the 'low count' implies high recovery rates and the 'high count' implies low recovery rates. Starting with the 'known' (if disputed) census figures, it would be easy to allow this matter to descend into a critique of the efficacy of field survey and the search for methodological solutions (e.g. higher intensity, larger samples). This, however, falls into the trap of assuming that recovery rates are predominantly shaped by post-depositional processes that can be measured and corrected. In other words, it perceives recovery rates to be unrelated to the behaviour and organization of people in the past. Here, instead, the intention is to evaluate the social and economic conditions that may have led to these two very different recovery rates.

Why might recovery rates be high? The ability of survey to recover the majority of sites assumes that rural populations were well integrated into urban and regional economies through the consumption of (diagnostic) material culture, especially (mass-produced) finewares and other manufactured and imported goods. Indeed, survey is dependent upon such goods in order to identify and date sites. These goods were presumably acquired in exchange at local markets for agricultural surpluses (including rural manufacturing such as textiles, e.g. Roth 2007). High recovery rates therefore suggest a rural socio-economic organization akin to Horden and Purcell's (2000: 270–7) Mediterranean peasantry: rather than independent and autarkic citizen–farmers, these rural populations were involved in agricultural production well beyond subsistence, with regular exchange of surplus through regional economic networks in order to access a wide range of manufactured and imported goods (Witcher 2007).

Conversely, low recovery rates imply extremely densely occupied landscapes but with very limited consumption of (diagnostic) material culture, rendering settlement and population less visible. This situation points towards much lower surpluses and more limited contact with urban and regional markets. The alleged inability of survey to recognize the vast majority of the population actually indicates a fundamentally different socio-economic interpretation of Roman Italy.

Recovery rates and economic growth

The social implications of these two recovery rate models are discussed elsewhere; in particular, despite their differences, both reveal the marked regionality of early imperial Italy (Witcher 2008a). Here, the focus is upon the economic implications. Recently, scholars have considered the performance of the Roman economy and, more precisely, whether there is evidence for *real growth* (Jongman 2007: 185; Scheidel 2007). If population increases, but overall production remains stable, *per capita* income falls. If overall production increases in pace with population growth, then *per capita* income remains stable. It is only when production increases at a greater pace than population that *per capita* income rises. In other words, *real* growth requires both population and *per capita* income to increase simultaneously. Looking across the Roman empire as a whole, both Jongman (2007) and Hitchner (2005) assume growing population during the late republican and early imperial periods, and seek to identify proxies through which to measure rising income, for example numbers of shipwrecks and levels of meat consumption. Each of these proxies contributes to an overall model of the Roman economy that emphasizes increasing scale and complexity. For example, Kron (2002) uses the archaeozoological evidence to document a substantial increase in average animal size; he argues that this reflects significant specialization of production within an integrated market economy. Improved nutrition, especially from meat consumption, is reflected in significant increases in mean human height (Kron 2005). Overall, Jongman (2007: 187, 191) concludes that 'significant sections of the working population' shared in an improved standard of living.

The intepretations of Jongman and Hitchner do not necessarily require a commitment to either 'high' or 'low' population count,[5] but the increased economic complexity and higher consumption proposed might be taken to suggest that it should be easier to see settlement and people in the archaeological record. For example, it is difficult to imagine that improved standards of living could be reconciled with the idea that tablewares, cooking wares, amphorae, and other portable material culture were entirely beyond the reach of the majority of the late republican and early imperial population (on pots as proxies, see Chapman 1999). In other words, the expanding economy as defined by Jongman and Hitchner would appear to imply high recovery rates. And in the terms of the two models outlined above, the implication of high recovery rates is a 'low count' population (this is, for example, the position of Fentress 2009 on the Albegna Valley).

Is it therefore possible to reconcile the economic model outlined by Jongman and Hitchner with low recovery and a 'high count' population? Although post-depositional processes may account for a significant percentage of 'missed' sites, an equally—if not more—important consideration is that very low recovery rates are the result of the limited quantities of (diagnostic) material culture consumed by the majority of the rural population (see Rathbone 2008; Witcher 2008a). Rural sites are difficult to find because their inhabitants existed outwith regional and urban exchange networks. Such limited market engagement, perhaps indicative of small agricultural surplus, conflicts with the model of increased and integrated economic

[5] Neither explicitly addresses the 'high/low count' debate. Both broadly argue for a growing population across the empire as a whole rather than Italy specifically, but both draw on much Italian evidence in the process. Growing late republican/early imperial population is widely seen as incompatible with the low count, but De Ligt 2004 has presented one method of reconciling the two.

activity proposed by Jongman and Hitchner. Alternatively, it is possible that rural populations did produce agricultural surplus, but it was concentrated in monumental urban centres through rents and taxes. Again, however, this implies an exploitative relationship that leaves the rural majority substantially worse off than urban populations. Or perhaps rural wealth was invested in archaeologically invisible ways, although this does not fit easily with Jongman's (2007: 186) assertions about the quantity and diversity of Roman material culture in circulation.

Whichever way it is conceived, it seems improbable that very low recovery rates can be reconciled with an argument for real economic growth in Italy during the early imperial period. Low recovery rates are suggestive of a rural landscape densely occupied by poor subsistence peasants. In contrast, the argument for real growth fits far better with the model of lower population and high recovery rates. The ability to identify more sites and more of the rural population is a function of their higher visibility as a result of greater participation in the market economy; specialization and agricultural surpluses permitted more opportunities for the acquisition of manufactured goods and imported foodstuffs. In this context, it is therefore interesting to note that Fentress's (2009) demographic models loosely correlate high recovery and low population with significant economic development (e.g. the export of murex purple and *passum* wine, and the import of grain to Jerba).

However, it is important to consider issues of scale and regionality. Both Jongman (2007) and Hitchner (2005) work at highly generalized levels, taking the Roman empire as a whole. It is therefore possible, indeed likely, that not all areas experienced demographic and economic trends in the same way. For example, Hitchner (2005: 213) observes that the acquisition of thinly occupied provincial areas allowed the *overall* economy to grow; in Italy, whether 'high' or 'low count', the population density was already high compared to other parts of the empire and there was consequently less scope for such growth. Indeed, within Italy, it is possible to discern rather varied early imperial settlement trends. In the *suburbium*, the increase in settlement numbers during the early imperial period, combined with the abundance and diversity of material culture in circulation (Witcher 2005), make a good case for the coincidence of increasing population and higher *per capita* income, i.e. real growth. However, the declining numbers of settlements in areas such as inland Etruria and Samnium, and the relatively restricted material culture found on rural sites in these areas, is more problematic (for detailed regional comparisons, see Witcher 2006a). Assuming high recovery, fewer sites suggest fewer people, but as Jongman (2007: 185) points out, even if *per capita* income rose as a result of this declining population, it would be perverse to see this as economic growth. Alternatively, settlement and population remained broadly stable, but recovery rates declined sharply; again, it is difficult to reconcile a reduction in the tangible evidence for wealth and market exchange with real economic growth.

Interpretations of the early imperial economy of Italy vary enormously; it has been argued to range from the moribund to the vibrant. In large part, this situation is the result of generalization of the archaeological and textual evidence (see Patterson 2006; Witcher 2006b). By linking population to recovery rates, it is possible to explore the socio-economic organization of Roman Italy. At a general level it is difficult to connect high population, low recovery, and real economic growth. At a regional scale, it is possible to identify distinct demographic and economic regimes: some areas undergoing demographic expansion, economic growth and opportunity; others experiencing population decline, reduced economic activity, and greater inequality. Some regions of Italy developed in quite different ways from the wider imperial economy. If there was real growth, there was important geographical variation in the distribution of 'the advantages of wealth and luxury' (Hitchner 2005).

4. FROM SITES TO POPULATION IN THE EARLY IMPERIAL LIRI VALLEY

The models in the previous section have used 'known', if disputed, population figures to establish recovery rates and their implications. However, this relies on documentary sources for population figures to estimate recovery rates; is it possible to work from recovery rates to population? This section reverses the approach, applying estimates of recovery rates to specific survey results in order to reconstruct population totals. Rather than establish precise figures for specific ancient populations, the aim is to develop a method of assessing the implications of variable recovery rates on the recognition of site types and population distribution. The following figures are excerpted from a dynamic spreadsheet that allows the impact of change to any individual parameter on the wider model to be assessed; in printed form, there is a danger that this particular set of variables takes on greater certainty than should be the case. It is therefore important to stress that this model is intended as an iterative device.

The model utilizes a simplified rural hierarchy of three site types: nucleated, large, and small. In effect, these categories map on to village, villa, and farm. However, these are contentious terms; for example, Rathbone (2008) has effectively critiqued the widely used dichotomy of farm and villa. Yet, in practice, most surveys have collected and interpreted artefact scatters with these categories in mind (see comments in Witcher 2008a). 'Farms' and 'villas' are extremely difficult if not impossible to eradicate from existing datasets (on use of legacy data, see Witcher 2008b).

The model is populated by the numbers of nucleated, large and small sites of specific date recovered by survey. In this example, Table 3.1 uses early imperial period (AD 1–100) settlement figures from the Liri Valley Survey (Hayes and Martini 1994).[6] To calculate the number of sites that the survey has failed to identify ('missing sites'), and therefore the total number of sites, it is necessary to define recovery rate. It is, of course, impossible to know the recovery rate

Table 3.1. Early imperial settlement sites (AD 1–100) recovered and missed by the Liri valley survey based on hypothetical recovery rates.

	Survey area (km^2)	No. of sites recovered	Site recovery rate (%)	No. of sites recovered per 100 km^2	No. of sites missed per 100 km^2	Total number of sites per 100 km^2
Nucleated (village)	–	2	80%	1.74	0.43	2.17
Large (villa)	–	12	60%	10.43	6.96	17.39
Small (farm)	–	93	30%	80.87	188.70	269.57
Totals	115	107	–	93.04	196.09	289.13
Percentages	–	–	–	32%	68%	100%

[6] Alessandro Launaro provided a summary of the Liri Valley Survey figures drawn from his recent doctoral thesis, now available in Launaro 2011.

without knowing the total number of sites. However, the aim of the model is not to establish *the* recovery rate, but to assess the implications of different recovery rates on population size and distribution.

The model permits the definition of different recovery rates for each site type (see Section 2). For small sites (farms), Cambi's (1999) figure of *c.* 20–33 per cent is widely cited; Witcher (2008a: 291) argues that recovery rates for the early imperial *suburbium* are likely to be higher than this because of the greater abundance of datable material culture, but does not provide a figure. The Liri Valley is at the limit of Rome's immediate territory, although settlement was more established than that in the fragile colonial landscape of the Albegna valley during the second century BC; an initial figure of 30 per cent will be used.

Next, large sites (villas). The larger size and greater consumption/deposition of obtrusive material culture (e.g. stone blocks, marble veneers, high densities of pottery) suggests that recovery rates should be set substantially higher than 30 per cent. However, the rate is still likely to be less than 100 per cent. The resurvey of previously reconnoitred areas suggests that although newly detected sites tend to be small, it is also possible to identify a few comparatively large sites previously unrecognized by earlier survey (e.g. Di Giuseppe *et al.* 2002). Similarly, the comparison of results from parallel surveys of the same territory indicates that even large and high-status sites can be missed (e.g. Fentress 1993; Witcher 2008b; also Mattingly, Chapter 4 in this volume). Given the medium intensity of the Liri Valley Survey, an initial figure of 60 per cent will be used.

Finally, nucleated sites (villages). In the context of Roman Italy, this is a comparatively poorly understood settlement category. Although many villages lack the monumental architecture and wealthy assemblages that increase the obtrusiveness of villa sites, the substantial size and dense surface scatters associated with villages should render them still easier to find; an initial figure of 80 per cent will be used.

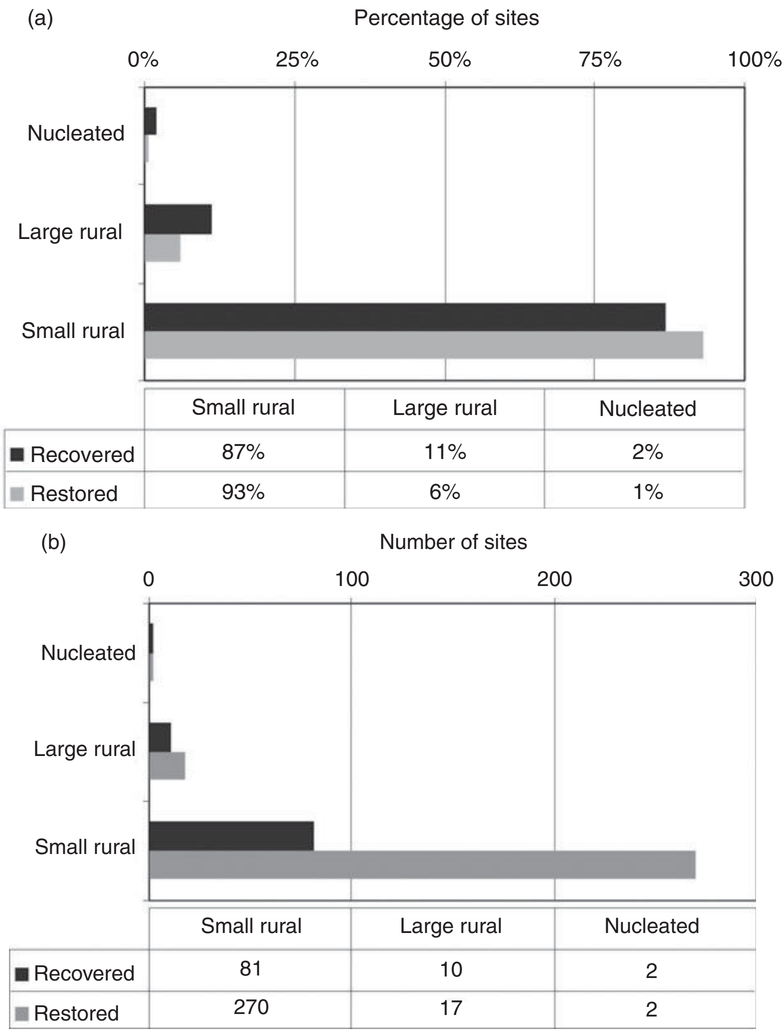
Populated with the numbers of each site type identified by the survey, and the estimated recovery rates, the model can calculate the hypothetical number of sites missed and, therefore, the total number of sites. For convenience, the model uses the survey area to standardize settlement figures per 100 km^2. In this case, the Liri Valley Survey identified the equivalent of 81 small rural sites and missed 189 similar sites, for a grand total of 270. Overall, *c.* 32 per cent of sites were recovered and *c.* 68 per cent missed.

The effects of these variable recovery rates can be assessed by comparing the proportions of types of site recovered with the restored proportions, i.e. including those sites missed by survey (Fig. 3.2a). In both cases, the settlement hierarchy remains 'bottom-heavy', but while the dominance of small sites increases only marginally, the significance of nucleated and large sites is halved. Fig. 3.2b presents the same data, but expressed as numbers of sites rather than percentages. This demonstrates the dramatic increase in the numbers of small sites and the substantial reshaping of the settlement hierarchy.

At this point, it is important to emphasize that the recovery rate of settlement sites is not necessarily the same as the recovery rate of population. This is because most settlement patterns, at least for the classical, Hellenistic, and Roman periods, are hierarchical. If survey recovers a higher percentage of larger sites with larger populations, then the population recovery rate will be higher than the site recovery rate. It is therefore useful to consider both site and population recovery rates.

Table 3.2 defines standard population sizes for the three site types. Such population estimates are contentious (Fentress 2009; Osborne 2004; Witcher 2008a), but again the aim of the model is to provide a means of assessing the effects of different figures (e.g. doubling the population of small sites). Using these figures, the model calculates the population recovered, missed, and the overall total. Per 100 km^2, the Liri Valley Survey identified 839 persons from a total of 2,000. In other words, the survey identified 32 per cent of sites, but 42 per cent of the population. In this case, the 'bottom-heavy' nature of the settlement hierarchy means that the recovery of population is not substantially greater than the recovery of sites.

The effects of converting site recovery into population recovery can be assessed by comparing the proportions of recovered population by site type with restored proportions of population by site type (Fig. 3.3a). The percentage of population living on small rural sites increases from 48 per cent to 67 per cent; Fig. 3.3b demonstrates the dramatic implications in terms of actual population figures. If the estimated recovery rates are even approximately correct, then not only is it necessary to revise population densities upwards (from *c.* 839 to 2,000/100km^2); it may also be necessary to rethink the associated socio-economic organization: how integrated or otherwise was this rural population if well over half is invisible to survey?



(a)

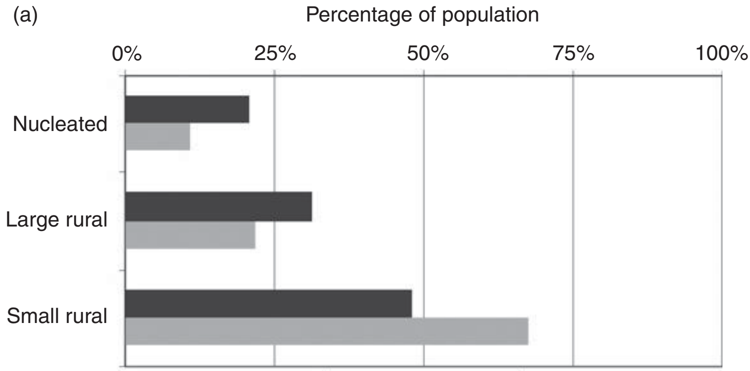
	Small rural	Large rural	Nucleated
Recovered	87%	11%	2%
Restored	93%	6%	1%

(b)

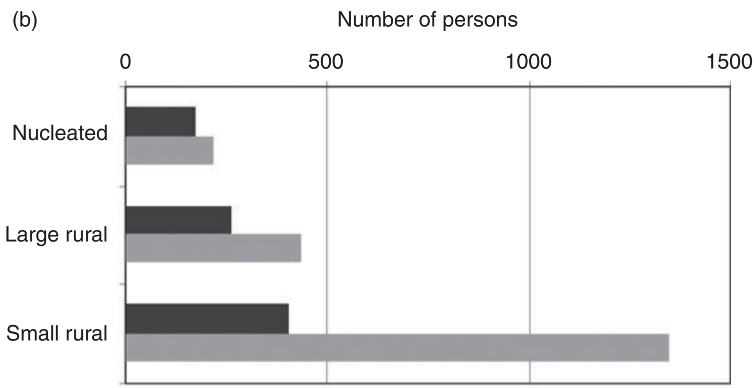
	Small rural	Large rural	Nucleated
Recovered	81	10	2
Restored	270	17	2

Fig. 3.2. Liri Valley Survey: (a) Recovered and restored proportions of sites by type; (b) recovered and restored numbers of sites by type.

NB all figures are rounded.



	Small rural	Large rural	Nucleated
Recovered	48%	31%	21%
Restored	67%	22%	11%



	Small rural	Large rural	Nucleated
Recovered	404	261	174
Restored	1348	435	217

Fig. 3.3. Liri Valley Survey (a) Recovered and restored proportions of population by site type; (b) recovered and restored numbers of persons by site type.

NB all figures are rounded.

Table 3.2. Early imperial site populations recovered and missed by the Liri Valley survey based on standard site population estimates. See Table 3.1 for associated site data and estimated recovery rates.

Site type	Population	Population recovered per 100 km^2	Population missed per 100 km^2	Total population per 100 km^2
Nucleated rural (village)	100	173.91	43.48	217.39
Large rural (villa)	25	260.87	173.91	434.78
Small rural (farm)	5	404.35	943.48	1,347.83
Totals	–	839.13	1,160.87	2,000.00
Percentages	–	42%	58%	–

The population of Italy

Although it is not the focus of this chapter, at this point it is worth reflecting on the implications of the figures laid out in Tables 3.1 and 3.2 for the wider debate about the total population of Roman Italy discussed in Section 3. To extrapolate these figures to Italy as a whole requires two other variables. First, the percentage of Italy under cultivation: this can be set at 50 per cent (for discussion, see Witcher 2008a: 291–2). Second, the rate of urbanization; this can be set at 15 per cent excluding Rome. On the assumption that the Liri Valley data are representative, 2,000 persons per 100 km^2 are projected across the 50 per cent of Italy under cultivation (*c.* 125,000 km^2); Table 3.3 lists a calculated total rural population of 2,500,000. This figure comprises 85 per cent of the Italian total population to which an urban population of 441,176 (i.e. 15 per cent of the total) is added. The city of Rome adds another 1,000,000, for a grand total of 3,941,176. Clearly, this figure is some way short of the 'low count' population of 6–7 million.

At this point, it is important to re-emphasize that the model is intended to be iterative, not definitive. All the individual variables input so far are subject to debate; the aim of the model is to explore the implications of different variables. For example, is the rate of urbanization too low? A total urban population of 441,176 (excluding Rome) equals *c.* 1,000 persons in each of *c.* 430 towns. All else being equal, the current model would require a rate of urbanization of over

Table 3.3. Extrapolation of Liri Valley population figures across Italy. See Table 3.1 for associated site data and estimated recovery rates, and Table 3.2 for associated population figures.

	Population
Nucleated rural (village)	271,739
Large rural (villa)	543,478
Small rural (farm)	1,684,783
Rural total	2,500,000
Urbanization @ 15% of total population	441,176
Rome	1,000,000
Italian total	3,941,176

50 per cent, averaging *c.* 6,000 persons per town, in order to achieve an Italian total population of 7 million. However, this may be rather too high for the majority of towns. At 150 persons/ha, towns would need to average 40 ha at 100 per cent occupancy to achieve populations of *c.* 6,000; most were smaller. For comparison, Morley (1996: Table 1) estimates 430 cities totalling 325,000 persons, or fewer than 1,000 persons per town.

Another way to increase both urban population and total population is to raise the rural base. This could be achieved by lowering recovery rates and/or increasing site populations. Finally, a critical consideration is that the Liri Valley figures may not be representative of the general Italian situation. Indeed, if the model is rerun with the same variables, but populated with the early imperial period results of the Biferno Valley Survey (5 villages, 16 villas and 68 farms/domestic sites across *c.* 400 km^2, Witcher 2008a: Table 3), the result is an Italian rural population of 757,813, an Italian urban population of 133,732 (plus a further 1,000,000 at Rome) for a grand Italian total of just 1,891,544. Clearly, any attempt to reconstruct the population of Roman Italy as a whole needs to allow for significant regional variability in survey results, recovery rates, urbanization, and site populations.

5. COMPARATIVE SURVEY

Greek world

Inter-regional comparative survey has become a central theme of recent Mediterranean archaeological studies (e.g. Alcock and Cherry

2004). However, there has been limited consideration of recovery rates in this context. This final section demonstrates that by comparing assumptions about recovery rates in different regions, it is possible to raise significant questions. Examples are drawn from Greece and North Africa.

As in Italy, the reconstruction of the population of the ancient Greek world has been the subject of long debate. Recently, M. Hansen (2006) has developed the 'shotgun method' to approximate the population of the Greek world during the fourth century BC. Starting with the number and size of urban centres, he uses average population densities[7] to calculate a total urban population of *c.* 3.3 million (encompassing both the Greek mainland and colonial areas). He observes that if the urbanization rate were 10 per cent, overall population would be more than 30 million (ibid.: 29). He suggests that a total population of such a size is unacceptably high and argues for an urbanization rate of up to *c.* 50 per cent for a total population of *c.* 7.5 million. However, Hansen does not clearly define how he establishes the upper limit on total population (e.g. comparison with nineteenth-century population or carrying capacity; for the latter, see Sallares 1991). In other words, Hansen 'squeezes' the rural population between his calculated urban population and an expected but undefined total. Turning to the rural survey data, Hansen (2006: 71–4) reviews some of the problems of reconstructing population, but concludes they either do not affect the urban:rural ratio, or serve only to shift it in favour of urban population. He observes that the number of sites identified by survey indicates sufficient population to bridge the 'gap' between his estimates of urban population and the overall but unstated total. In other words, he more or less accepts the results of regional field survey at face value; for Hansen, site recovery rates are high.

It is informative to compare this population distribution with the situation in Italy. In the fourth century BC Greek world, Hansen (2006: 23–4) adjusts his average figure rate so that small *poleis* have urbanization rates of 67 per cent, medium-sized *poleis* 50 per cent, and large *poleis* 33 per cent. These figures contrast sharply with those widely assumed for Roman Italy, i.e. 10–20 per cent (Wilson 2008: 245 notes the limited basis of this assumption). The Salento peninsula

[7] 150 persons/ha assuming 67 per cent occupancy of intramural space at small *poleis*, 50 per cent at medium *poleis*, and 33 per cent at large *poleis* (Hansen 2006: 61).

in southern Italy provides an intermediary area in which to discern the differences of Greek and Roman traditions. Yntema's (2008) brief consideration of the third-century BC population of Messapia demonstrates an extremely high urbanization rate. Yntema explicitly assumes 50 per cent rural site recovery and hence doubles the number of sites identified by survey. He also assumes rather higher site populations than other demographic reconstructions (8–12 persons per farm). He calculates urban population by assuming that *c.* 50 per cent of walled areas were occupied at *c.* 80–120 persons/ha. In other words, Yntema makes generous allowances to boost rural population in comparison to Hansen, but still reaches an urbanization rate of *c.* 90 per cent.[8]

In Hansen's approach to the broader Greek world, much depends on starting assumptions. For example, Price (Chapter 2, this volume) questions frequently assumed urban population densities; fewer persons per hectare would lower overall urban populations and allow for a larger rural base—in effect, a low recovery rate. However, Bintliff (1997b: 237) suggests that even if recovery were low, it would make minimal difference for the overall distribution and total population of classical Greece; similarly, Osborne (2001) notes that even if the site recovery rate of the Southern Argolid Survey were reduced to just 10 per cent, then rural population would only rise from *c.* 26 per cent to *c.* 48 per cent of the total. However, while the effect of low recovery is certainly less dramatic in Greece than in Italy, such an interpretation underplays the significance of the near doubling of rural population and, more importantly, neglects consideration of the possible reasons for such low visibility in terms of socio-economic integration.

In order to investigate the apparently high recovery rates in Greece, it is useful to approach the issue from a number of angles. Using the results of the Laconia Survey, Table 3.4 summarizes the number of sites and calculated population distribution of the archaic/early classical and the classical periods by site type. The figures demonstrate a modest reduction in population, with a relative shift towards larger sites; much of this is the result of the abandonment of small farms.

With due caution, the surveyors project these figures across Laconia as a whole. When Sparta and other large centres are included, this

[8] Intramural population ranging from 10,000/145,000 to 15,000/117,000 (Yntema 2008: table 1).

Table 3.4. Laconia Survey. Site numbers and population estimates.

	Archaic/early classical (c. 550–450 BC)			Classical (c. 450–300 BC)		
	No. of sites	Population	% of population	No. of sites	Population	% of population
Farmsteads	63	315	31	27	135	16
Villas	17	255	25	10	150	17
Hamlets	4	155	15	7	270	32
Villages	1	300	29	1	300	35
Totals	85	1025	100	45	855	100
Persons/km^2		14.6			12.2	

Source: Based on Catling 1996a: Table 5.5. N. B. Standard hamlet populations vary by site size.

indicates an urbanization rate of *c.* 50–60 per cent during the archaic/early classical period, rising to *c.* 57–64 per cent in the classical period—in other words, very similar to Hansen's urbanization rate in Greece as a whole.[9] However, even assuming 100 per cent site recovery (which the surveyors do not, Catling 1996a: 161), these population figures are almost double those of the nineteenth century; further, the surveyors note that this is relatively marginal agricultural land. If Hansen's 'acceptable' total is influenced in any way by nineteenth-century population figures, his method might need revision.

The Laconia surveyors explicitly note a series of post-depositional processes that may have eroded or destroyed sites, as well as other visibility issues that may have reduced the ability of survey to identify sites. The effects are likely to be biased towards the smallest sites, which contribute the least population, but the correction will be upwards. Further still, there is a heavy reliance on finewares for site dating. 'A generous selection of the most diagnostic [artefacts]' was collected from sites (Cavanagh *et al.* 1996: 43); 79 per cent of these sherds are tablewares (Catling 1996b: 87). Sites that did not make use of such tablewares are therefore likely to be under-represented. This

[9] Hansen 2006: 70–1 stresses the issue of 'boundary effects'—i.e. urban:rural ratio is dependent on where the boundaries of the *polis* are drawn. He argues that the Laconia data cannot be used to address the issue because it is impossible to define where the political boundaries were. However, the surveyors address this by extrapolating their results to the whole of Laconia.

does not mean that such sites existed, but there is an implicit assumption within the methodology of a certain level of economic integration and social status before a site is recognized.

Finally, both surface scatters and excavated sites demonstrate a clear shift in the quantity and quality of material culture in circulation during the fifth century BC; a reduction in ceramic imports to Sparta makes dating of locally produced wares more difficult (Catling 1996b: 35). Hence, even if settlement numbers remained stable, a sharp reduction in recovery rates would be expected at this time (i.e. fewer sites identified; Pettegrew 2007 notes a similarly dramatic *in*crease in site visibility due to a surge in diagnostic material culture during the late Roman period in Greece). Again, this does not rule out a nucleation of population—indeed, the foundation of several large hamlets clearly attests the importance of this category of site (Table 3.4). However, the disappearance of the smallest sites could be a result of reduced visibility, that is, not abandonment but poverty. In summary, the results of the Laconia survey offer a number of reasons to suspect that recovery may be neither as complete nor as uniform as Greek demographers have assumed. These issues do not disprove Hansen's argument, but they should encourage greater attention to recovery rates in the interpretation of Greek survey.

Carter (1990: 406) uses a similar technique to Hansen to address the rural population around Metapontion. Using the estimated capacity of the *ekklesiasterion* at *c.* 8,000 citizens, he calculates a total population of *c.* 40,000. The fourth-century BC city provided space for *c.* 12,500, leaving *c.* 27,500 in the surrounding *chora*. However, if the known settlement numbers for the period *c.* 350–300 BC are extrapolated across the whole *chora*, this indicates *c.* 870 farms totalling only *c.* 4,500–9,000 persons (*c.* 22–44 persons/km^2). Carter does not comment on the reasons why this figure should be so different from his expected figure of *c.* 27,500, but this low rural total helps to maintain the high urbanization rate (*c.* 58–74 per cent) found in other Greek landscapes. Carter assumes 100 per cent recovery: dividing the *chora* between these sites, he calculates overall agricultural production and notes that the scale of surplus is indicative of substantial profit. He notes that despite their small size, black-glazed wares and amphorae were collected from all farm sites, with the former comprising the main pottery classes recovered (ibid.: 408). This forms a coherent argument in favour of a 'well-to do but also remarkably egalitarian society' (ibid.: 430). However, a lower recovery rate would not only reduce the size of these large hypothetical estates, but also depress overall surplus, shift the urban:rural ratio, and create a rather less benevolent impression of rural society. In effect, we may only see the wealthy 'middle-class' peasants and miss the poorest. This rather less egalitarian vision of rural society might also explain the discrepancy with Carter's calculated rural population.[10] Again, these are possibilities not proofs, but they put a clear onus on surveyors to acknowledge and consider the issues of recovery rates for their interpretations.

In general, it appears that there are very different approaches to recovery rates in Greece and Italy. In Greece, there is an assumption of high recovery rates, perhaps because lowering rates is perceived to have limited impact, perhaps due to the powerful historical tradition of the *polis*. (In the Greek context, it is noticeable that there has been more debate about possible *over*counting, e.g. counting barns as farms, rather than low recovery.) Conversely, in Italy, there is a widespread if not universal belief that survey recovers less than 100 per cent, maybe as low as 10–20 per cent. In part, this difference may be related to the independent 'checks' used to frame understanding. Hence, in Greece, Hansen squeezes rural population between calculated urban population and an 'acceptable' total, possibly informed by nineteenth-century figures or carrying capacity; as Greek survey has identified sufficient sites to bridge this 'gap', consideration of low recovery is deemed less important. In contrast, to achieve even the 'low count' Italian population of 7 million, it is necessary to assume *c.* 50 per cent recovery and probably considerably lower (see Table 3.3).

However, the implications of these very different recovery regimes for the understanding of social and economic organization have been neglected. High recovery rates in archaic/classical Greece should be indicative of the close integration of rural populations into regional and urban exchange networks; the suggestion that Laconian farmsteads were subsistence-based and produced limited surplus for exchange (Catling 1996a: 197) seems difficult to sustain when survey collected finewares from all these sites. In comparison, the farmers of

[10] More recently, Carter (2006: 204–10, n. 45) has reduced his estimate of the urban population to a maximum of 2,000 households (i.e. 10,000 persons) with 1,000 households (i.e. 5,000 persons) in the countryside. This is an urbanization rate of 67 per cent. New thinking about the so-called *ekklesiasterion*, and its unusual size in particular, may also reduce overall estimates for population.

Roman Italy appear to have struggled to acquire sufficient material culture to make themselves visible to survey. If more people shared in more wealth than ever before, becoming more specialized producers and more powerful consumers (Jongman 2007), it is difficult to explain why survey struggles to find them. Thus inter-regional comparison promotes consideration of potential similarities and differences: did a more 'cellular' Greek economy promote greater local urban–rural integration? Did the more 'global' economy of the early imperial period expose Italian farmers to greater economic pressures?

North Africa

Finally, it is instructive to consider an example from North Africa. Discussing the results of the Segermes survey in northern Tunisia, the surveyors note that the sites recovered by the survey are affected by processes such as alluviation (Carlsen 2000: 108; C. Hansen 2000: 58–9). Hence, when considering the farms of the period *c.* AD 200–450, they estimate that an additional eight sites should be added to the 37 identified (i.e. *c.* 82 per cent recovery rate). This brings the figures broadly into line with those of the French colonial era, which are used more or less as an independent 'check'. Ørsted (2000a: 135–6) concludes a 'virtually complete and at any rate representative picture of the ancient settlement pattern'. However, despite brief mention of the invisibility of shepherds' huts (Ørsted 2000b: 174), there is no consideration of low recovery resulting from past behaviour.

As with Laconia, it is possible to identify potential variability in recovery rates. Settlement from the period AD 200–450 (see Hansen 2000: 65–7) illustrates two relevant issues. First, the prominence of architectural remains among sites identified: *c.* 90 per cent have structural features, including over 50 per cent with cisterns; just six sites comprise scatters of artefacts only. This situation may be related to Tunisia's different climatic and land-use history compared to the northern Mediterranean. However, the prominence of architectural remains is extremely high compared to Greek and Italian survey results (on this issue, see Mattingly, Chapter 4 in this volume). Second, there is a large number of undated artefact scatters (i.e. 30 scatters of generic Roman date); if added to the 62 sites dated to AD

200–450, these would be sufficient to reconfigure settlement hierarchies and population totals.

Despite the surveyors' confidence that post-depositional disturbance is low, a number of factors question the assumption that recovery rates are high. The Segermes Survey was primarily an architectural survey that collected samples of surface artefacts; it was clearly capable of identifying scatters, but did not necessarily prioritize them. As noted in Section 2, the more 'obtrusive' a site, the easier it is to find. Indeed, the surveyors note the particularly strong continuity of occupation at individual sites and the difficulty of relating artefactual and architectural evidence (Hansen 2000: 61). An alternative interpretation is that the surveyors mapped sites with architectural remains and collected artefacts from each; within these assemblages it was then possible to identify artefacts from a number of other periods (cf. Bintliff *et al.* 1999 on discovery of prehistoric material on classical sites in Boeotia). Other sites, for example, single-phase sites from periods that are not characterized by stone architecture, are likely to be under-represented.

Second, the surveyors explicitly note that the artefactual evidence is insufficient to reconstruct the occupational history of many individual sites (Hansen 2000: 59). Just 15 per cent of the highly selective sample of material collected is diagnostic. If there are insufficient sherds available from many 'obtrusive' architectural sites, the ability to recognize more modest sites may be significantly lower. Indeed, the existence of 30 undated artefact scatters may be significant in this context; many sites are dated by structures not artefacts. Of course, none of this proves the existence of other sites, but it does stress that it is important to consider the possible effects of methodology on interpretation. Targeted resurvey work is one way forward.

Here attention has focused on site recovery rates in the Segermes Valley; Ørsted (2000a) goes on to develop a rather different approach to population reconstruction based on calculations of the labour necessary to work farm estates. The details will not be discussed here; it is sufficient to note that, in comparison with the methods outlined in Section 2, this approach may generate rather higher population estimates. This is clearly of relevance if attempting to compare regional population densities. Further, there is an important question surrounding the 'urban' status of the *municipium* of Segermes. Despite its unambiguous legal status and architectural form, a population of just *c.* 200 persons would not clearly qualify as 'urban' in Greece or Italy.

In sum, what are the implications of inter-regional comparison? Quite different assumptions underlie the treatment of survey results in these case-study areas. In the Segermes Valley, surveyors have assumed a high rate of site recovery. Population was highly dispersed and density was low; the overall urbanization rate was *c.* 12.5 per cent.[11] Reducing the site recovery rate would increase rural population, but densities would always remain low in comparison with much of Italy and Greece. However, low recovery rates would have a disproportional impact on the urban:rural ratio. With a population of just *c.* 200, Segermes was a small centre; even modest reductions in rural site recovery would therefore dramatically affect interpretations of the town's significance. Ørsted (2000a: 137) concludes a 'very superficial Romanization of the countryside' in the Segermes valley, but it is worth noting the contrast between the architectural wealth of rural sites such as baths and cisterns, and the comparative lack of (diagnostic) portable material culture. If recovery rates were high, as Ørsted believes, the rural population of Segermes appears to have been rather wealthier and more 'Roman' in its adoption of cultural practices (e.g. bathing and specialized agricultural production) than the populations of areas such as the Liri and Biferno valleys in Italy.

In contrast, in Greece it is widely assumed that survey recovers the vast majority of rural sites, with population evenly divided between town and countryside. As a result of large urban size, rural site recovery rates would have to be significantly lower in order to diminish the relative importance of towns. Although the population of North Africa was dispersed and the population of Greece was nucleated, both areas share the assumption of high recovery rates and, by implication, closely integrated urban and rural populations. Italy presents greater difficulties. In areas such as the Biferno Valley, recovery rates would need to be extremely low in order to populate the countryside to the levels identified in the *suburbium* or Laconia, or to reduce the high urbanization rates to 'expected' levels. But in Italy, both historical texts and comparative agricultural evidence explicitly allow the possibility of much lower recovery rates—and

[11] I.e., 200 at Segermes and 1,400 in the surrounding municipal territory (or 2,400 in the whole survey region) (Ørsted 2000b: 174). Urbanization rate: 200/1,600 = 12.5 per cent.

hence larger rural populations—than is credible for Greece or Africa. Yet, if recovery rates are this low, then consensus interpretations will need to be radically rethought. If the small sample of Greek, North African, and Italian surveys discussed here is representative, then the issue of recovery rates is more pressing in Italy because there is more at stake in terms of current understanding.

6. CONCLUSIONS

The aim of this discussion has not been to prove that the Greek rural population has been underestimated or that the Italian population cannot possibly have reached 14 million. Rather, it has sought to address the effects of recovery rates on understanding of Greek and Roman societies. Recovery rates have often been reduced to the identification and correction of post-depositional distortion or a convenient means of squaring the archaeological evidence with 'known' population figures or prior beliefs. Here, it is suggested that post-depositional processes must be taken into account, but of no less importance is the variability of past human behaviour. Sites, periods, and regions are rendered visible to survey in different ways because of different social and economic behaviour in the past; the result is variability in recovery rates. By reconceiving of this variability as the object of study, recovery rates become a creative means through which to investigate social and economic organization. By their very nature, recovery rates cannot be defined with any precision or accuracy. Historical texts provide some independent 'checks', but their interpretation is no less problematical than the interpretation of the archaeological data. Neither source provides superior insight into demography; neither source provides conclusive evidence. However, their critical juxtaposition can improve overall understanding of the strengths and weaknesses of both.

Two different modelling approaches have been presented to explore the implications of variable recovery rates, with particular attention to Roman Italy. Neither resolves the key demographic dispute about the size of the Italian population *per se*; but by shifting the debate towards the implications for interpretation of the archaeological record, these models take the subject forward in a new direction. Finally, inter-regional comparison has made it clear that very different beliefs about recovery rates prevail in different regions. Recovery rates in Greece and North Africa are usually assumed to be high; conversely, recovery rates in Italy are often assumed to be comparatively low. There is likely to have been variability by period and by sub-region, but if these general trends are valid, then it is worth considering their significance. Hansen's 'shotgun method' can be critiqued in detail, but the Greek population remains relatively highly urbanized; similarly, the population of the Segermes Valley will remain highly dispersed. In Italy, it is possible to see marked differences between areas such as the *suburbium*, the Biferno Valley and Messapia. For example, urbanization levels and rural settlement density vary enormously: either we accept that this is a reliable picture (uniform recovery), or use variable recovery rates to even out the differences. Either way, we are compelled to explain significant regional variability. Likewise, on the basis of his own demographic models for arid environments, Mattingly (Chapter 4 in this volume) raises a fundamental question about the relative intensity of agriculture in the Mediterranean heartlands and on the arid margins.

Evidence of absence is always intangible but the implications of recovery rates are sufficiently important that more sustained consideration is warranted (Wilson 2008: 252). We must consider recovery rates or we risk allowing methods to determine interpretations. One of the most important successes of regional survey has been to populate ancient landscapes 'beyond the acropolis' (e.g. Snodgrass 2002: 188). But there is still much we do not understand about the significance of what we map; and potentially, there are many more people still to be found.

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4

Calculating Plough-Zone Demographics

Some Insights from Arid-Zone Surveys

David Mattingly

INTRODUCTION

In a paper at the 2006 OXREP conference, Lisa Fentress offered a positivistic vision of the potential efficiency of Mediterranean field survey in recreating ancient settlement numbers and modelling demography.[1] The contribution went to the heart of the sort of debate that OXREP is seeking to open up. After the initial 'wow' factor of her trenchant presentation of her data and models had receded, I tried to address the picture she painted with some constructive criticism.[2] Another stimulus has been a series of seminal papers on Italian survey and demography by Rob Witcher, with similar emphasis on drawing some big demographic models from survey data.[3] Both of these contributions got me thinking about the relationship between what we find in conventional Mediterranean fieldwalking and the total site universe that once existed. Andrew Wilson, it transpires, had been similarly stimulated and, having read his paper on the theme, I have slightly changed my focus to avoid unnecessary overlap with his excellent analysis.[4]

[1] Fentress 2009.
[2] Mattingly 2009.
[3] Witcher 2005; 2006a, to be read alongside his outstanding critique of survey analysis, 2006b.
[4] Wilson 2008.

One of the most striking of Fentress's observations from the Albegna Valley data was that her population figures 'seem to support the lower range of estimates [for Italy as a whole], those of Beloch, Brunt and Hopkins'.[5] Before the 'low counters' pop the celebratory champagne, it is perhaps worth discussing a little further just how conclusive we should expect data to be when they are based on fieldwalking in the heavily agricultural and intensively developed north Mediterranean landscapes. Blanton has characterized Mediterranean archaeologists as rather cautious in trying to draw out demographic trends from their data and as somewhat obsessed with refining methodologies to counteract potential biases.[6] Subsequently, he has demonstrated (in my opinion at least) why we have had good reason to be more cautious than Mesoamerican archaeologists, with his flawed attempt to construct comparative population models for Mesoamerican and Mediterranean societies.[7]

Much of my early field survey experience was in these Mediterranean plough-zone landscapes[8] and, like many others working in the late twentieth century, I have been astonished (and appalled) to see site after site laid out in haloes of modern plough destruction. Fuelled by technological developments in ploughing and subsidies under the EU Common Agricultural Policy, the period from 1950 to 2000 has provided a remarkable window on past settlement in many European rural landscapes. However, it was perhaps all too easy for field directors to assume that we only had to get our teams into the field in order to be able to capture snapshots of past settlement patterns. There are many factors to take into account concerning the actual relationship between the sites that we have recorded and those that originally existed in a given area at a particular phase of human history. Colin Haselgrove's well-known diagram of levels of inference illustrates the problem perfectly[9]—the physical remains of sites are degraded and blurred by many human activities from the moment of abandonment, through incidents of robbing, burial, superimposition, subsequent land use, etc., but also through natural forces of erosion

[5] Fentress 2009: 144.

[6] Blanton 2003, reviewing the POPULUS project volumes on Mediterranean survey and demography; see Bintliff *et al.* 1999; Francovich *et al.* 2000; Gillings *et al.* 1999; Leveau *et al.* 1999; Pasquinucci and Trément 2000.

[7] Blanton 2004.

[8] See for instance Coccia and Mattingly 1993; 1996 on the Rieti Survey in Central Italy.

[9] Haselgrove 1985: 9–11.

and deposition and through the further variables introduced by sampling strategies, fieldwork methods, and analytical techniques. There is potentially a substantial difference between our recorded sample and the pristine settlement patterns of the past, and no matter how sophisticated our methods and sampling techniques, this grey area probably covers both high and low counts of ancient demography. While I remain unconvinced that we can resolve the high/low count argument to everyone's satisfaction from survey data, I do believe that it is worthwhile to explore our data to see if the probability overall favours one estimate over the other.

What we have witnessed in the last fifty years is of course just an extreme manifestation of an inevitable process of site degradation where land is under cultivation. The dramatic surface debris of sites that were first deep-ploughed in the 1950s or 1960s has become abraded and increasingly less distinct over subsequent decades, and some sites would now elude ready identification as such. The first point I want to make is that plough-zone field survey is fundamentally about recording the processes of destruction of settlement patterns, rather than the settlement patterns *per se*. These are very long-term processes and at a certain point each site may reach a point of degradation where its traces are no longer discernible or so ambiguous as to defy confident identification.[10] My main observation from this is that it is unrealistic to believe that we can recover the totality of settlement through survey in regions that are under intensive cultivation or dense vegetation, or where modern development is rife.

Our ability to assign a function or a place in an overall typology or hierarchy to sites represented only by surface scatters of debris is also markedly diminished as a factor of the depth and duration of deep-ploughing or other damage.[11] In the end, it is quite a leap of faith to say that one spread of surface debris equals 30 inhabitants and another only 5—although I have every sympathy with attempts to do so. It has long been recognized that the more intensive the field methodology used by a project, the higher the density of sites recorded is likely to be, with the greatest success for more exhaustive

[10] Fentress noted in her paper (see n. 1) the possibility that 'off-site' background noise equates in many cases to 'sites which have been so destroyed as to not leave a clear signal in the ploughsoil'.

[11] Mattingly 1995 discusses a Roman villa whose interpretation was significantly enhanced by the destructive action of recently dug vine trenches across the site. It is doubtful that as much could be deduced 20 years on.

investigation being better recognition of the lower echelon sites in the settlement hierarchy.[12] Yet simply devoting more and more person-days to the recording of each km^2 is not the whole answer. No matter how carefully we look, some part of the archaeology is permanently lost or obscured from view.

The parts of the landscape that are most effectively closed off from field survey include built-up areas, the course of modern roads, private land with uncooperative owners (typically carrying guns and accompanied by dogs), as well as areas of drastically reduced archaeological visibility—typically land under woodland or permanent pasture (although many surveys do the best they can with these categories). Visibility has always been and will remain one of the key determinants of field survey results—although it is downplayed by many archaeologists in presenting their distribution maps.[13]

In her OXREP paper of 2006 Fentress quoted figures from her own and Rob Witcher's work suggesting densities for rural sites of *c.* 3–4 per km^2 and population densities of 20–60 people per km^2 (Table 4.1).[14] These figures may well be valid, but I find myself increasingly pessimistic about our hit rate in terms of the ratio of sites of a given period recorded to the total sites of that period that originally existed within our surveyed areas. Far from approaching 100 per cent recovery rates, I suspect that because of factors of loss and visibility problems, many survey projects fall below a 50 per cent level of site identification. It may be that the majority of the missing sites are small ones and thus not

Table 4.1. Some population density figures generated from plough-zone survey data.

	Region	Population density/km^2
Witcher	Inner *suburbium*	60
Witcher	Outer *suburbium*	42
Fentress	Jerba Survey (incl. towns)	52
Fentress	Jerba (excl. towns)	30
Fentress	Albegna Valley	21

[12] Cherry 1983; Terrenato 2004: 38–9.

[13] For a range of interesting reflections on this critical variable, see Ammerman 2004; Ammerman and Feldman 1978; Terrenato 2000; 2004: 36–8; Terrenato and Ammerman 1996; Witcher 2006b.

[14] See also Witcher 2005, 2006a, and Chapter 3 in this volume.

likely significantly to move the figures upwards if the gap were filled, but it is by no means certain that survey does not also miss a percentage of larger sites, villas, and villages say, and that cumulatively the under-estimate of population could be quite substantial.

The purpose of this chapter is to explore the issue further and to provide some illustrations of the potential disparity between plough-zone results and those in a variety of arid-zone projects, where surface preservation of physical features allows better site identification and crucially important additional information on site typologies and functions.[15] I draw on my personal involvement in the Kasserine Survey (Tunisia), the UNESCO Libyan Valleys Survey and the Fazzan Project (both in Libya), and the Wadi Faynan Landscape Survey in Jordan. The sample areas in each case were of necessity small due to the intensity of the survey methods used, and I do not claim that these figures should form reliable pointers to population levels across larger regions. However, they do give indicative information about fairly typical parts of specified landscape zones. I would also stress that all the examples come from arid zones where the carrying capacity of the land should be a good deal lower than in the Mediterranean agricultural heartlands. Our starting expectation might well be that human occupation levels would be very much less dense in these arid landscapes, even at locations where water and cultivable soils existed.

The exercise is somewhat arbitrary—applying hypothetical population numbers to broad categories of site without full control of contemporaneity of occupation (although this is true of all survey data). Because of the state of surface preservation and visibility of the four case-study areas presented, I am reasonably confident that we have a (near) complete record of all Roman period sites within these surveyed areas. The ability of the survey teams to produce plans of the sites encountered from their surface traces should also give us greater confidence that there is a reasonable match between what lies below the ground surface and the site type applied (this is something that is much more questionable in plough-zone survey).

[15] See Mattingly 2004 for some preliminary observations along similar lines.

THE KASSERINE SURVEY

The Kasserine Survey (1982–9), directed by Bruce Hitchner, investigated rural settlements around ancient Cillium and Thelepte in the arid Tunisian High Steppe region.[16] Over 200 Roman sites were recorded within a series of sectors covering 75 km^2; these figures at face value suggest a relatively modest site density of fewer than three sites per km^2. However, much of the survey work was extensive in character and, in the most intensively surveyed area, selected pretty much at random, a much higher total was registered through more comprehensive coverage of the landscape. This comprised a sector of only 3.5 km^2, where total mapping of sites and other surface traces was carried out (Fig 4.1), resulting in a record of a total of fifteen Roman settlement sites. In a largely unploughed steppic landscape, the surface traces of the buildings provided a good indication of site morphology. Two sites were characterized as major oileries (comprising large olive-pressing facilities with four presses and associated

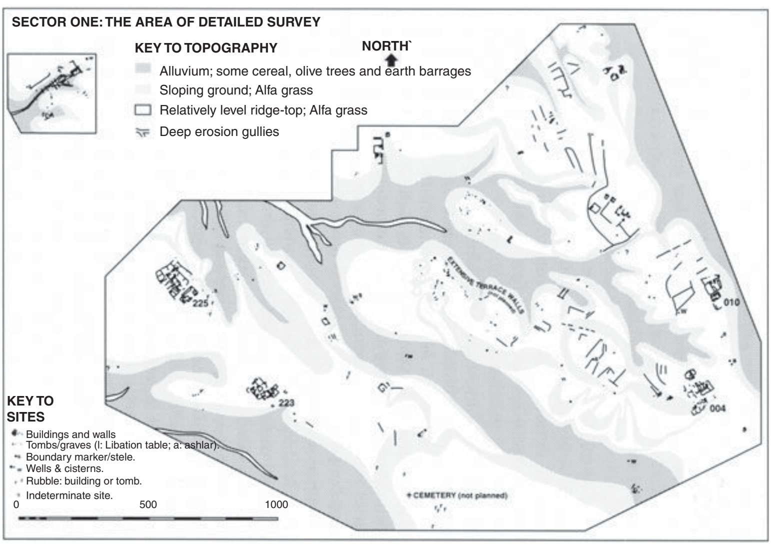

Fig. 4.1. The area of detailed survey from the Kasserine survey, Tunisia.

[16] Hitchner 1988; 1989; Hitchner *et al.* 1990.

Table 4.2. Settlement numbers and population estimates in detailed survey of 3.5 km^2 of Sector 1 of the Kasserine Survey.

Type of site	Population, nos per site	No. of sites	Total people	Total people per km^2
Villa/oilery	30	2	60	17.14
Large farm	10	5	50	14.29
Farmstead/ building	2	8	16	4.57
Total		15	126	36

ancillary structures), and there were five other largish farms or hamlets, eight farmsteads or minor buildings and over thirty tombs or small cemeteries, as well as numerous terraces and linear features. If we assume broad contemporaneity (not necessarily the case, of course, although sites with diagnostic pottery were of consistent third- to fifth-century date) and apply rough figures based closely on those used by Fentress, we get the estimate presented in Table 4.2.

I have allowed 30 people for each of the large oilery sites and 10 for the large farms, while opting for a low figure of 2 people for each of the smaller sites and buildings. The total estimated population of 126 people equates with a density of 36 per km^2, though in a part of the landscape with no villages or urban centres.

THE UNESCO LIBYAN VALLEYS SURVEY

The UNESCO Libyan Valleys Survey in north-western Libya investigated the wadi systems of the Sofeggin and Zem-Zem basins *c.* 100–200 km south of Tripoli (a region *c.* 50,000 km^2 in extent), with more than 2,500 sites recorded and over 55,000 sherds of pottery collected and processed.[17] The settlement distribution here was related to the exploitation of the soils of the dry river beds or wadis that bisect the pre-desert plateau, and settlement and activity were limited in areas of the landscape away from these wadi systems. The density of settlement recorded in different wadis was very much related to the intensity of archaeological recording and, again, where we mapped

[17] See Barker *et al.* 1996a; 1996b.

sites in greater detail we produced extraordinarily busy landscapes.[18] The site hierarchy was dominated by elite farms, initially undefended, later often fortified. There were also large numbers of less substantial farms and farmsteads, small settlements, huts, and tent bases (occurring singly and in groups).

To take just one example in detail, the detailed mapping of *c.* 4 km^2 in the Wadi Mimoun (of which about half was farmland, the rest barren rock hamada) revealed a major fortified settlement, two villages, six small farms, and five isolated buildings or structures (one of these was almost certainly a rural temple), plus four cemeteries, four isolated cisterns, and numerous traces of field systems and water

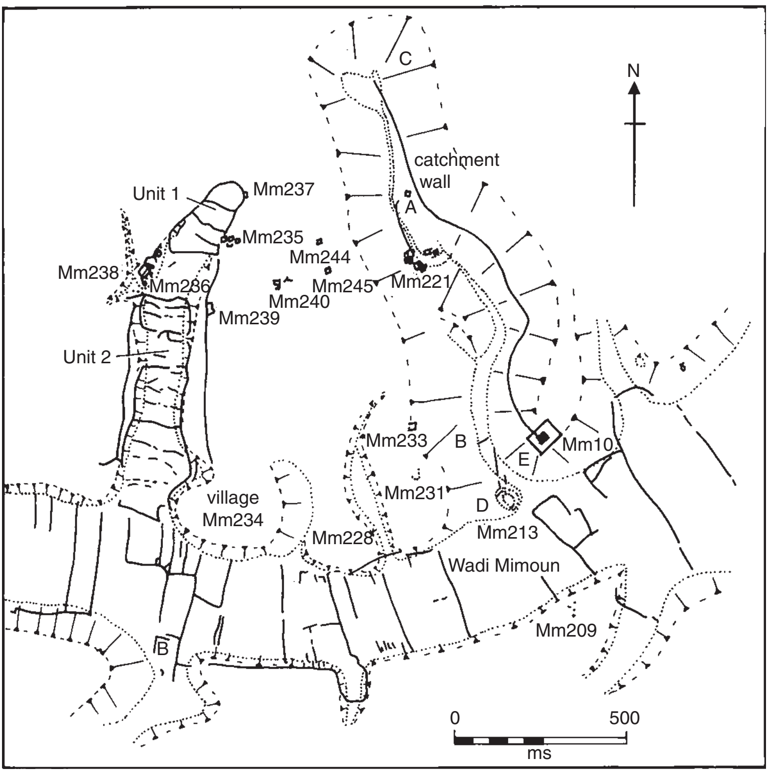

Fig. 4.2. Detailed survey of area of Wadi Mimoun, Libya.

[18] See for instance, Barker *et al.* 1996b: 64, 106, 211 (discussed here), 236.

Table 4.3. Settlement numbers and population estimates in detailed survey of 4 km^2 of the Wadi Mimoun, in the Libyan Valleys Survey.

Type of site	Population, nos per site	No. of sites	Total people	Total people per km^2
Major settlement/ village	30	3	90	22.5
Farm	5	6	30	7.5
Isolated building	2	5	10	2.5
Total		14	130	32.5 (65)

conduits (Fig 4.2). Again, applying rough population estimates produces the result shown in Table 4.3.

The potential population of this one small area of wadi farming (typical in its density of settlements) could have been as high as 130 people or 32.5 people/km^2 over the 4 km^2 surveyed area. If we consider only the wadi edge part of the landscape here (*c.* 2 km^2), a notional population density of *c.* 65 people/km^2 is registered.

THE FAZZAN PROJECT

My most recent fieldwork has been in the central Saharan oasis landscape of the Garamantes—located about 1,000 km south of the Mediterranean and *c.* 500 km outside the Roman empire. Human activity in this hyper-arid location has been limited in historic times to a series of linear depressions where oasis agriculture has been developed. The most significant of these linear oases is the Wadi al-Ajal. Before the Fazzan Project (1997–2001) little was known of the settlement pattern in the centre of this valley beneath the modern oasis.[19] We used conventional fieldwalking techniques wherever modern cultivation patterns offered sufficiently large windows for laying out systematic gridded transects alongside wider prospection elsewhere in the cultivated zone. The results of the Fazzan Project have transformed knowledge of the numbers and density of ancient settlements.[20]

[19] Mattingly 2003. [20] Mattingly 2007.

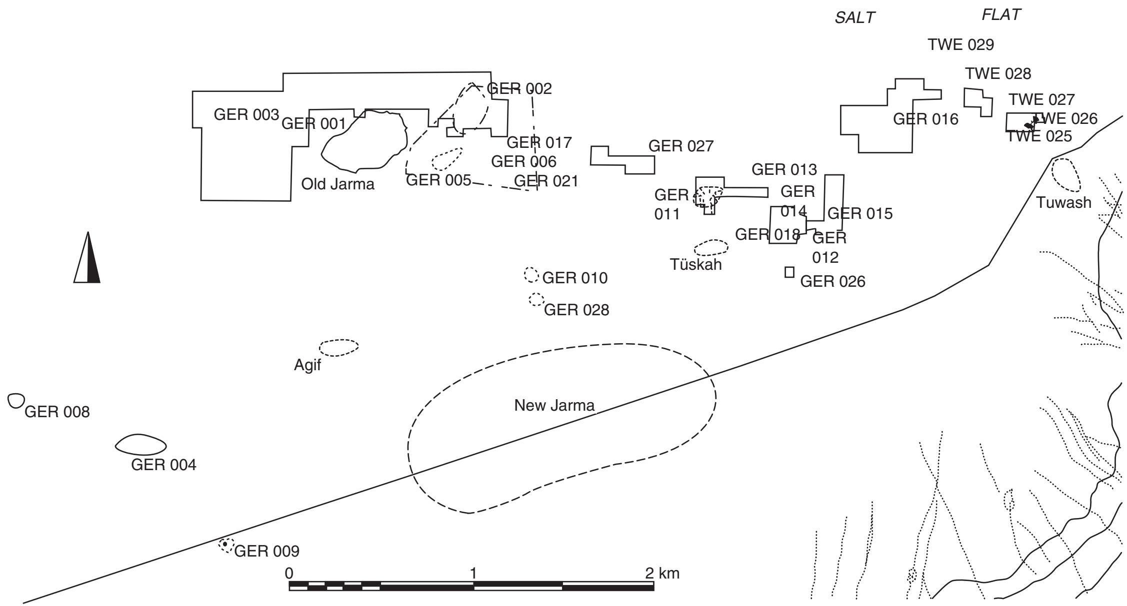

Fig. 4.3. Garamantian sites discovered by systematic (in rectangular boxes) and extensive survey around Jarma, Libya.

In a sample area of *c.* 18 km^2 of oasis around the Garamantian capital at Old Jarma we recorded a major urban site (Jarma) and 16 satellite settlements, comprising villages and hamlets (Fig 4.3). Although the overall density of settlements of just under 1 per km^2 is relatively low, there is a possibility here that the continued farming activity and later villages have obscured some further sites. Moreover, the nucleated nature of these sites and the fact that some of them can be shown from surface traces to have been quite extensive in area suggests that population levels were high. The situation was not unique to the region around the Garamantian capital at Jarma, as further systematic survey and exploratory prospection in other parts of the valley have confirmed the pattern. The visible surface detail of the best-preserved sites confirms that these were large and sophisticated nucleated centres. In a region with summer temperatures in excess of 55°C, the pattern of regularly distributed settlements throughout the long thin strip of oasis cultivation is perhaps unsurprising, as no farmer will have wanted to be far from his fields in such a climate. The preference for nucleated settlements as opposed to widely dispersed individual farmsteads may reflect an aspect of Garamantian socio-political organization.

Adopting the figures of one town, six major villages and ten hamlets—with notional populations of 3,000, 200, and 30 for each class—gives a total for this 18 km^2 area of 4,500 souls or 250 per km^2 (Table 4.4). If we exclude the exceptional Garamantian town, the villages and hamlets alone still yield a total density of *c.* 83 people per km^2 of developed oasis. As a rough estimate, the Garamantian oasis lands may have comprised *c.* 1,000 km^2, suggesting a population in the region of 83,000 in villages and perhaps another 9,000–15,000 in urban centres.

Table 4.4. Settlement numbers and population estimates in detailed survey of 18 km^2 of the Jarma Oasis, Fazzan Project.

Type of site	Population, nos per site	No. of sites	Total people	Total people per km^2
Town	3000	1	3,000	166.67
Large village	200	6	1,200	66.67
Hamlets	30	10	300	16.67
Total		17	4,500	250

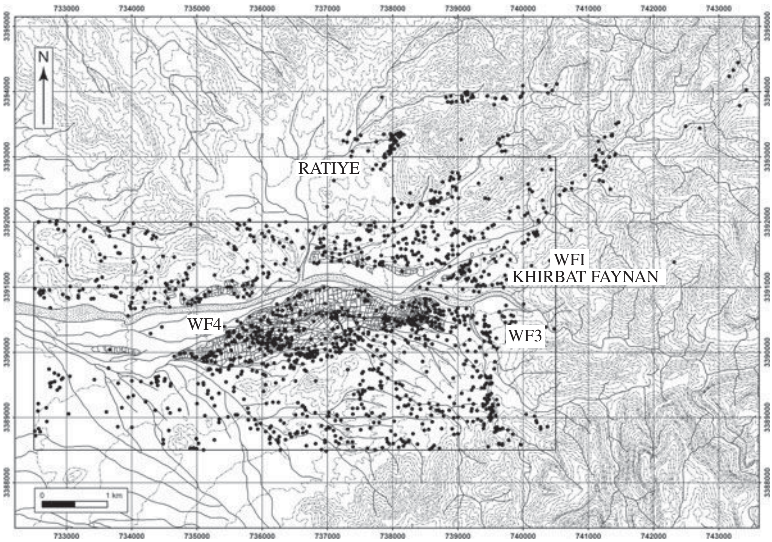

Fig. 4.4. The Wadi Faynan Survey, Jordan: overall distribution of sites.

THE WADI FAYNAN PROJECT

Recent survey in the Jordanian pre-desert zone of the Wadi Faynan has provided another example of a densely filled archaeological landscape. In the Roman period and probably continuing as such into the Byzantine period also, this was the core zone of an imperial mining operation (*metalla*) known as *Phaino*.[21] The main area of intensive survey covered 30.5 km^2 of desertic and mountainous terrain, of which perhaps 20 km^2 comprised the valley zone where settlement activity was concentrated (Fig. 4.4.).[22] Survey method varied across the five seasons of fieldwork in order to address an evolving series of research questions, but the core 30.5 km^2 area was systematically and comprehensively searched, yielding over 1,500 archaeological sites

[21] Infamous in the Christian sources on the Great Persecution (and at other times in the fourth century too), Eusebius *De martyribus Palaestinae* 7.1–2; 8.1; 13.1, 4–10; *Ecclesiastical History* 8.13.5; Athanasius *Historia Arianorum* 60; *Collatio legum Mosaicarum et Romanarum* 15.3.7; Epiphanius *Haer.* 68.3.6.

[22] Barker *et al.* 2008.

and structures—ranging from a Roman/Byzantine town to individual burial monuments, to vestigial stone settings of uncertain function. The detailed recording of minor structures has inflated overall site numbers here, but the domestic structures alone comprised 411 settlements, equivalent to *c.* 13.5 sites of all periods per km^2 (broken down as follows: 4 major settlements, 4 other fortified settlements, *c.* 150 rectangular structures of varying complexity, 85 cirular/oval structures of varying complexity; 17 caves and rock shelters, and 150 'bedouin' encampments).

The later Roman and Byzantine phases focused on the large site of *Phaino* (made up of the three separate settlement areas WF1, 2/11). Although the site is quite extensive in area, its industrial nature, coupled with its role as the logistical centre of the mining, smelting, and farming communities, means that it is difficult to estimate how much of the *c.* 15 ha area comprised domestic habitations (Table 4.5). The limited carrying capacity of the associated field system (estimated as enough to feed *c.* 300 people) would suggest that the total population at *Phaino* itself was probably not more than 600. This is supported by the relatively small size (1,700+ burials) of the main Byzantine cemetery (WF3). There were of course additional settlements in the surrounding landscape, including another major site, Khirbat Ratiye, *c.* 2.5 km north-west (but just outside the demarcated survey grid and thus not counted in my figures here), close to the main area of Roman mining in the Qalb Ratiye, that might have accommodated 100 or more people between the 'elite' control fortlet and the one-room hovels clustered round it. There appears to have been a further substantial site on the south-western approach route into the valley and about twenty other sites might be classified as hamlets with potential

Table 4.5. Settlement numbers and population estimates in detailed survey of 30.5 km^2 of Wadi Faynan, Jordan.

Type of site	Population, nos per site	No. of sites	Total people	Total people per km^2
Town	600	1	600	19.67
Villages	100	1	100	3.28
Hamlets	30	21	630	20.66
Minor sites	5	31	155	5.08
Total		54	1,485	48.69

populations numbering around thirty, as well as about thirty small settlements dated to either late Roman or Byzantine phases (or both). A total of 70 mines show evidence of Roman/Byzantine exploitation, *c.* 55 in the Qalb Ratiye alone. In addition to the resident population close to the mines and smelting centre at *Phaino*, there were no doubt more transient groups involved with the supply of a range of commodities and the transport of material out of the valley. There are traces here and there of a Roman pastoralist presence also, though archaeologically elusive.

The total Roman/Byzantine population level in the valley could thus have numbered 1,500–1,700, but is not likely to have been much higher primarily for reasons relating to supply. This was a highly centralized and organized mining landscape, with the overall settlement pattern skewed in all sorts of ways by the availability of water, cultivable land, and the surveillance and supervisory imperatives of the controlling imperial power.

CONCLUSIONS

These demographic order-of-magnitude estimates have no greater intrinsic validity than the figures advanced for plough-zone surveys and, like them, they are ultimately unverifiable. They are useful to our debate, however, because they show that where conditions of surface preservation and visibility are higher—as is typical of arid desertic margins—the density of ancient settlement of a given period commonly equals or exceeds the estimates based on plough-zone survey results. I acknowledge that the results cannot strictly be set against each other like this, as we are not comparing like with like. However, I think my figures do give some indication of carrying capacity per km^2 of farmland in arid margins—the anomalous Fazzan figures reflecting the high carrying capacity of an intensively irrigated oases. There are of course thousands of square kilometres of almost empty desert lands around some of these hotspots of activity.

Since the plough-zone surveys in northern Mediterranean landscapes have generally focused on landscapes of good agricultural potential (and thus a greater carrying capacity than desert lands),

Table 4.6. The Witcher/Fentress and Mattingly density figures set in parallel sequences (not, of course, strictly comparable).

	Region	Population density/km^2		Region	Population density/km^2
Witcher	Inner *suburbium*	60	DJM	Fazzan	250
Fentress	Jerba Survey (incl. towns)	52	DJM	Faynan	49
Witcher	Outer *suburbium*	42	DJM	Kasserine	36
Fentress	Jerba Survey (excl. towns)	30	DJM	ULVS	33
Fentress	Albegna Valley	21			

this should give us pause for thought as regards the completeness of the picture derived from Italian or Greek survey (Table 4.6).[23] Were the Mediterranean agricultural heartlands less intensively exploited than the arid margins? It is also true that a wider range of site types can generally be identified in these arid-zone landscapes—where we can confidently talk of cemeteries, temples, cisterns, field walls, and so forth. How much of this is simply lost in the blur of background noise in the plough-zone?

The problem with the plough-zone data is not simply one of visibility; it is also about the destructive loss of sites. It is probably fair to say that in any given area we are more likely to have some record of most towns, small towns, villas, and village-scale sites, even when they lie beneath more recent villages, urban sprawl, motorways, or railways. But whether that record or local knowledge will be sufficient to make an accurate interpretation is a moot point, and some sites may have been destroyed so comprehensively or so anciently as to have escaped academic notice. Complete loss of minor sites will be at a much higher rate, but we should not assume that our knowledge of major sites is complete—especially in areas where communications lines and prime locations have remained near constants over time.

The solution to the difficulty is probably to use quite wide brackets or, as Wilson has done in his paper modelling the Biferno population, to calculate population based on a series of different recovery rates for

[23] See Osborne 2004 on the difficulty of reconciling historical and archaeological data for population levels in Greek landscapes.

different categories of site.[24] The consequence of that sort of caution is to make the figures much less conclusive in the ancient demography debate, with both upper and lower limits lying within the range between the figures proposed by high and low counting historians. How then should we seek to use survey data? Fentress has argued that the most reliable surveys for modelling ancient demography are those with large areal coverage and systematic sampling methods. But achieving that sort of coverage often involves a reduction in survey intensity. One of the lessons from the surveys I have cited is that the picture derived from very intensive survey is considerably more detailed than would have been suggested by more extensive phases of these projects. Various survey archaeologists have observed that there is a close to straight-line relationship between survey intensity and site density.[25] This has given rise to a major dilemma in modern field survey—whether to use available resources to examine the region or the locality, and Lisa Fentress and I are to some extent on opposite sides of the argument (although both of us acknowledge the complementary importance of the data that the other style of survey produces).[26]

However, I think the logic of my argument here is that we should be cautious not to base our overall judgement of the high/low rural demography debate simply on a few projects that have covered large areas using systematic sampling, but operating at speed and with little account paid to the offsite scatters. The so-called background noise may very well relate to additional sites as well as to manuring and rubbish disposal strategies, and while it is true that missing a few small sites may have little effect on the overall demographic model, the effects are more significant if we have recovered only a small minority of any of our site types. The putative sites contained in the offsite sample may be relatively minor ones—with concomitantly less distinctive material assemblages or with more vestigial structural characteristics—or they may be sites (even of large size) that have been so heavily degraded by long-term ploughing that their true character is no longer recognizable.

24 Wilson 2008.

25 See Cherry 1983; Plog *et al.* 1978; Terrenato 2004: 39–40.

26 Fentress 2000; Mattingly 2000. Very intensive surveys stand as a useful counterbalance to the more extensive surveys in terms of what each records (or misses), but they are not easy to compare because of the fundamental differences in approach and sampling strategy.

Measuring the numbers of people is an exercise in uncertainties, it would appear, although within reason I think that we can identify some broad patterns of change over time. What is much more difficult is putting a numerical value on those observed moments of expansion or contraction of settlement numbers. Overall, I feel it is better to hypothesize regional population trends than absolute numbers.[27]

The final point I want to raise concerns whether there are other ways in which the available survey data could be deployed to assess economic change in the countryside and how fieldwork should be developing next.[28] One alternative approach is to look for other indicators in the survey data that might be taken as proxies for more far-reaching economic transformations. A good example here, of course, concerns counting economic structures like olive presses or fish-salting tanks—something that the OXREP project is actively pursuing.[29] But the physical detail of rural settlement sites in many areas of the Roman provinces is still an area of woeful ignorance. Surface survey can only take us so far. We need more excavations of rural settlements—notably in places like North Africa, where I cannot think of a single major oilery site excavated to modern standards. Despite advances in the last 30 years, even in Italy rural settlement in many regions remains poorly defined and abysmally synthesized. Jean-Pierre Brun's magnificent overview of oil and wine production in the ancient world highlights the inequalities in the data all too well.[30] What is needed above all is greater definition to be added to our amorphous plough-zone scatters, to elucidate what these sites were up to, on what scale, and with what technological and capital investments, and with what visible outcomes in terms of the material

[27] Mattingly and Witcher 2004; Witcher 2005.

[28] For some recent overviews of where field survey is heading, see Alcock and Cherry 2004b; Cherry 2004; Witcher 2006b.

[29] It is now over twenty years since I published my key article on olive oil production in Spain and Africa (Mattingly 1988), and although there are now more data for some regions, the picture overall has not changed greatly, largely due to the lack of excavation of rural sites. The work of Muftah Ahmed, a recent Ph.D. student at Leicester, provides the first major breakthrough in Libya.

[30] Brun 2003; 2004a; 2004b; 2005.

prosperity of their owners/occupiers. In northern Europe, major landscape excavations have been taking place for many years now—most spectacularly in the French TGV project or in the Netherlands, where the Belvedere Memorandum and similar initiatives have enshrined large-scale excavation of landscape in the planning process.[31] Excavation would allow us to get better control of the difference between surface and subsurface remains, to develop estimates of site occupancy levels and economic function, and above all to test the relatively crude models that have been developed to date from the plough-zone survey data.

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[31] For the French TGV, Boissinot 2001; Ferdière *et al.* 2002; for the Netherlands situation, Bloemers 2005.

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5

Rural Settlement and Population Extrapolation

A Case Study from the Ager *of Antium, Central Italy (350 BC–AD 400)*

Peter Attema and Tymon de Haas

INTRODUCTION

In this chapter we present a case study on regional demographic reconstructions based on data assembled for the *Carta Archeologica* of the municipal territory of Nettuno, central Italy. The aim of this case study is to contribute to the methodological debate on the use of survey data for past (Roman) population reconstructions. The data of the *Carta Archeologica* derive from three sources: past topographical studies; the study of a museum collection; and recent intensive surveys. The project was carried out between 2003 and 2006 by a team of the Groningen Institute of Archaeology (GIA) of the University of Groningen and is part of the Institute's Pontine Region Project (PRP), started in 1987.[1] The study area of *c.* 216 km^2 is located on the Tyrrhenian seaboard, approximately 50 km south of Rome (Fig. 5.1). We shall focus on the period between 350 BC and AD 400 when the survey area was part of the *ager* of the Roman colony of Antium.

[1] The initial surveys have been published as a Ph.D. thesis (Attema 1993). For later surveys, see Attema and van Leusen 2004a and 2004b. An overview publication of all surveys is planned for 2012.

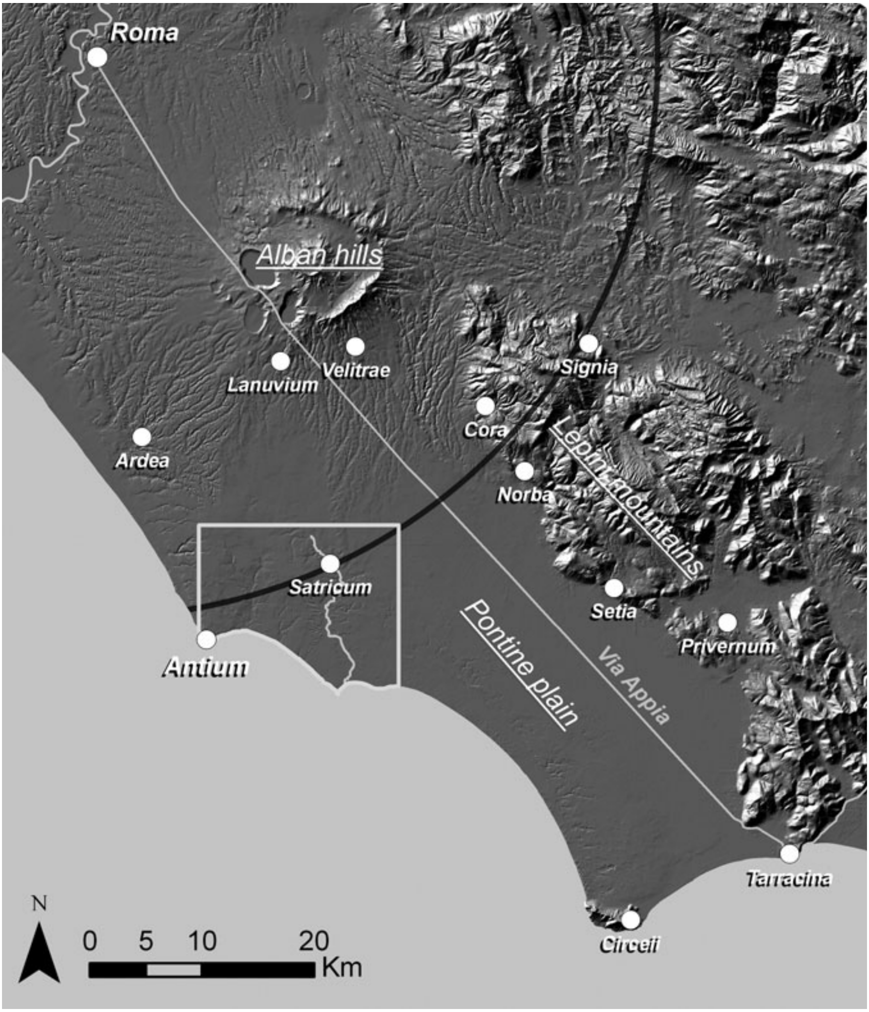


Fig. 5.1. Location of the study area within the Pontine Region with a 50-km radius black circle around Rome as the hypothetical extent of the suburbium.

Source: T. C. A. de Haas, GIA.

Following an introduction to the uses of survey data in demographic reconstructions (Section 1) and an assessment of the way the data were assembled (Section 2), diachronic changes in the density and distribution of rural settlement types over the landscape are dealt with (Section 3). These data are then used to extrapolate population figures, elaborating methods used in earlier studies (Section 4). The combined analysis of rural site data and subsequent demographic extrapolations furnish insights into the economic growth and decline of a part of the *ager* of Antium. The study highlights important methodological issues (especially on the relations between survey intensity and site recovery) that in the context of the present volume are in our view of great importance. It also serves as a test case for future application to datasets available for other parts of the Pontine Region. Ultimately, the results may be used to test recent ideas on the extent of Rome's *suburbium* that would have reached as far as Antium and the Pontine Region (Section 5).

1. SURVEY, RURAL SETTLEMENT, AND DEMOGRAPHY

In the introductory paper to the Populus volume *Reconstructing Past Population Trends in Mediterranean Europe*, Sbonias lists five possible demographic issues that can be studied on the basis of survey data, three of which will be dealt with in the present chapter:[2]

- Detection of changes in the demographic patterns in the medium and long term.
- Differences in population trends across space.
- The estimation of the population size of a region at a given time.

In our treatment, we shall emphasize the reliability of our survey data for demographic reconstructions. As Sbonias points out, it should be realized that survey data furnish a pattern of artefactual distribution that cannot be treated as an actual pattern of past settlements. It is well known from the survey literature that various factors, most importantly site visibility, profoundly affect the recovery rate of sites. This rate is moreover differential, as smaller sites have much lower recovery scores than larger sites. In the present volume, Witcher proposes ways to correct for the 'missing sites' and their residents, and we shall also deal with this issue in this chapter.[3]

[2] Sbonias 1999: 1–2. The two points that will not be discussed here are: contribution to an estimation of the population based on carrying capacity; explanation of population change.

[3] Witcher, Chapter 3 in this volume.

The methodology commonly used to extrapolate population numbers from survey data is in principle straightforward. Sites defined in a given survey area are counted, classified, and interpreted as to type of rural settlement. Next, to each type (normally farm, villa, village, and town) a number of residents is assigned. Broken down into time periods, this will give a relative population trend. Once corrected for the recovery rate, a trend based on absolute figures can be produced. However, published examples have not generally used variable recovery rates for different site types and survey intensities. In this chapter we argue that it is of crucial importance to take into account in such calculations the various methods by which the site data were collected.

Using the regional data of the PRP, various interesting demographic issues can be addressed. We mention:

- Estimates of population numbers at the time of the Roman colonization of the Lepine mountains, the Pontine plain, and the coastal strip during the early and mid-republican period. Can we trace Roman colonization in the form of an increasing population and, if so, where in the landscape did this occur?
- The demographic relationship between Roman colonies and their rural territories from a medium-term perspective. How did population numbers and social stratification develop in town and country?
- Monitoring social changes in the Pontine landscape on a regional scale through quantification of rural settlement types and an analysis of their distribution. Which parts of the landscape were fully economically and socially integrated and which parts remained marginal? How did this fluctuate over time?

These issues have gained relevance in light of a recent paper by Witcher on the population of Rome and its *suburbium*.[4] In that paper, the author models the *suburbium* as a radius of 50 or 100 km around Rome. On the first view, the Roman colony of Antium would, by the early Imperial period, have been situated on the *suburbium*'s border (Fig. 5.1). Enlarging the radius to 100 km, Witcher's *suburbium* would include the entire Pontine Region, as far as Terracina. Various criteria underlie this model; one is the presence of the Roman elite. In the settlement pattern this is represented by the

[4] Witcher 2005.

appearance of luxurious villas from the late republican period onwards. On the Pontine coast, this was indeed a widespread phenomenon, where it took the form of lavish *villae maritimae*.[5] The presence of the elite is, however, not the only criterion for Witcher's model. Other criteria include the measure of integration of production and consumption between the *urbs* and the suburbs, the degree of (daily) mobility between the two, and the use of the countryside by Roman citizens for all kinds of activities, for example ritual festivals. The notion of the Pontine Region as part of the *suburbium* of Rome thus adds an extra point of interest:

- What was the relation between the Pontine Region, Rome, and other parts of the *suburbium* in terms of demography?

In the following, we shall use the data of the *Carta Archeologica* to explore their possible use in studying the demographic relationship between colony (in this case Antium) and countryside in the medium term. Following a discussion of the dataset itself and some of the potential biases it holds, we shall then proceed with an analysis of changes in settlement typology and relative changes in population size. Next we shall apply existing methods for extrapolating absolute population figures from the dataset, and modify these to take into account variations in site recovery resulting from differences in research intensity. As we shall see, such variations have a considerable impact on the extrapolations and we consider them of crucial importance in any demographic reconstruction based on survey data.[6] Finally, we shall evaluate the results in the light of the *suburbium* model and comment on possible future applications of the method to survey data from other parts of the Pontine region.

2. THE *CARTA ARCHEOLOGICA DI NETTUNO*

The *Carta Archeologica di Nettuno*,[7] a recently concluded project, comprises the inventory of archaeological sites in the municipality of Nettuno (Fig. 5.2). For the following reasons the dataset is deemed suitable for demographic analysis:

[5] Lafon 2001; for the surroundings of Antium, see also Piccarreta 1977.
[6] Cf. Witcher, Chapter 3, this volume.
[7] Attema, De Haas, and Tol 2009.

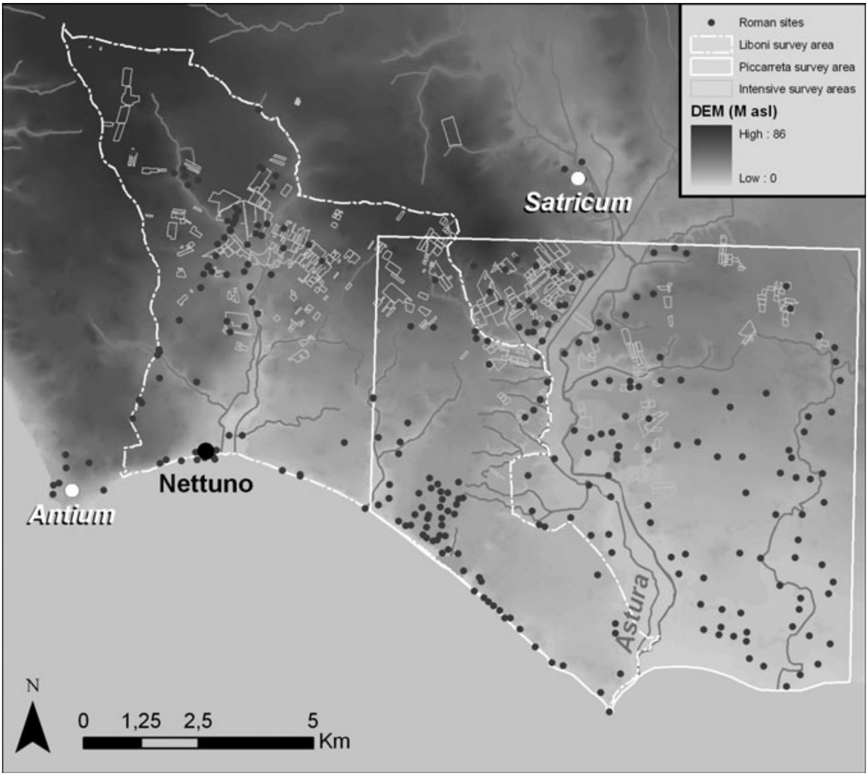
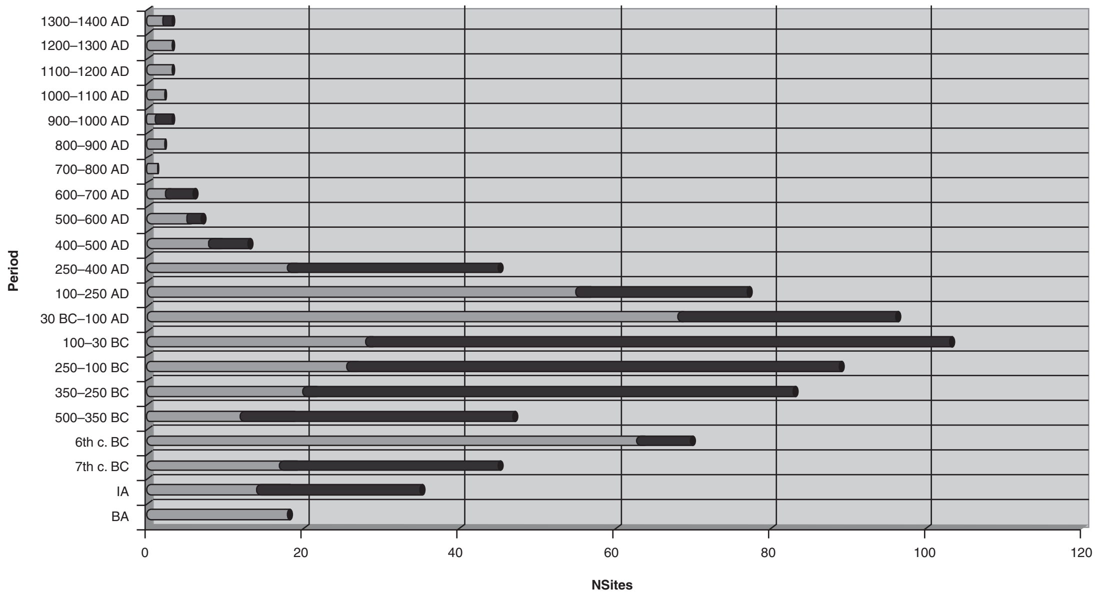


Fig. 5.2. The study area with various survey areas and distribution of all Roman sites.

Source: T. C. A. de Haas, GIA.

- The Roman period can be studied against the background of long-term settlement dynamics from the Bronze Age to the medieval period.
- The quality of the dataset is sufficiently high.
- The dataset allows differentiation in site types from small farms to large, luxurious *villae maritimae*.
- There is a clear link with the Roman colony of Antium.

The bar chart in Fig. 5.3 summarizes the long-term settlement trend (from the Bronze Age to the medieval period) of the Nettuno area. From this it appears that, after an initial peak in the Archaic period, settlement density was highest in the late republican and early



	BA	IA	7th c. BC	6th c. BC	500–350 BC	350–250 BC	250–100 BC	100–30 BC	30 BC–100 AD	100–250 AD	250–400 AD	400–500 AD	500–600 AD	600–700 AD	700–800 AD	800–900 AD	900–1000 AD	1000–1100 AD	1100–1200 AD	1200–1300 AD	1300–1400 AD
■ Possible sites	0	21	28	7	35	63	63	75	28	22	27	5	2	4	0	0	2	0	0	0	1
■ Certain sites	18	14	17	63	12	20	26	28	68	55	18	8	5	2	1	2	1	2	3	3	2

Fig. 5.3. Settlement trend from the Bronze Age to the medieval period.

Source: G. W. Tol, GIA.

imperial periods. This successful development of the countryside in the Roman period is linked to the development of Antium as a Roman colony, a status it obtained in 338 BC.

The bar chart is based on various sources, most importantly topographical work by the Italian topographer Fabio Piccarreta[8] and the director of the local museum Arnaldo Liboni.[9] Many of these sites were revisited by us in order to collect surface artefacts, as these might improve the chronology of the sites and give information on their functional interpretation. The study of a large artefact collection in the store rooms of the museum was also helpful in this respect.[10] In various campaigns additional intensive surveys were carried out by the GIA to complement the existing dataset.[11] Taken together, Piccarreta, Liboni, and our own intensive surveys have covered an area of 134 km^2; the bar chart in Fig. 5.3 thus presents us with a trend that is based on a sample of sites collected in 62 per cent of the entire study area as indicated in Fig. 5.2.

It must be noted, however, that this area has not been covered uniformly, as the three surveys were carried out with different intensities. Moreover, land use and land cover limit the surveyable area: as early as the 1970s (when Piccarreta carried out his survey and Liboni was also active in the region) significant areas were covered by the town of Nettuno and its 'suburbs', forests, and dunes. Since then, urban expansion has further reduced the surveyable area, while other parts cannot be accessed for lack of permission. Within the surveyed area itself, we must reckon with the differential visibility between fields and the intensity of research, whether extensive (topographic) or intensive. All these factors affect the recovery rate of sites, and it is imperative to quantify their effect if we want to use the data for demographic analysis. We shall come back to this when discussing the site and population calculations for the study area.

8 Piccarreta 1977, henceforth referred to as the Piccarreta Survey.

9 His work is unpublished; henceforth referred to as the Liboni Survey.

10 The study of the artefact collection and survey ceramics and an accompanying site catalogue has been published in a supplement to the journal *BABesch*; Attema, De Haas, and Tol 2011.

11 For a description of the methodology and preliminary results of these surveys, see De Haas 2008; Attema, de Haas and Tol 2010.

3. SETTLEMENT HISTORY OF THE NETTUNO AREA

In total, 285 Roman sites have been mapped in the study area (including the Roman colony of Antium). Based on material evidence, 140 of these have been assigned to one or more phases (Fig. 5.4);[12] for the remaining 145 sites, this is unfortunately not possible as we only have very limited descriptions.[13] The evidence that we have for the 140 dated sites does not always allow us to place a site in a phase with certainty. For example, if black glazed wares are present, we know a site is republican, but we cannot be certain during which phase(s) it was occupied. Such sites are therefore ascribed to each of the three republican periods, 350–250 BC, 250–100 BC, and 100–30 BC as 'possibly' occupied. We therefore use two different sets of data, one consisting of only the 'certainly occupied sites' and the other also including the 'possibly occupied sites'. We should however keep in mind that even the 'certain and possible' figure is low as the large group of 'Roman' sites (see Fig. 5.4) is not taken into account.

Based on the finds assemblages and architectural remains, we can discern the following site classes: pottery scatters; building debris scatters; pottery and building debris scatters; pottery and building debris scatters with standing architecture; pottery and building debris scatters with 'luxury indicators' (marble, *tesserae*, wall plaster, sometimes in combination with standing architecture); large architectural complexes; non-habitation sites; and sites without information on the assemblage or architectural remains.

Size and location can in some cases help us in interpreting sites: a number of pottery and/or building debris scatters are located close to a site with luxury indicators, indicating that these belong to a single complex consisting of several buildings. Size estimates are available for a limited number of sites (we have 41 estimates ranging from 114 m^2 up to 1.24 ha). In a number of cases these are unreliable due to the influence of recent agriculture, erosion, and/or site degradation. In

[12] We have used a chronology that is based on the dating evidence provided by Piccarreta and a study of the ceramics from both surveys and the museum collection by ourselves. The following phases are used: 350–250 BC; 250–100 BC; 100–30 BC; 30 BC–AD 100; AD 100–250; AD 250–400. Obviously, the variations in period length influence our analysis.

[13] For example, *aree di frammenti fittili*, *sito romano*.

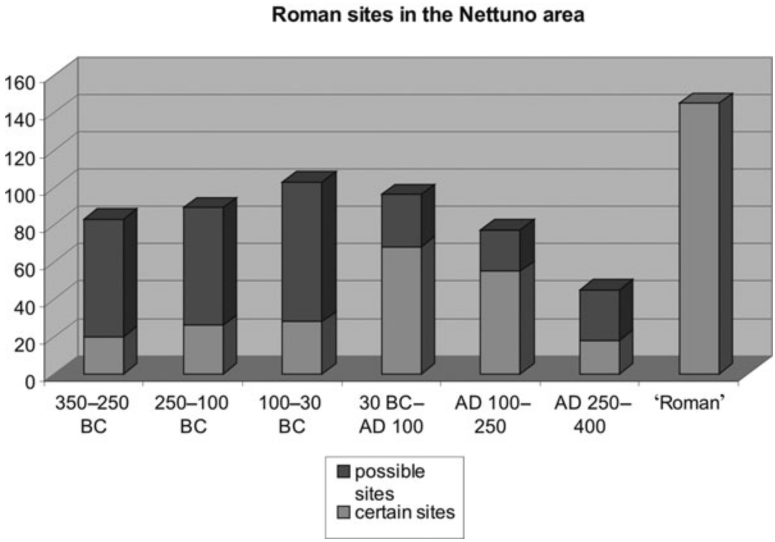


Fig. 5.4. Settlement trend of the Roman period.

Source: T. C. A. de Haas, GIA.

some cases the estimates may indicate that we are dealing with very small structures that are probably not habitation sites.

3.1 Rural settlement typology

To interpret the sites in terms of settlement types, we have discarded all certainly non-habitation sites, all sites for which we have no information, and a number of sites that on the basis of size and location are considered to be part of multi-building complexes.[14] The remaining sites are grouped into the following settlement types:

- *Farm or non-habitation sites*: we here group all pottery scatters (15 sites), building debris scatters (17 sites), and very small[15] pottery and building debris scatters (2 sites) not situated within close range of a villa (see below). These sites may be modest

[14] The non-habitation sites include tombs, roads, and aqueducts (in total 13 sites); for 17 sites we have no information; 3 sites are excluded being part of multi-building complexes.

[15] By very small we here mean smaller than <250 m^2; cf. Perkins 1999.

habitation sites, but could also represent burials, outbuildings, or other non-habitation structures.

- *Farms*: we here group all pottery and building debris scatters larger than 250 m^2 (170 sites) as well as all sites with standing architecture but without luxury indicators (13 sites).
- *Villas*: in this class we include all sites with luxury indicators (22 sites).
- *Villae maritimae*: this group comprises the large architectural complexes (10 sites); these are all located on the coast and include elaborate villa architecture (platforms, baths, etc.), and in some cases evidence for industrial activities and/or fishponds.
- *Villages*: based on location, size, and data from excavations, we interpret the sites of Satricum and Astura as villages. Astura was recorded by Piccarreta as a site with pottery, tile, and standing architecture of considerable size.[16] The site of Satricum, a Latin town that in the written sources is also recorded as a Roman colony, has so far yielded only evidence for limited occupation after 350 BC.[17]

We realize that this classification may not reflect the original variation in rural settlement: the distinction between farms and villas in reality must have been less marked and there may have been a whole range of farms of varying size. However, using this dataset, it is not possible realistically to expand the site typology.[18] We also note that it is hard to establish when a site with luxury indicators 'became' a villa;[19] we have here chosen to consider all 'future villas' in the period 350–250 BC as farms. We have (admittedly arbitrarily) assigned half of the 'future villas', including the *villae maritimae*, villa status for the period 250–100 BC as a number of sites known from excavations support this interpretation. We assume that all such sites can be interpreted as villas in later periods. The resulting settlement typology for each period is displayed in Table 5.1.

[16] Piccarreta 1977: no. 1; Piccarreta's research and finds in the museum collection indicate that the site was occupied in the republican and (early) imperial period; recent investigations at the site have yielded evidence for late Roman and early medieval occupation of the site as well (Attema, Derks, and Tol 2010).

[17] Most recently, Gnade 2007 (with further references).

[18] Others have used similar site typologies for demographic calculations; cf. Perkins 1999; Witcher 2005.

[19] Cf. Di Giuseppe 2005.

Table 5.1. Number of sites per settlement type for each period (C: certain sites; C+P: certain and possible sites).

Period	Farm/non-habitation sites		Farm		Villa		Villa Maritima		Village	
	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P
350–250 BC	1	12	17	67	–	–	–	–	1	1
250–100 BC	1	13	16.5	62.5	4.5	8.5	–	–	2	2
100–30 BC	2	13	14	62	7	13	3	7	1	2
30 BC–AD 100	7	14	32	47	13	13	9	10	1	1
AD 100–250	4	12	25	35	11	12	8	9	1	1
AD 250–400	3	9	3	16	5	6	3	6	1	1

3.2 Diachronic changes in settlement typology and spatial distribution

The diachronic changes in the site typology are displayed in Figs 5.5a and 5.5b. Fig. 5.5a (certain sites) shows a limited rise in the number of sites through the republican period with a 'boom' in the early imperial period, a slight decline after the first century AD and a strong decline after AD 250. In this diagram, the share of villas and *villae maritimae* is relatively large (*c.* 35 per cent in the late republican period to over 50 per cent after AD 250), but with the increase in the number of villas there is also an increase in the number of farms in the early imperial period.[20]

This picture, however, changes if we also take into account the possible sites (Fig. 5.5b): there is already a large number of sites in the early republican period with a peak in the total number of sites in the late republican period. Decline already sets in during the early imperial period, but is less marked after AD 250. The share of villas

[20] Ikeguchi (1999) relates the presence and absence of farms to the rise and decline of intensive villa production, as farmers were indispensable for villas as a seasonal labour force. The disappearance of farms from the countryside may thus indicate a transition to more extensive modes of exploitation on villas. Similarly, Ikeguchi interprets small sites as outbuildings or other structures related to intensive agriculture (this class would match our farm/non-habitation sites). The decline of this class would then also be an indicator for the decline of intensive agriculture and the transition to extensive agriculture, as the need for such structures would drop.

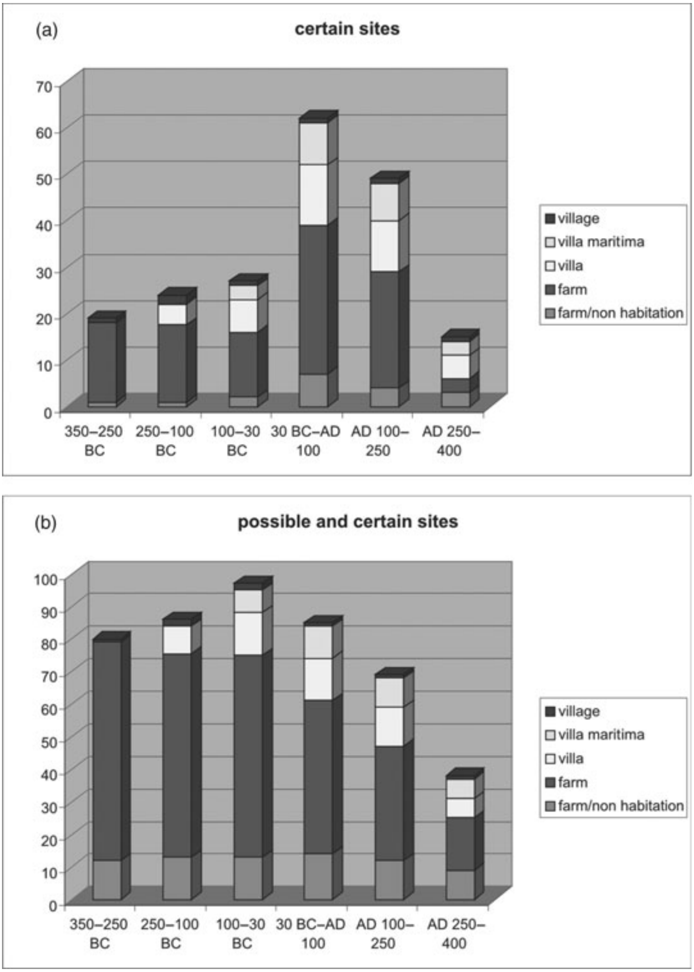


Fig. 5.5. Stacked bar chart of frequency of site types for each period: (a) certain sites; (b) certain and possible sites.

Source: T. C. A. de Haas, GIA.

and *villae maritimae* is much smaller (*c.* 20 per cent in the late republican period increasing to *c.* 30 per cent after AD 250) and the decrease in the number of farms is more gradual.

These differences are largely due to the fact that black glazed wares occur on many sites mapped by Piccarreta, but more closely datable pieces are rare; all these sites are included as possible farms. We must also take into account that the 'generically Roman' sites that are excluded from this analysis are almost exclusively pottery and building debris scatters (here interpreted as farms) that are likely to be republican.[21] This would indicate that the share of (republican) farms is more reliably represented by the certain and possible sites.

The distribution of sites over the area exhibits some interesting patterning (Figs 5.6a–f).[22] The area north-east of Antium (along a paved road that connected Antium to the Alban Hills and the *Via Appia*) shows a remarkably high density of sites throughout the Roman period.[23] The number of villas is especially high in this area (*c.* 50 per cent of all certain sites); these are almost exclusively located immediately along the road. A cluster of farms further away from the main road is abandoned in the late republican period,[24] but farms continue to exist both near and further away from the road. The estates in this area will have supplied the city of Antium with cereals, wine, and oil, part of which was probably shipped to Rome.[25] Especially in the (later) imperial period the relation between site location and the road is striking. The fact that almost all sites dated between AD 250 and 400 are villas located directly on the road in our view indicates that these continued to produce for the local market and Rome. The disappearance of farms in their vicinity and the decreasing site density may indicate accumulation of estates and a shift to a more extensive mode of production.[26]

[21] Many of these sites include *tegole sabbiate*, a fabric group that is predominantly (but not exclusively) republican.

[22] We here focus on three relatively well-investigated areas: the area along an important Roman road that runs towards Antium from the north; the coastal strip east of Antium; and the Astura valley in the eastern part of the research area.

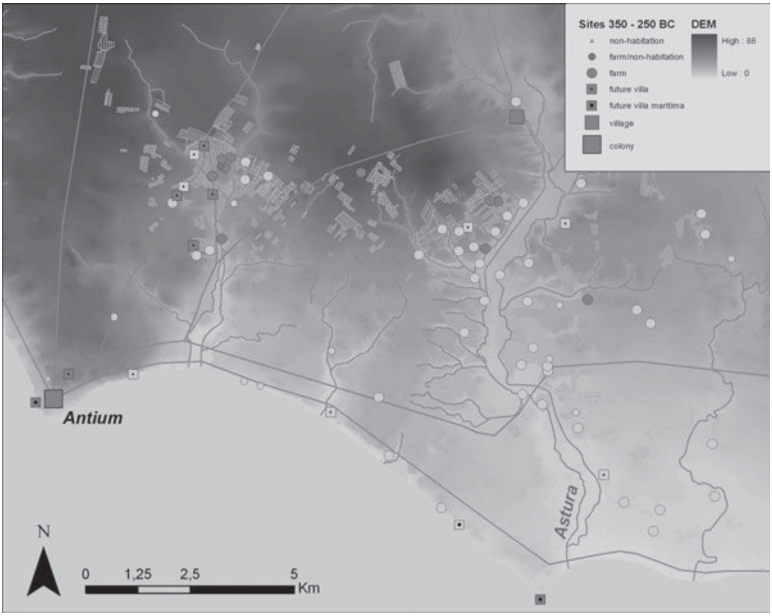
[23] Although the area has been investigated more intensively than other areas, the density of sites and their richness are striking.

[24] See also De Haas 2008.

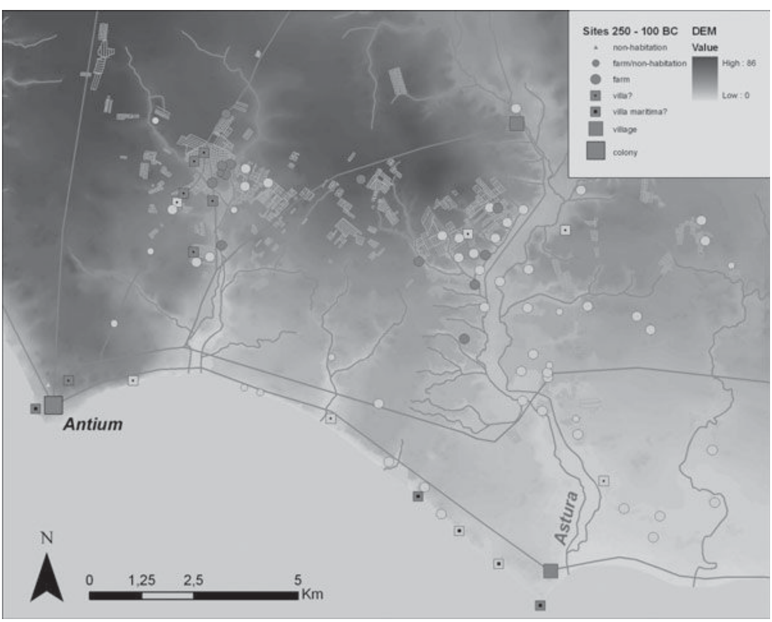
[25] A harbour was constructed at Antium under Nero, who also had a large residence outside the city.

[26] Cf. note 20 above.

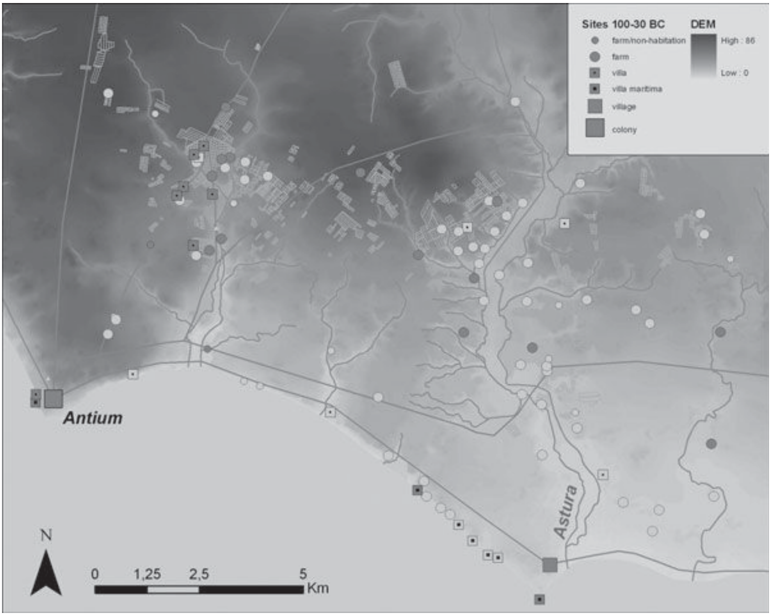
(a)


Sites 350 - 250 BC
non-habitation
farm/non-habitation
farm
future villa
future villa maritima
village
colony
DEM
High : 86
Low : 0
Antium
Astura
N
0
1,25
2,5
5
Km

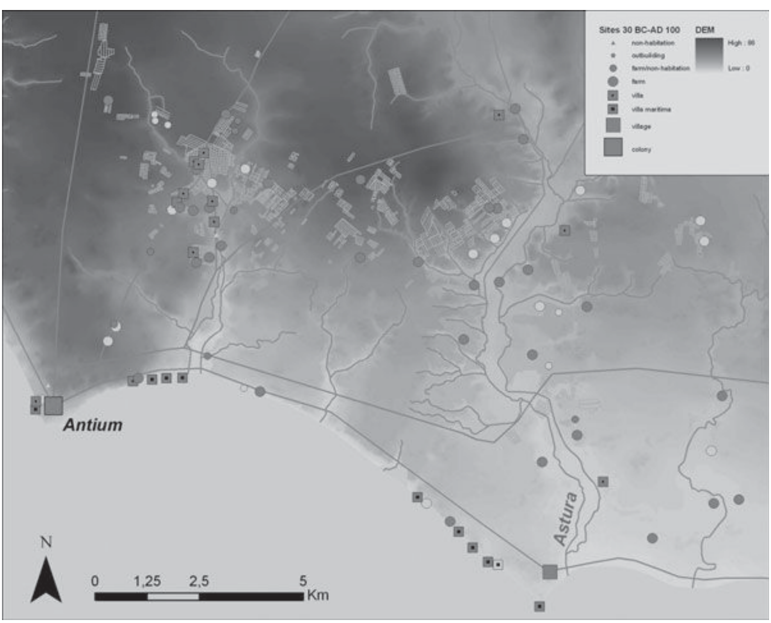
(b)


Sites 250 - 100 BC
non-habitation
farm/non-habitation
farm
villa?
villa maritima?
village
colony
DEM
Value
High : 86
Low : 0
Antium
Astura
N
0
1,25
2,5
5
Km

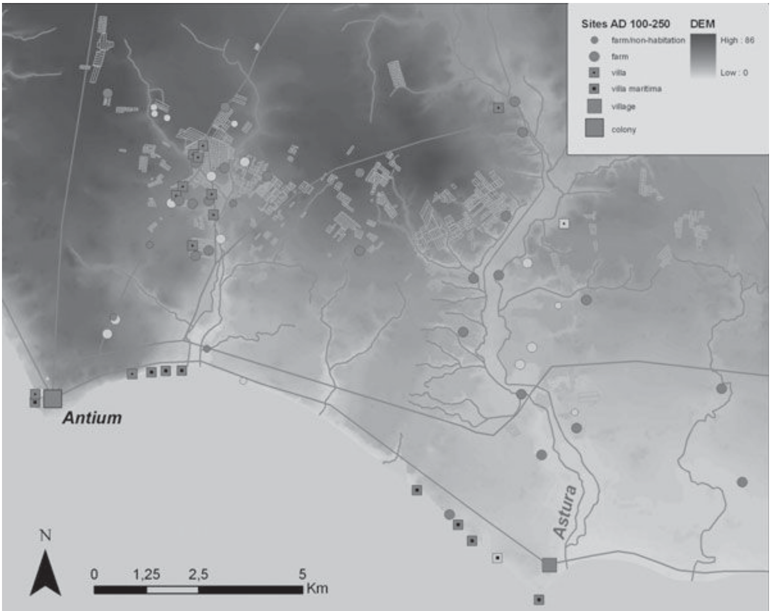
(c)


Sites 100-30 BC
farm/non-habitation
farm
villa
villa maritima
village
colony
DEM
High : 86
Low : 0
Antium
Astura
N
0
1,25
2,5
5
Km

(d)


Sites 30 BC-AD 100
DEM
Antium
Astura
N
0
1,25
2,5
5
Km

(e)



(f)

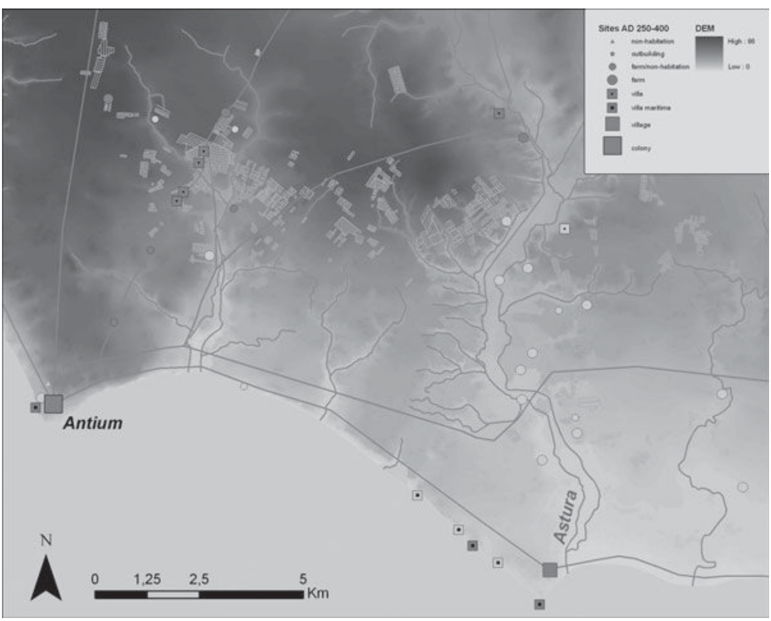


Fig. 5.6. Distribution of rural settlements over the study area for each period: (a) 350–250 BC; (b) 250–100 BC; (c) 100–30 BC; (d) 30 BC–AD 100; (e) AD 100–250; (f) AD 250–400.

Note: Light symbols indicate possibly occupied sites, dark symbols certainly occupied sites.

Source: T. C. A. de Haas, GIA.

The area along the coast may have been sparsely settled in the republican period,[27] but the rise of large *villae maritimae* in this area can already be seen in the second century BC, with a clear peak in the early and mid-imperial period. These large *villae maritimae* cluster in two areas: around Antium, and in the south-eastern coastal strip west of the river Astura. Especially in the second area, elite involvement in agriculture and other 'industrial' activities is clear: at one large villa we have evidence for amphora production,[28] clearly indicating that estates were involved in wine and olive oil production. Tiles were produced at the same site, and a tuff quarry is located nearby; perhaps the owner(s) not only used these for the construction of their own villas, but also for commercial purposes.[29] Whether the *piscinae* that have been found at various *villae maritimae* were used for commercial fish raising is still debated.[30]

There may also be a relation between these *villae maritimae* and the sites in the fertile Astura valley. This area, in the sixth and fifth centuries BC still part of the territory of Satricum, contains a number of republican farms—unfortunately their density is rather unclear considering the high number of 'possible' republican farms. The almost complete absence of villas in this area is conspicuous: for the mid republican period we may think of a dispersed population of smallholders, but over time the area may well have become part of larger estates controlled from the *villae maritimae*.[31] An indication for this socio-economic tie can be seen in the contemporaneous disappearance of the farms in this area and a number of *villae maritimae* after AD 250.

[27] Although we should be cautious, as there are about forty pottery and building debris scatters in the area that have not been dated (all are 'generically Roman'). Revisits have not been made in this area as it is part of a closed military base (see also Fig. 5.9).

[28] This site produced Graeco-Italic, Dressel 1A, and cylindrical amphorae, probably dated in the second and early first century BC: Hesnard *et al.* 1989; Attema, De Haas, and Nijboer 2003; De Haas, Attema, and Pape 2008. Additional evidence for oil and wine production in the area comes from stamped amphorae from Antium (Brandizzi Vittucci 2000: 132).

[29] See also De Haas, Attema and Tol 2011.

[30] On fishponds and fish raising, see Giacopini 1994 and Higginbotham 1997. See also Marzano 2007: chapter 2.

[31] See also De Haas, Attema and Pape 2008. These farms may have been run by tenants leasing them (cf. Foxhall 1990) or by slaves. Of course, independent small landholders may also have continued to exist.

3.3 Diachronic changes in rural population

We shall now present a set of calculations to reconstruct diachronic changes in rural population by assigning a number of inhabitants to each settlement type.

Although some variations in the literature exist regarding the numbers of inhabitants assigned to site types,[32] we have here chosen to follow the fairly commonly used figure of five people for farms; for the villas and villages we follow Witcher's 'informed estimates' giving 25 and 100 people for villas and villages respectively.[33] For the villae *maritimae* we refer to Perkins's number of inhabitants for a villa, estimated at 35.[34] Also here we consider all 'future villas' in the period 350–250 BC as farms; for the period 250–100 BC half of all villas and *villae maritimae* are interpreted as villas, the rest as farms. When applied to our dataset, these estimates give us the rural population figures displayed in Table 5.2 and Figs 5.7a and 5.7b.

Compared with Figs 5.5a and 5.5b, the differences between the data based on the 'certain' and on the 'certain and possible' sites are much less marked; this is of course largely due to the fact that the possible sites are often of the smaller types (i.e. farm/non-habitation sites and farms) with a small number of inhabitants. The peak in population is also here situated either in the early imperial (certain sites) or the late republican (possible and certain sites) period. Although farms were in all periods the most common site type (except perhaps the period AD 250–400), farm population may always have been a minority: in the early periods the villages housed a large proportion of the rural population, whereas from the late republican period onwards most people lived in villas (*c.* 60 per cent of the population of certain sites, 50 per cent of the population of certain and possible sites).[35]

32 Cf. Perkins 1999 and Cambi 1999 for the Albegna valley; Witcher 2005 for the *suburbium*; for various surveys in Greece, see Osborne 2004. Approaches based on scatter size (cf. Price, Chapter 2, this volume) are promising but our data do not allow such an approach, as (reliable) size estimates are lacking for most sites.

33 Witcher 2005: Table 2.

34 Perkins 1999: 167.

35 However, the farm population may still be under-represented as there are relatively many farms among the 'generically Roman' sites. Applying the corrections to come to absolute population figures (see below) seems to indicate farm population may indeed have been larger.

Table 5.2. Rural population size for each phase (C: certain sites; C+P: certain and possible sites).

Period	Farm/non-habitation site population		Farm population		Villa population		Villa Maritima population		Village population		TOTAL RURAL POPULATION	
	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P
350–250 BC	2.5	30	85	335	0	0	0	0	100	100	187.5	465
250–100 BC	2.5	32.5	82.5	312.5	112.5	212.5	0	0	200	200	397.5	757.5
100–30 BC	5	32.5	70	310	200	350	70	210	100	200	445	1102.5
30 BC–AD 100	17.5	35	160	235	350	350	280	315	100	100	907.5	1035
AD 100–250	10	30	125	175	300	325	245	280	100	100	780	910
AD 250–400	7.5	22.5	15	80	150	175	70	175	100	100	342.5	552.5

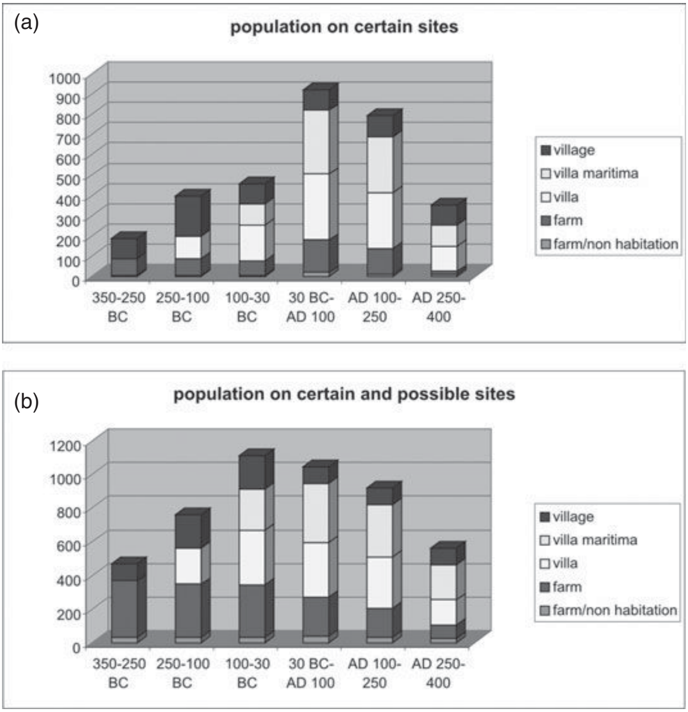


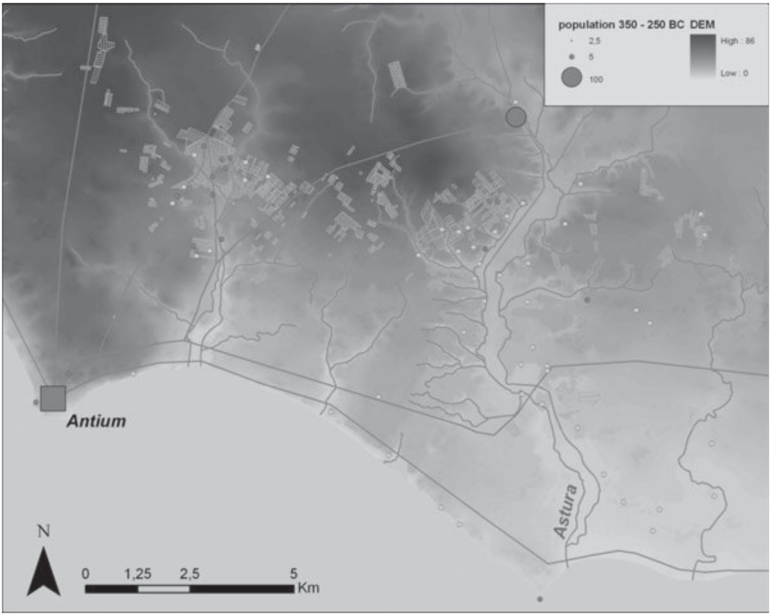
Fig. 5.7. Rural population figures for each phase: (a) certain sites; (b) certain and possible sites.

Source: T. C. A. de Haas, GIA.

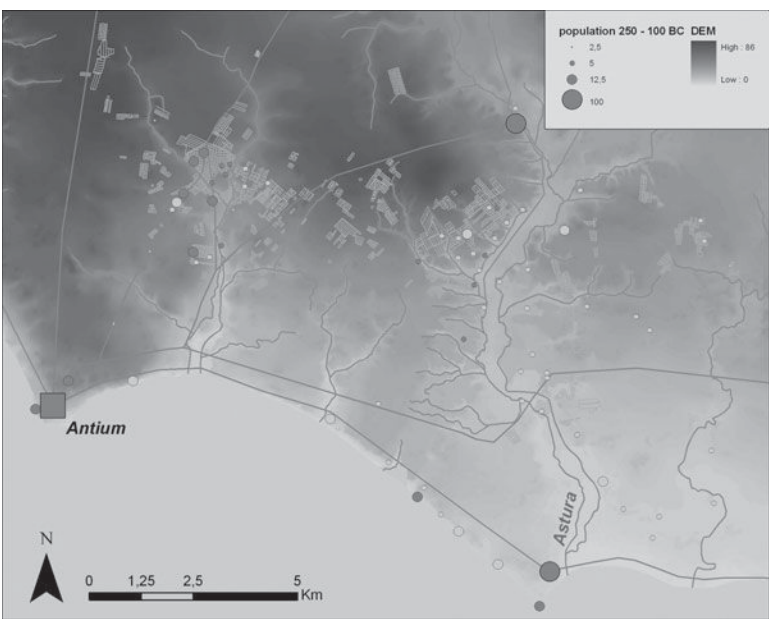
In Figs 5.8a–f we have plotted the distribution of this rural population.[36] The maps clearly show that the rural population was far from evenly distributed over the territory: perhaps not surprisingly, the area north of Antium and the coastal strip were the areas where most population growth took place. The Astura valley had a relatively small—but perhaps rather stable—population. In this area, a large proportion of the population lived in the two villages, which may have provided some of the central (religious and economic) functions Antium had for rural sites in other areas.

[36] As noted above, for the period 250–100 BC we have assumed that half of the villas and *villae maritimae* were indeed villas, and half were still farms. Rather than randomly assigning the full number of villa inhabitants to half of the sites in Fig. 5.8b, we have here chosen to display all villas with the half number of villa inhabitants.

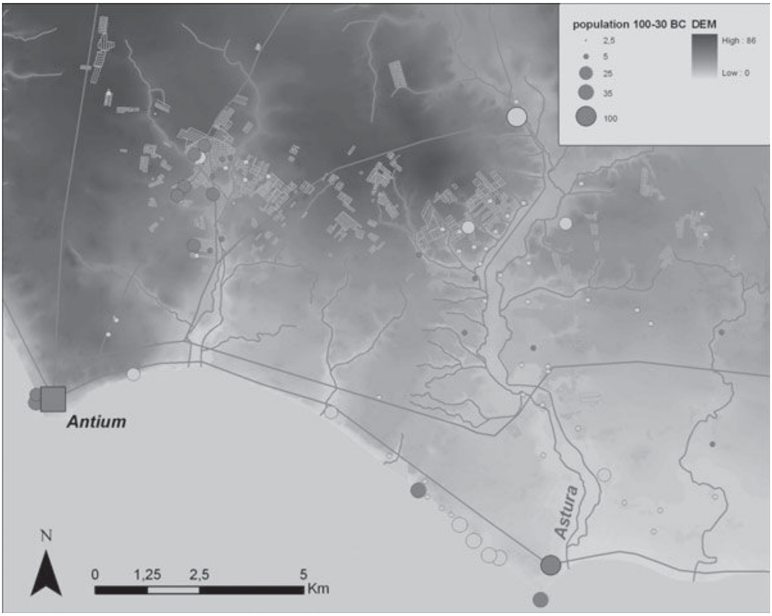
(a)


population 350 - 250 BC
DEM
2,5
5
100
High : 86
Low : 0
Antium
Astura
N
0
1,25
2,5
5
Km

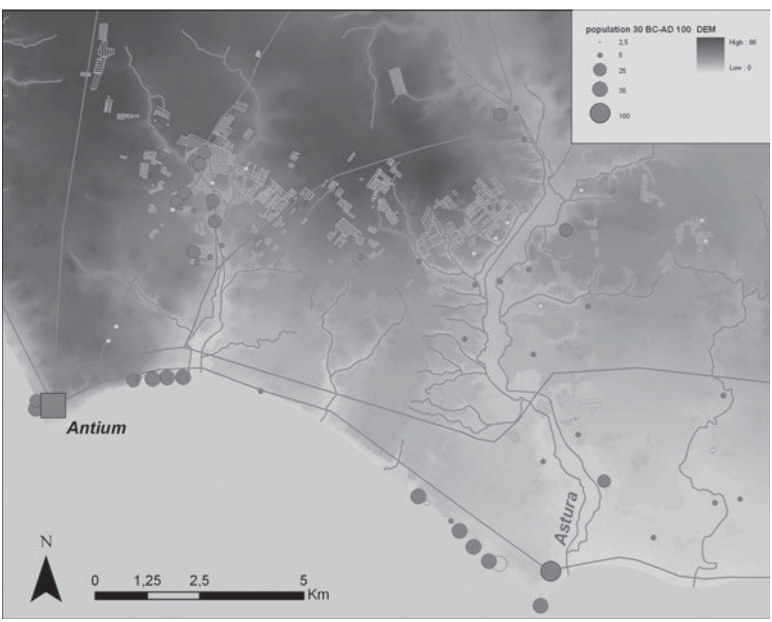
(b)


population 250 - 100 BC
DEM
2,5
5
12,5
100
High : 86
Low : 0
Antium
Astura
N
0
1,25
2,5
5
Km

(c)


population 100-30 BC DEM
2,5
5
25
35
100
High : 86
Low : 0
Antium
Astura
N
0 1,25 2,5 5
Km

(d)


population 30 BC-AD 100 DEM
2,5
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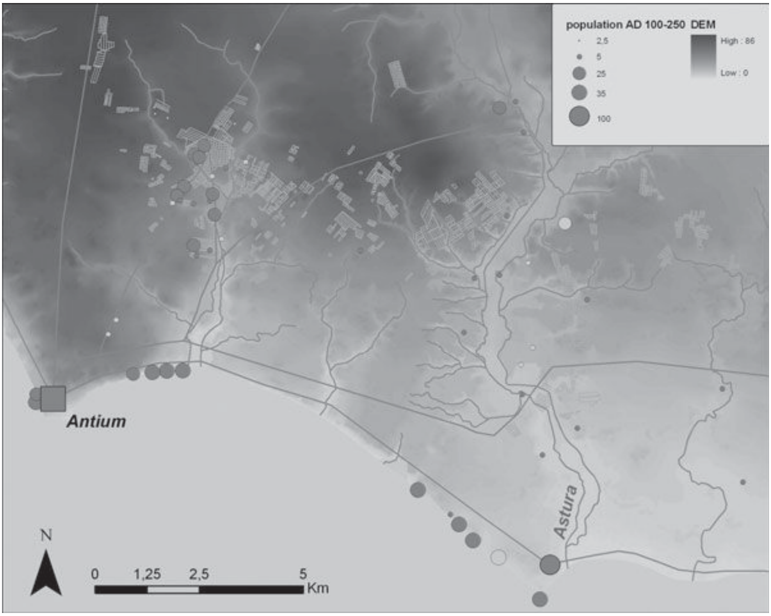
High : 86
Low : 0
Antium
Astura
N
0 1,25 2,5 5
Km

(e)



(f)

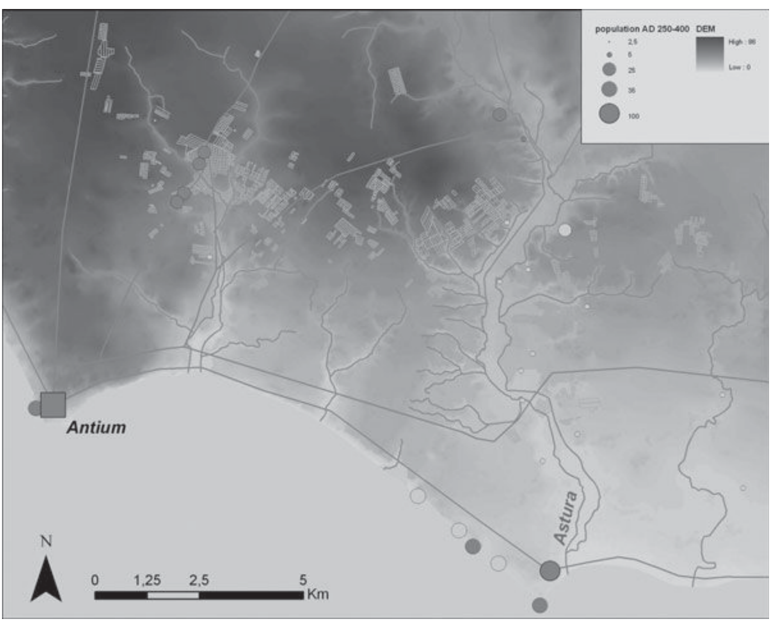


Fig. 5.8. Distribution of rural population over the study area (a) 350–250 BC; (b) 250–100 BC; (c) 100–30 BC; (d) 30 BC–AD 100; (e) AD 100–250; (f) AD 250–400.

Note: Light symbols indicate possibly occupied sites, dark symbols certainly occupied sites.

Source: T. C. A. de Haas, GIA.

4. EXTRAPOLATION OF THE ABSOLUTE RURAL POPULATION SIZE

Based on the site typology and estimated population numbers per site type presented above, we shall now focus on absolute population calculations.[37] As we have seen in Section 1, the use of survey data for demographic reconstructions has become an important issue in recent literature on Roman Italy and the wider Mediterranean.[38] However, methods for doing so are still in development, especially those dealing with biases such as land use and land cover, research intensity, and (their implications for) site recovery.[39]

If we want to extend the estimate of relative changes in rural population size to an estimate of absolute population figures, we need to take a number of circumstances into account, most importantly modern land use and land cover, research intensity, and site recovery rates.[40] Land use and land cover exclude certain parts of the landscape from archaeological survey. The fact that surveys yield only a limited part of rural occupation is widely accepted; both natural (mainly erosion and deposition) and anthropogenic (especially mechanized agriculture) processes have reduced the number of sites on the surface available for mapping.[41] Research intensity subsequently determines the proportion of different site types that is actually mapped: extensive (topographic) surveys retrieve a lower percentage of sites

[37] The calculations assume contemporaneity of sites within a phase and permanent habitation on a site; cf. Price, Chapter 2 in this volume.

[38] Cambi 1999; Perkins 1999; Witcher 2005; Wilson 2008; see also various contributions in De Ligt and Northwood 2008 and Fentress 2009 (and other papers in the first OSRE volume); more generally see Bintliff and Sbonias 1999; Osborne 2004.

[39] See also Witcher, Chapter 3 in this volume.

[40] For a more complete overview of issues, see Sbonias 1999.

[41] That the surveys in the 1970s did not map 'complete distributions' is clear from the fact that our intensive surveys in the areas that were investigated previously by Piccarreta and/or Liboni have yielded many 'new' farms and farm/non-habitation sites (see above). That more recent intensive surveys similarly miss many sites is clear from our attempts to revisit sites mapped in the 1970s by Liboni and Piccarreta: of the 'Piccarreta sites', between 20 and 65 per cent could no longer be found in the field, whereas of the 'Liboni sites', 57 per cent may have disappeared. Most of these sites are farms, but urbanization has also wiped out a number of villas; see also Attema, Derks and Tol 2010.

than intensive surveys.[42] In the following we shall discuss these three issues in more detail.

4.1 Site density and land use/land cover

We shall here examine the relation between site density and present-day land use/land cover in the municipality of Nettuno (Fig. 5.9 and Table 5.3). Within the municipality's territory, land use has had a profound impact on the archaeological record. Over the last forty years, the amount of agricultural land has decreased with a proportional increase

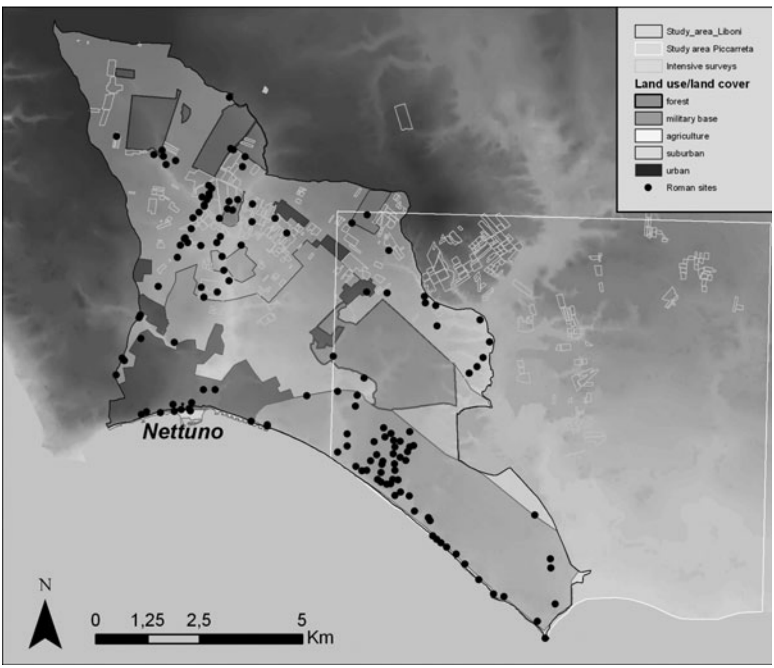


Fig. 5.9. Land use and land cover in the municipality of Nettuno.
Source: T. C. A. de Haas, GIA.

[42] For relations between site density and research intensity see, for example, Sbonias 1999 with references; Wilkinson, Ur, and Casana 2004. It is mainly the smaller sites that are missed in the more extensive surveys.

Table 5.3. Number of sites and site density in the main land-use/land-cover units in the municipality of Nettuno

Land use	Area (km^2)	N sites	N sites/km^2
Urban	6.88	14	2.03
Suburban	12.49	9	0.72
Military base	14.76	59	4.00
Forests	8.66	4	0.46
Agricultural land	28.61	56	1.96
Whole municipality	71.40	142	1.99

in urban and suburban zones.[43] However, the extent of the forests and the military base did not change much in this period.

Site densities are highest in areas we would perhaps not expect: on the military base, an area with dense overgrowth and not available for intensive surveys (Piccarreta had access to this area); and in the urban areas, where most sites have been found during construction works and reported to Liboni. As would be expected, site density is lowest in the suburban zones and in forested areas, whereas site density in agriculturally used areas is around 2 sites/km^2.

Table 5.3 clearly shows the impact of land use/land cover on site retrieval rates, as the variation is in our view too large to be ascribed solely to genuine spatial patterning. Unfortunately, at the moment we do not have at our disposal the land-use and land-cover data for the entire study area, which makes correcting site numbers and population densities difficult. We shall therefore focus on the relation between research intensity and site retrieval rates.

4.2 Site density, survey intensity, and relative retrieval rates

As we have seen in Section 2, the *Carta Archeologica* contains information from various sources, most importantly the Piccarreta survey, the Liboni survey, and our own intensive surveys. This means that not all parts of the area have been studied with the same intensity, if at all (Fig. 5.10). When attempting a demographic reconstruction for the area, we should correct for this.

In Table 5.4 we have quantified the variations in site numbers and site density for the different areas indicated in Fig. 5.10. Although part of the

[43] By suburban we mean areas that are not extremely densely settled, but are characterized by relatively small, fenced-in plots with only few agricultural fields.

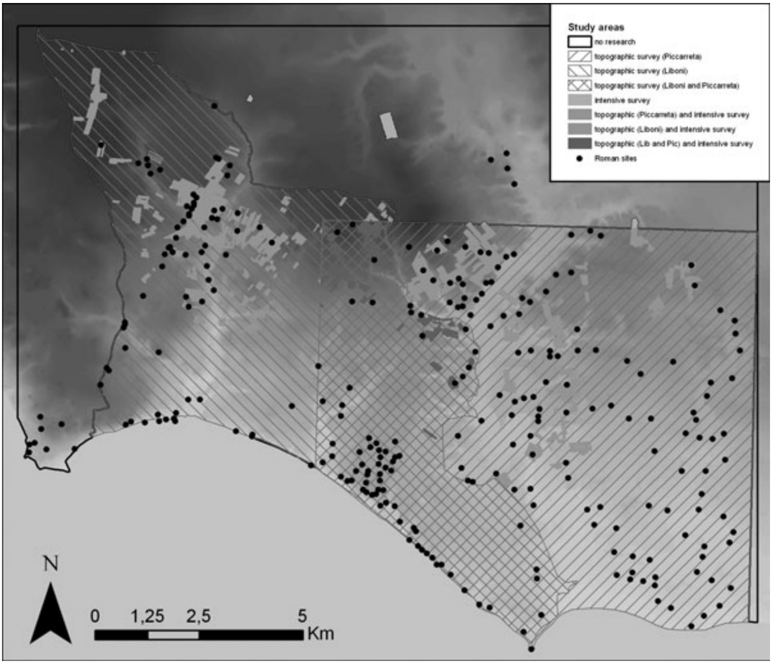


Fig. 5.10. Variations in research intensity in the study area.
Source: T. C. A. de Haas, GIA.

variation may be explained by genuine spatial patterning, the data show that there are indeed strong correlations between survey intensity and site retrieval. The overall site density increases with repeated and more intensive survey. The lowest figure is recorded in areas covered only by the Liboni Survey (*c.* 1.22 sites/km^2) and only by the Piccarreta Survey (*c.* 1.75 sites/km^2). Site density almost doubles in areas explored by both the Liboni Survey and the Piccarreta Survey (2.58 sites/km^2), and is more than twice as high again in areas also covered by our own intensive surveys (over 6 sites/km^2). The areas covered only by intensive survey and by all three researches are very small and contain an insufficient number of sites to be taken into account here.

There are also significant variations in density according to site type; we shall here specifically look at the villas, farms, and farm/non-habitation sites.[44]

[44] The number of villages is too small to be used for an evaluation of recovery rates, whereas the *villae maritimae* are left out of the discussion here because of their by default limited distribution.

Table 5.4. Number of sites and site density in areas studied at different intensities.

Research	Area (km²)	Sites		Site types (excluding non-habitation sites)									
		N	N/ km²	Villages	Villages/ km²	*Villae maritimae*	*Villae maritimae*/ km²	Villas	Villas/ km²	Farms	Farms/ km²	Farm/non-habitation sites	Farm/non-habitation sites/ km²
No surveys	81.6	13	0.16	1	0.012	1	0.012	3	0.037	3	0.037	0	0
Topographic survey (Liboni)	39.2	48	1.22	0	0	3	0.077	5	0.128	8	0.204	12	0.306
Topographic survey (Piccarreta)	60.0	105	1.75	0	0	1	0.017	5	0.083	90	1.5	9	0.15
Topographic survey (Liboni and Piccarreta)	27.5	71	2.58	1	0.036	5	0.182	3	0.109	51	1.855	9	0.327
Intensive survey	0.2	0	0	0	0	0	0	0	0	0	0	0	0
Topographic (Liboni) and intensive survey	3.3	22	6.69	0	0	0	0	5	1.515	14	4.242	0	0
Topographic (Piccarreta) and intensive survey	3.2	20	6.17	0	0	0	0	1	0.313	16	5	3	0.938
Topographic (Liboni and Piccarreta) and intensive survey	1.0	2	1.97	0	0	0	0	0	0	1	1	0	0
Total area	216.0	281	1.30	2	0.009	10	0.046	22	0.101	183	0.847	33	0.152

- There is variation in 'villa densities' for areas with differing research intensity: their density in areas also covered by intensive surveys is significantly higher than in areas surveyed only topographically.[45] However, these variations can be explained largely by genuine spatial patterning rather than differences in survey intensity.[46] This indicates that there are no big differences in villa retrieval rates between our various sources.
- The 'farm density' is conspicuously low in areas covered by the Liboni Survey.[47] Although some of the differences may be due to spatial patterning (see Section 3.2), the difference can mainly be explained by Liboni's personal interest in 'rich' Roman sites, making his farm retrieval rate low.[48] The density of farms in areas covered by the Piccarreta Survey is considerably higher, but still about three times lower than in areas also covered by intensive surveys; this means his dataset should also be corrected for a lower farm retrieval rate.[49]
- The 'farm/non-habitation sites density' also shows differences according to survey intensity, but an explanation for this is difficult to give. As would be expected, their density is highest in areas surveyed topographically and intensively, but surprisingly, in areas covered by the Liboni Survey their density is

[45] For areas covered by the Piccarreta and Liboni surveys, densities range between 0.083 and 0.128 per km^2 for topographic surveys; for areas covered by the Piccarreta Survey and intensive surveys the density is about three times higher; for areas covered by the Liboni Survey and intensive surveys fifteen (!) times higher.

[46] Virtually all villas were already mapped by the Piccarreta and the Liboni surveys; the intensive survey has yielded very few additional villas. This indicates that in the areas covered by both topographic and intensive surveys, villas are indeed more common than in other areas; this would be in line with our discussion of settlement patterns in Section 3.2: many villas are located along the road northeast of Antium, whereas few villas are located in the Astura Valley.

[47] Farm densities are seven times lower in areas covered by the Liboni Survey than in areas covered by the Piccarreta Survey and at least twenty times lower than in areas also covered by intensive survey.

[48] Roman sites are often described by Liboni as pottery scatters, which have here been included as farm/non-habitation sites. This group probably includes a number of farms. However, as intensive surveys in areas also covered by the Liboni Survey do yield farms, Liboni's recovery rate for farms is indeed low.

[49] Intensive surveys have yielded additional farms in areas covered by the Piccarreta Survey. Areas covered by both the Liboni and Piccarreta surveys have a somewhat higher farm density, but still about 2.5 times lower than areas also covered by intensive survey.

higher than in areas covered by the Piccarreta survey.[50] Another complicating factor is degradation of the archaeological remains by agriculture: many farm sites previously mapped by Piccarreta are in recent intensive surveys observed as very thin and poor scatters, which would be classed as farm/non-habitation sites. This means that recent agricultural practices probably led to an increase of this site type at the expense of the number of farms, which makes correction for this settlement type more problematic than for the villas and farms.

The variations in site density and their relation to survey intensity make it clear that we need to correct our dataset by site type.[51] In general, topographic surveys are more focused on larger sites, whereas they have in all probability missed more small sites. In our case we should also differentiate between the topographic datasets, as Piccarreta apparently was much more successful at (or interested in) recording smaller sites than Liboni.

4.3 Extrapolating absolute rural population size

Using the differences in density (see Table 5.4) to correct the dataset is not without difficulty. The discussion above makes clear that a direct use of multiplying factors is dangerous, especially as we may be dealing with genuine spatial patterning as an explanation for variations in density. The *relative* retrieval rates we propose in Table 5.5 are therefore loosely based on the observations made above. We must stress that they are tentative figures that may need refinement.[52]

[50] In areas surveyed by Liboni, their density is about 0.3 sites/km^2, twice as high as in areas surveyed by Piccarreta; in areas covered by the Piccarreta Survey and intensive survey, their density is about three times higher. However, since Liboni did not describe the assemblages very precisely, we assume that at least part of the farm/non-habitation sites in his study area are in fact farms (see also note 48).

[51] Wilson 2008: 244–5. Other factors of course also influence retrieval rates; we have already discussed the influence of land use and land cover, but also the different characteristics of the evidence of different periods may be important.

[52] V, F, and F/n represent the percentage of villas, farms, and farm/non-habitation sites detected in the most intensively investigated areas. Piccarreta's farm density is about three times lower than the figure for topographic and intensive survey, and this to us seems a reasonable correction factor. Liboni's very low (twenty times lower than in areas with topographic and intensive survey) farm density is perhaps exaggerated; we propose correction by a factor of 10. As discussed, the figures for the lowest class

Table 5.5. Proposed relative retrieval rates per site type for various levels of research intensity.

Research intensity	Villas	Farms	Farms/non-habitation
Topographic and intensive	V	F	F/n
Topographic (Liboni)	V	1/10*F	1/6*F/n
Topographic (Piccarreta)	V	1/3*F	1/6*F/n
Topographic (Liboni and Piccarreta)	V	1/2*F	1/6*F/n

We shall use these estimates of relative retrieval rates in order to come to an estimate of the total rural population of the surveyed area. In doing this, the first and most crucial step is to relate the relative retrieval rates presented in Table 5.5 to 'absolute' retrieval rates: in other words, which percentage of each site type do we consider to be found in the most intensively investigated areas? And thus, which percentage of all villas, farms, and farm/non-habitation sites do 'V', 'F', and 'F/n' represent?

We realize that this is a highly problematic issue (involving 'guess-timates'), but necessary if we want to move beyond relative population changes. The aim of similar attempts has been to reconstruct the possible size range of the population rather than come to an absolute figure.[53] In line with this, our aim is not a fixed absolute figure, but rather a minimum estimate.[54]

The recovery rates we propose for the survey area are displayed in Table 5.6. We estimate 80 per cent retrieval for villas, 60 per cent for farms, and 40 per cent for farm/non-habitation sites in our most intensively surveyed areas.[55] These figures are somewhat higher than in other published examples,[56] but applying the correction factors for

are more problematic; we here stick to the figure suggested by the density ratio Piccarreta:Piccarreta and intensive survey (1:6).

[53] For example, Wilson 2008; see also Witcher 2008.

[54] As discussed above, our calculations only use the well-dated sites (140 out of 285).

[55] For the *villae maritimae* and the villages we propose a 90 per cent retrieval rate as we deem the chances of such sites being missed rather low; for villages, this may however be too optimistic; see Pelgrom 2008: 336–7.

[56] For the *ager Cosanus*, Cambi (1999: 117–21) estimates that 20–33 per cent of all republican farms were found by the surveys; in the Cecina Valley Survey, Terrenato and Ammerman (1996: 106) estimate site retrieval at *c.* 50 per cent; cf. Bintliff 1999 for

less intensively investigated areas gives us rather lower values for the smaller sites, in line with the estimates for farms in the *ager Cosanus*.[57]

Establishing period-by-period population figures using these correction factors involves the following steps:

- Overlay our period maps with the survey intensity map to establish how many sites are located in areas with various levels of research intensity.
- Correct the results using the estimated retrieval rates in Table 5.6.
- Recalculate the number of inhabitants per site type and summarize these data to get a total number of inhabitants for the surveyed area.

Table 5.7 and Figs 5.11a and 5.11b show the resulting extrapolated population for the whole surveyed area of 134 km^2.

Applying differential retrieval rates has important consequences for our interpretation of the settlement history of the area.[58] The most conspicuous differences with the uncorrected graphs (Figs 5.7a and 5.7b) concerns the percentage of farm inhabitants in the total population. First, farm inhabitants would outnumber the villa and *villa maritima* inhabitants in almost all periods (except for the periods 100–30 BC and AD 250–400 in the certain sites dataset). A second difference would be the less marked population growth (possible and certain sites, Fig. 5.11b) in the course of the republican period.

If we look at the estimate based on the certain sites only, the area would have had a population density of 3.4 persons/km^2 between 350 and 250 BC, rising slowly in the course of the republican period with a substantial increase in the early imperial period to more than 13 persons/km^2. Hereafter, density would drop again to 3.3 persons/km^2 between AD 250 and 400. The extrapolations based on the certain and possible sites suggest a larger population, especially for the

a similar estimate for Boeotia; for the Biferno Valley Wilson estimates a recovery rate between 10 and 25 per cent (2008: 252).

57 See Pelgrom 2008 for a critique of Cambi's estimates for the *ager Cosanus*: for the third century BC, Pelgrom estimates the recovery rate at only 3.4–6.4 per cent (Pelgrom 2008: 332, n. 46). We have here not differentiated recovery rates by period, but we acknowledge that archaeological visibility of sites may differ between periods as well.

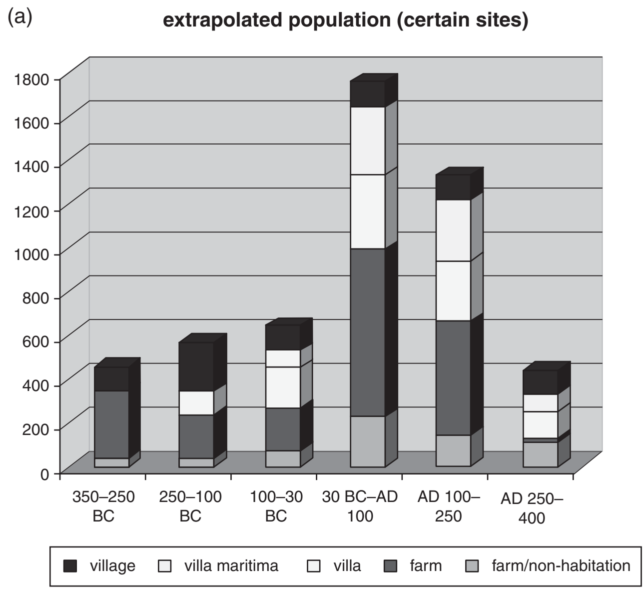
58 It may also be possible to apply the varying retrieval rates to our site distribution maps, but this would go beyond the aim of this chapter. We believe the interpretations we have proposed for the uncorrected distribution maps in Section 2 are still valid.

Table 5.6. Proposed absolute retrieval rates per site type for various levels of research intensity.

Research intensity	Villages	*Villae maritimae*	Villas	Farms	Farm/non-habitation sites
Topographic and intensive	90%	90%	(V=) 80%	(F=) 60%	(F/n=) 40%
Topographic (Liboni)	90%	90%	80%	(1/10*60%) 6%	(1/6*40%) 6.7%
Topographic (Piccarreta)	90%	90%	80%	(1/3*60%) 20%	(1/6*40%) 6.7%
Topographic (Liboni and Piccarreta)	90%	90%	80%	(1/2*60%) 30%	(1/6*40%) 6.7%

Table 5.7. Extrapolated absolute rural population figures for all surveyed areas (134.4 km^2) (C: certain sites; C+P: certain and possible sites).

Period	Population on farm/ non-habitation sites		Population on farms		Population in villas		Population in *villae maritimae*		Population in villages		Total rural population		Rural population/ km^2	
	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P	C	C+P
350–250 BC	37	317	308	1317	–	–	–	–	110	110	455	1744	3.4	13.0
250–100 BC	37	355	200	1163	109	234	–	–	220	220	566	1972	4.2	14.7
100–30 BC	75	355	192	1142	188	375	78	233	110	220	643	2325	4.8	17.3
30 BC–AD 100	230	392	758	1175	344	344	311	350	110	110	1753	2371	13.1	17.7
AD 100–250	149	348	517	867	281	313	272	311	110	110	1329	1949	9.9	14.5
AD 250–400	112	236	17	300	125	156	78	194	110	110	442	996	3.3	7.4



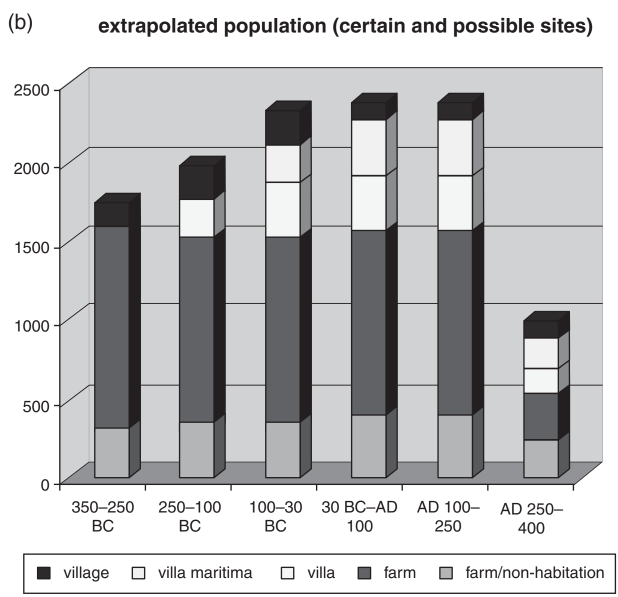


Fig. 5.11. Extrapolated absolute rural population figures for each period (a: certain sites; b: certain and possible sites).

Source: T. C. A. de Haas, GIA.

republican period (*c.* 13 persons/km^2 between 350 and 250 BC) with a higher peak of around 17.5 persons/km^2 in the late republican and early imperial period. Again, we should stress that this estimate is an absolute minimum, and (considering that all generic Roman sites are still excluded) that a higher estimate is probably more realistic.

4.4 Urban versus rural population: Antium and its hinterland

How should we view the proposed rural population figures in the light of the urban population of Antium? For the maritime colony founded in 338 BC, a number of 300 colonists is generally accepted, which would indicate, including their families, some 1,000 people involved in the foundation. However, not all colonists may have lived in the colony itself,[59] and there must have been a considerable (Volscian and Latin) population living in the area as well, some of whom may also have lived in the city. Thus it remains hard to estimate the size of the urban population; still, 1,000 urban residents may be in the right order of magnitude.

For other periods, there are no historical data on the population size, and estimates of urban populations based on city size are problematic.[60] Moreover, while for the pre-Roman phase the extent of the town is known from its defences, for Roman Antium it is not so well defined.[61] However, at its peak in the early imperial period, the city could well have housed some 10,000 people.[62]

If we want to look at the relations between urban and rural population and the overall population density, we have to estimate the total size of the hinterland for different periods. Defining the city's *ager* is rather

[59] Salmon 1969: 71–2, 75–6.

[60] For a discussion, see De Ligt 2008; see also the contributions by Wilson and Price, Chapters 7 and 2 in this volume.

[61] We know the location of several *necropoleis* that may indicate the extent of the town. However, whether the Vignacce hill, which was part of pre-Roman Antium, was included in the city or should rather be seen as suburban, is unclear; a large republican villa and a private theatre are located here as well as at least two votive deposits (for the archaeology and topography of Antium, see most importantly Lugli 1940; Brandizzi Vittucci 2000). The size of Antium would range somewhere between 70 and 120 ha.

[62] At 100 people per hectare (cf. Fentress 2009), the city may have housed a population of up to 12,000; however, this may well be a conservative estimate as densities in late republican/early imperial towns may have been higher. See also Wilson (Chapter 7, this volume) for discussion of this issue. For estimates of the (free) population of Roman towns, see Lo Cascio 1999: 164–6.

problematic, but in Fig. 5.12 we propose two hypothetical territories: one consists of all land within a 7.5 km radius from Antium; the other is based on Thiessen polygons that divide the whole Pontine Region among the main Roman towns.[63] The former area is rather small (58 km^2), whereas the second (236 km^2) is comparable to the study area, in both size and location (see Table 5.8).[64]

For the early colonial phase (after 338 BC), we propose a limited hinterland (the 7.5 km radius area), whereas for the flourishing early imperial city, a more extensive *ager* may be postulated (the Thiessen polygon area).[65] Interestingly, in both phases the urban population would outnumber the rural population (1,000 urban versus 197 to 754 rural for the period 350–250 BC; 10,000 urban versus 3,092 to 4,177 rural between 30 BC and AD 100). This would imply a rather large urban population (57–83.5 per cent of the entire population in the early colonization phase;[66] 70–76 per cent in the early imperial period). We should, however, be cautious here, as our rural population estimates are probably minimum estimates, and perhaps these urbanization rates should be considered as maximum values.[67]

A second interesting observation concerns the overall population density. For the early city and hinterland, our extrapolations would indicate an overall population of 1,197 to 1,754 people at 20.3 to 29.7

[63] Of course this is a simplification of reality: there were probably a number of secondary centres (for example the road stations along the *Via Appia*) with their own territories. Satricum is not included as a centre since no substantial remains have been excavated here (see note 17). The situation is further complicated by the fact that parts of the Pontine plain were viritane distributions and may have been administered directly from Rome. We also note that the colony of Norba disappeared in the first century BC. However, we believe the polygons do give a reasonable estimate for the possible size of each town's *ager* (for a more elaborate approach, see Keay and Earl, Chapter 10, this volume).

[64] From all areas 1 km^2 has been subtracted as the urban extent of Antium itself.

[65] With good connections along its coast into the Astura valley and along the major roads running inland, it seems probable that (at least) the whole study area was dependent on Antium. With its harbour, Antium may also have had strong external ties to Rome; see below.

[66] If we use the Thiessen polygon territory for the early phase, the urbanization rate would drop to 24.6–55.5 per cent.

[67] The direct surroundings of the colony probably had a considerably higher population density than the average figure we use here, but as this area is taken up by the modern towns of Anzio and Nettuno, we have no way of verifying this. This would decrease the urbanization rate, but perhaps not too much.

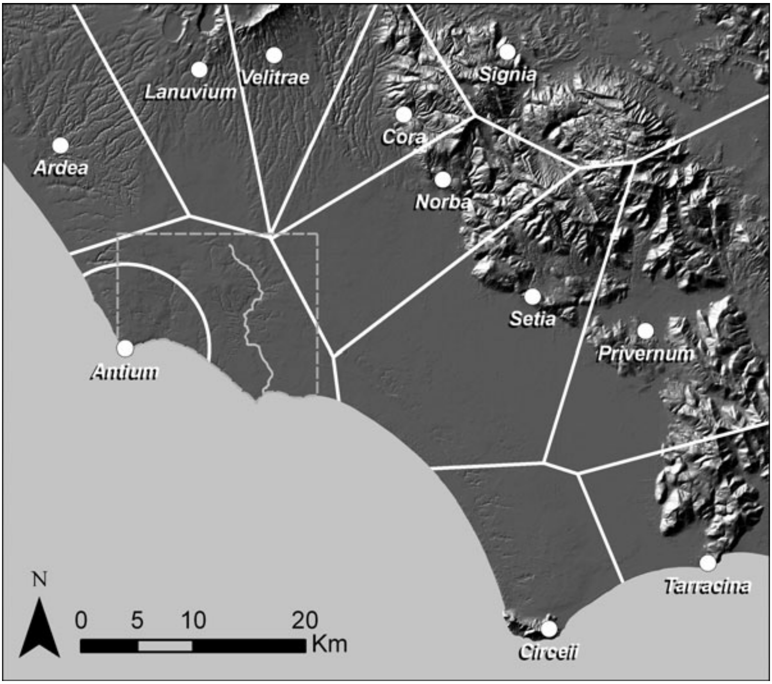


Fig. 5.12. Hypothetical territory of Antium defined by a 7.5-km radius and Thiessen polygons. Dashed line indicates the study area.

Table 5.8. Extrapolated rural population in a hypothetical territory around Antium based on Thiessen polygons and in the study area.

Period	Rural population/ km^2		Rural population within 7.5 km of Antium (58 km^2)		Rural population in the Thiessen polygon area (236 km^2)		Rural population in the study area (215 km^2)	
	C	C+P	C	C+P	C	C+P	C	C+P
350–250 BC	3.4	13.0	197	754	802	3068	731	2795
250–100 BC	4.2	14.7	244	853	991	3469	903	3161
100–30 BC	4.8	17.3	278	1003	1133	4083	1032	3720
30 BC–AD 100	13.1	17.7	760	1027	3092	4177	2817	3806
AD 100–250	9.9	14.5	574	841	2336	3422	2129	3118
AD 250–400	3.3	7.4	191	429	779	1746	710	1591

persons/km^2.[68] These figures would rise to 13,092 to 14,177 with a population density of 55.2 to 59.8 persons/km^2 in the early imperial period. It thus seems that the population in the area increased considerably during the republican period. Rural population probably contributed modestly to this growth, and mainly through an increase in villas and *villae maritimae*. The larger part of the growth can be assumed to have taken place at Antium; however, whether its population grew gradually or rather more abruptly from the late republican period onwards remains unclear.

5. DISCUSSION

In this chapter we have investigated the potential of one of the datasets of the PRP for a demographic study of rural population in the *ager* of Antium. Using data assembled for the *Carta Archeologica* of Nettuno, we described trends in rural site density in a part of the *ager* and studied the spatial patterning of sites over the study area. In doing so, we discerned various rural site types and mapped these for various phases of the Roman period. We then calculated relative and absolute population figures for each phase. This entailed various steps meant to correct for differential site retrieval rates in the datasets that were used. The result of these calculations was an estimate of the (minimum) total rural population in the study area, distributed over various site types; farm, villa, *villa maritima*, and village. The outcome of these calculations was subsequently extrapolated to the whole of the *ager* of Antium. For the early colonial phase we assumed a limited *ager*, whereas for the early imperial period we proposed a much larger area. Finally, we added an estimate of the number of inhabitants at Antium itself and examined overall population densities and rates of urbanization.

Although the methodology itself can still be improved,[69] it has some important implications for the use of survey data in

[68] Taking the larger area (Thiessen polygon), the total population would in this phase consist of 1,802 to 4,068, with a considerably lower overall population density of 7.6–17.2 persons/km^2.

[69] For example, by incorporating corrections for variations in land use/land cover, adjustment of population figures per site type, and the application of set periods of 100 years instead of phases of unequal length.

demographic calculations. It shows that the survey data underlying such calculations should be reviewed carefully, and more refined correction procedures should be applied. Once this has been achieved, such calculations may give important results for historical interpretations of settlement patterns. To conclude this chapter, we thus turn to two of the four demographic issues we would like to confront in the PRP, as outlined in Section 1 (pages 100–1).

One of these issues concerns the demographic relationship between Roman colonies and their rural territories from a medium-term perspective; in Section 1, we asked how population numbers and social stratification developed in town and country. In the case of Antium, two outcomes catch the eye. From the calculations it appears that the presence of villas and *villae maritimae* had a strong impact on population numbers in its *ager*, provided, of course, that our estimation of an average of 25 for a *villa* and 35 inhabitants for a *villa maritima* is accepted as realistic. A second outcome is that the urban population would have been considerable, maybe even outnumbering the rural population (accepting the proposed extents of the *ager* in the early colonial and imperial period). Perhaps this is a situation typical for coastal colonies, and it will thus be interesting to compare the case of Antium with other coastal colonies in the region (Circeii and Terracina) and with the colonies Cora, Norba, and Setia in the Lepine foothills. In addition, we feel that demographic calculations are necessary also for areas outside the urban sphere, such as the Pontine plain and the coastal areas further south of Antium, for which we also have suitable datasets. Ideally, this will result in a demographic reconstruction on a regional scale.

Another issue we brought up in Section 1 concerns the relation between the Pontine Region, other parts of Rome's *suburbium*, and Rome itself in terms of demography. We referred to Witcher's geographical model of the *suburbium* as the area within a radius of 50 (with Antium on its border) up to 100 km (which would include all of the Pontine Region) around Rome. Remarkably, our estimate of urban and rural population density in the *ager* of Antium of 55.2 to 59.8 persons per km^2 for the early imperial period matches Witcher's 'informed estimate' of 60 persons/km^2, rather than his estimate for the additional area between 50 and 100 km, for which the figure drops to 42 km^2.[70] The reasons for this high population density may be sought in the

[70] In both cases, this is a higher figure than Blanton's for south Etruria; he arrived at an urban and rural population density of 31 persons per km^2 (Blanton 2004: 226). We note that our rural population density is close to that reconstructed for the *ager Cosanus* by Fentress (2009).

successful economic and social integration of Antium into Rome's suburban territory. Essential for its economic integration were the construction of the harbour and good roads opening up the countryside. Antium's harbour facilitated an easy trading and travelling connection with Rome via Ostia, while paved roads connected Antium directly with Rome and with the *Via Appia*, and thus with the *municipia* in the Alban Hills and the colonies in the Monti Lepini. The social basis for demographic increase was doubtless the interest the Roman imperial and senatorial elite showed for Antium and its coasts.[71] The calculations in this chapter indicate that the significant demographic increase in the rural population in the *ager* during the late republican and imperial period was mainly due to the presence of villas and *villae maritimae*. However, a crude estimate of the population at Antium itself in the late republican and early imperial period suggests that urban population growth outpaced rural population growth, the particulars of which, however, merit much further research.

For now, we conclude that the successful economic and social integration of Antium and its *ager* into the extending *suburbium* of Rome well accounts for the demographic increase put forward in our calculations and maps, as such supporting Witcher's *suburbium* model.

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[71] De Haas, Tol, and Attema 2011.

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Part II

Urbanization

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6

Cities and Economic Development in the Roman Empire

Neville Morley

1. URBANIZATION IN ROMAN ITALY

It is a common assumption that the Roman empire was a 'world of cities'; as Ward-Perkins put it, 'the history of the classical town is in a very real sense the history of classical civilization itself'.[1] This observation is frequently taken as a straightforward indication of the empire's level of development, not only in social and cultural terms, with the emergence of what might be considered an 'urban mentality', or in terms of the sophistication of Roman architecture and building techniques, but specifically its economic development. It is generally assumed that a high level of urbanization is a trait of modernity or proto-modernity, in contrast to the predominantly rural orientation found in most pre-industrial contexts.[2] Interestingly, those historians who take a more pessimistic view of Rome's level of development in comparison with later periods also focus on the role of the city, arguing not just that the Roman city lacked the special qualities possessed by the late medieval and early modern city that made the latter into the crucible of capitalism and modernity, but that the particular nature of the Roman city was precisely the reason why the ancient world did not provide a hospitable environment for

[1] Ward-Perkins 1974: 8.
[2] Most obviously Rostovtzeff 1957, but see also many of the papers in Parkins and Smith 1998 and Lo Cascio 2009.

economic 'take-off'.[3] That is to say, it is taken for granted by both sides in the long-running primitivist–modernist dispute that the ancient city is one of the aspects of ancient society in which the degree of modernity of the ancient economy can be most clearly discerned and evaluated.

It is surprising therefore how poor the evidence base is on which such arguments depend. Older accounts rely almost entirely on the general impression of Roman society drawn from literary sources and on the archaeological remains from a few sites such as Pompeii to support their view of a thriving urban culture and economy.[4] More recent discussions offer the appearance of a broader and more reliable knowledge base citing in particular an estimate of the urban population of Roman Italy derived from a reconstruction of its urban system or hierarchy (Table 6.1).[5] This estimate is invoked by both sides in the debate between the 'high' and 'low' counts for the population of Roman Italy, with arguments about whether the rate of urbanization implied by the low count is implausible in comparison with other pre-industrial societies. More recently, the size of the Italian urban population has been offered as a direct indicator of the level of economic development in the peninsula, again in comparison to early modern European societies.[6] The lack of scrutiny of these figures in the decade since they were first proposed suggests that they are, if nothing else, convenient. They provide the right sort of answer consonant with our

Table 6.1. Urbanization in Roman Italy.

The city of Rome	1,000,000
Major ports: Ostia, Puteoli; 30,000 each	60,000
Regional centres: Mediolanum, Patavium, Capua 25,000–40,000 each; average 30,000	90,000
About 25 major cities: 5,000–25,000 each, average 15,000	375,000
400 minor cities: 1,000–5,000 each, average 2,000	800,000
Urbanization rate 39%; 26% excluding Rome	2,325,000

Source: Morley 1996: 182.

[3] Weber 1958; Finley 1981; discussed by Nippel 1987–9 and 1991; Bruhns 1985 and 1987–9; Capogrossi Colognesi 1995; and various papers in Parkins 1997.

[4] See for example Moeller 1976, critiqued by Jongman 1988: 166–86.

[5] Morley 1996, cited by, e.g. Lo Cascio 2009, Scheidel 2008.

[6] Lo Cascio 2009.

general impression of the ancient world and compatible with a wide range of more detailed historical scenarios. It seems worth emphasizing quite how speculative and problematic this or any other reconstruction of urbanization is.

The most obvious difficulty is of course the limited and problematic evidence for the sizes of urban populations, whether these are calculated on the basis of inscriptions recording civic benefactions, the length of the city walls, or the size of the built-up area.[7] It is certainly possible that more detailed archaeological studies, based on sampling the number and nature of residences within a specified area, will produce a more secure estimate for average population density and hence for the number of inhabitants in a centre at a particular point in time, although, as Fentress has noted, there remains a tendency to accept figures as reasonable because they accord with what we expect them to be.[8] Even if this work is successful, there will remain difficulties in establishing the 'typicality' of the site being studied and hence in extrapolating the results to cover Italy as a whole, let alone the rest of the empire. If more detailed knowledge of, for example, Placentia indicates its population was at least 25,000, should this be taken as grounds for promoting it to the rank of a 'regional centre', or for modifying the suggested range and average population for 'major cities', or should it be accepted as being almost within the range suggested in the model for a 'major city'? Should this information be employed to support the development of a more elaborate urban hierarchy than the crude division of major, minor, and regional centres? The overrarching model is impossible to verify without detailed knowledge of the populations of large numbers of urban centres; an individual case that does not quite fit the proposed pattern can easily be accommodated without greatly affecting the overall picture. This is a problem with the model rather than a strength.

A second problem, common both to the overrarching model and to most estimates of the populations of individual cities, is chronological vagueness. In many cases estimates of urban population relate to the period of the site's greatest extent, since they are based on the size of the built-up area; that may be identified readily enough, but it does not necessarily coincide with the peaks of expansion at other sites that

[7] Duncan-Jones 1982: 259–77. [8] Fentress 2009.

are nevertheless then incorporated into the same model. The hypothetical Italian urban system relies on descriptions of Italy offered by Strabo and Pliny in different centuries and on a miscellany of epigraphic and archaeological evidence from four centuries' worth of development. It perhaps most closely relates to the first century AD, when the system had allegedly reached 'maturity', but it entirely fails to convey any sense of change or development, and is thus almost impossible to relate to other changes within the peninsula in the late Republic or early Principate. There is no reason to suppose (and plenty of anecdotal evidence to contradict the idea) that all cities in Italy developed, matured, and declined within the same or even a similar timeframe.[9] Since we are never going to have the sort of detailed information about changes in the urban population over time that we really need, we can proceed only on the basis of extreme caution and scepticism about the basis for the estimates and what the implied level of urbanization might represent.

That last point might seem to represent a way forward; the history of individual towns is after all a 'cul-de-sac', whereas we are interested in the overall picture, the proportion of Italians living in towns, in which case adjustments to our estimates of the population of individual sites might make relatively little difference to the wider scheme. However, there remain two significant questions about what figures should be included in this calculation. The aim of establishing the level of urbanization in Italy is primarily to determine what sorts of size of urban population Italy could support in comparison with later European societies. However, Italy was not a bounded region; Rome's expansion was not supported solely by Italian production but can only be understood within a Mediterranean-wide context. It is tempting, then, to exclude the population of the capital from the total for Italian urban population, since Rome's growth was inconceivable without imports from provinces like Sicily, North Africa, and Egypt. Indeed, a case could be made for excluding ports like Ostia and Puteoli as well, since their development was directly dependent on their place within the capital's supply system. On the other hand, the fact that much of Italy was orientated towards the demands of the capital, both for migrants and for agricultural products, makes it faintly absurd that Rome should be excluded. One response is to

[9] See Lomas 2004: 207–13 and Patterson 2006 for discussion of the changing patterns of urban foundations, crises, and destruction.

conclude that trying to discuss 'Italian urbanization' makes little sense within an inter-regional system that was, to some extent at least, integrated and interdependent. It seems highly likely that the level of urbanization in Italy was much higher than in other parts of the empire, especially compared with the western provinces, but that is something that needs to be understood in an empire-wide context rather than treated in isolation. Pragmatically, however, even our profoundly imperfect knowledge of Italian urban population is superior to our knowledge of urbanization elsewhere in the empire; for the sake of establishing a hypothetical order of magnitude, we might omit the city of Rome from the calculation but include the two ports as a means of avoiding the need to guess what proportion of the capital's population ought to be 'credited' to the Italian urban system.

The second major question is that of the threshold for inclusion in the model. As far as Greek and Roman commentators were concerned, the 400-odd small centres identified in Roman Italy by Strabo and Pliny were cities; their definition was essentially political and juridical, supported by the presence of the sorts of social and cultural attributes that were expected of a 'proper' city.[10] However, the main purpose of this exercise is to enable comparison with other periods and contexts, and it is striking that models of later European urbanization focus on centres of 5,000 or even 10,000. This means that most cities in Roman Italy, on the basis of the estimate for their populations of just a few thousand, would not be counted as 'urban'.[11] Unless it is argued that significant numbers of the 'small cities' had populations of more than 5,000, the attribution to Roman Italy of levels of urbanization of 25 per cent or more, vastly superior to any part of early modern Europe besides exceptional regions like the Netherlands, seems absurd. At the very least the model needs to be modified to take this into account (Table 6.2).

Given the uncertainties about any of the data discussed above, it makes sense to consider models of high and low estimates rather than relying on a single middle-of-the-road reconstruction to explore some of the implications of raising or lowering the figures. The first high estimate assumes that the populations of the larger sites were higher and that a number of the minor cities crossed the 5,000 threshold to be

[10] The question of definition is discussed at length by Finley 1981.
[11] E.g. De Vries 1984: 21–2.

counted as urban; this increases the number of major cities while keeping the average size at the same level (Table 6.3).

The second high estimate restores the category of 'minor cities' on the assumption that there were significant numbers with populations in the range of 5,000–10,000 (Table 6.4).

The low estimate assigns more pessimistic figures for all sites, including the assumption that some of the 'major cities' would have fallen below the 5,000 threshold (Table 6.5).

Finally it should be noted that all the urbanization rates quoted so far are based on the low population count for Roman Italy of roughly 6 million inhabitants. We can get a full sense of the possible range of estimates for Italian urbanization only by relating the different

Table 6.2. Urbanization in Roman Italy (threshold for inclusion 5,000).

The city of Rome	1,000,000
Major ports: Ostia, Puteoli; 30,000 each	60,000
Regional centres: Mediolanum, Patavium, Capua 25,000–40,000 each; average 30,000	90,000
About 25 major cities: 5,000–25,000 each, average 15,000	375,000
Urbanization rate 25%; 11% excluding Rome	1,525,000

Table 6.3. Urbanization in Roman Italy: high count 1.

The city of Rome	1,000,000
2 major ports: average 40,000 each	80,000
3 regional centres: average 40,000 each	120,000
40 major cities: average 15,000 each	600,000
Urbanization rate 30%; 16% excluding Rome	1,800,000

Table 6.4. Urbanization in Roman Italy: high count 2.

The city of Rome	1,000,000
2 major ports: average 30,000 each	60,000
3 regional centres: average 30,000 each	90,000
25 major cities: average 15,000 each	375,000
50 minor cities: average 7,500 each	375,000
Urbanization rate 32%; 18% excluding Rome	1,900,000

Table 6.5. Urbanization in Roman Italy: low count.

The city of Rome	800,000
2 major ports: 20,000 each	40,000
3 regional centres: 20,000 each	60,000
20 major cities: 10,000 each	250,000
Urbanization rate 19%; 7% excluding Rome	1,150,000

Table 6.6. Comparison of methods.

Urban population ▶ Total population ▼	High 1 (1.8 million)	High 2 (1.9 million)	Medium (1.525 million)	Low (1.15 million)
High	15%	16%	13%	10%
(12 million)	(7%)	(8%)	(5%)	(3%)
Medium	20%	21%	17%	13%
(9 million)	(10%)	(11%)	(7%)	(4%)
Low	30%	32%	25%	19%
(6 million)	(16%)	(18%)	(11%)	(7%)

estimates for urban population to the different reconstructions of the population as a whole (Table 6.6).

It can be noted that the high count for overall population makes all the urbanization figures look distinctly average by early modern standards unless the city of Rome is included. Conversely, the low estimate for urban population looks respectable only in the context of the low count for overall population. Obviously in neither case does this represent an argument for excluding those estimates from consideration; once again we are faced with the risk noted by Fentress that certain figures look reasonable because they accord with our expectations and our prejudices, including a tendency to increase the importance of classical antiquity in comparison with later periods. Overall, we can note that it is the calculations excluding the *c.* 400 small centres that yield estimates for the level of urbanization that are not so drastically out of step with expectations but that nevertheless in most scenarios compare favourably with many areas of early modern Europe.

2. COUNTING CITIES

This might appear, after all the games with figures, to validate the basic point that historians have been assuming hitherto: the level of urbanization in Roman Italy, and perhaps by extension across the empire, is an indication of the overall level of economic development. This, however, is the fundamental problem with the entire exercise: it assumes a direct connection between urbanization and economic development, with little or no discussion as to why this should be the case. There is, admittedly, a long-standing tradition of associating cities with modernity and vice versa, not least because of the apparently close association between urbanization and the development of the economy in early modern Europe.[12] This can take the form of assuming that all urbanism is a symptom of, if not a catalyst for, economic development, following Fernand Braudel in seeing towns as 'electric transformers' and 'accelerators of all historical time'.[13] Alternatively, in the face of evidence that not all urban centres (even within early modern Europe, let alone in other historical contexts) were associated with the dynamic expansion of trade and industry, it may lead to the elaboration of urban typologies, distinguishing between cities that are generative and parasitic, occidental and oriental, producer and consumer.[14] This final contrast is all too familiar to ancient historians, as the basis of the Weber–Finley argument that the high level of ancient urbanization was not after all an indication of a high level of economic development. Indeed, as Weber at least believed, the particular structure of the ancient 'consumer' city may have been precisely the factor that impeded the modernization of the ancient economy.[15]

What all these approaches, even the primitivist argument, have in common is a tendency to reify the 'city' and to treat it as an independent social object with a cross-cultural significance, which has at least the potential to have a transformative effect on its surroundings. This is, as Philip Abrams argued thirty years ago, an example of the fallacy of misplaced concreteness, mistaking a space or site of social interaction for a social agent: 'the town as a physical object is turned

[12] Williams 1973; Holton 1986. [13] Braudel 1973: 373.
[14] E.g. Hoselitz 1954–5; Weber 1958; Sjoberg 1960.
[15] Discussed in Parkins 1997.

into a taken-for-granted social object and a captivating focus of analysis in its own right'.[16] This habit might be explained innocently, as a consequence of deeply embedded attitudes in western culture that associate the countryside with conservatism and the urban centres with dynamism, or it may be interpreted, following Manuel Castells, as an essentially ideological theory, a myth, establishing the peculiar nature of modern western development as a universal law of history.[17] In either case, merely identifying the presence of a relatively large number of 'cities' in a given society in itself tells us nothing about the level or trajectory of economic development. The city is the product of processes and tendencies within society as a whole, not their point of origin.

At best, the emergence or growth of cities might be considered to offer a proxy for the sorts of processes that are associated with 'economic development' along the lines identified in early modern Europe. The traditional account of this development emphasizes craft production and trade; the city is thus interpreted as a proxy for the progressive division of labour within society and consequently the elaboration of systems of production and exchange.[18] This is tempting but highly arguable, not least since it rests on an old-fashioned and now largely outmoded narrative of the course of the Industrial Revolution. It is now generally accepted that much industrial activity took place in the countryside in the early stages of the 'take-off' of the European economy; the popular image of the industrial city is for the most part a nineteenth-century development. It is arguable how far the simplistic notion of 'division of labour' as the shifting boundary between agricultural and non-agricultural production is especially useful. Certainly Adam Smith's account of the division of labour as the driver of economic progress relates to specialization *within* different processes of production, not merely the growth of the non-agrarian sector. It is clear that until industrialization has become fully established, the same individuals may be involved, either simultaneously or in succession (e.g. seasonally), in both agricultural and non-agricultural activities. A crude measure of the proportion of the population involved in non-agricultural production in the Roman empire would conceal at least as much as it reveals. The idea then that the level of urbanization can be taken as a proxy for this figure, as if

[16] Abrams 1978: 9. [17] Castells 1976: 70; Holton 1986: 9.
[18] See general discussion in Holton 1986.

everyone in the city and no one in the countryside were involved in non-agricultural production, is clearly even more problematic.[19]

A pragmatic case might be made that an inadequate proxy is better than none; in other words, taking the rate of urbanization as a proxy for the division of labour between agricultural and non-agricultural production is acceptable on the assumption that the failure to count rural-based craftsmen is compensated for by counting town-based farmers. Apart from the fact that this is impossible to prove, it is arguable whether it progresses the argument about economic development. Considered at a regional rather than a local level, it may seem entirely obvious that an increase in the proportion of the population whose income is derived entirely from non-agricultural production implies an increase in the volume of exchange and in the productivity of agriculture, since a smaller number of farmers is producing a larger surplus than before. However, the increase is marginal; for example, a doubling of the rate of urbanization from 5 per cent to 10 per cent implies a productivity gain of only just over 5 per cent. More significantly, it cannot be automatically assumed that such a rise in the urban population was supported by increased productivity rather than, say, redistribution of the existing surplus production. This is one of the crucial points of the 'consumer city' model; not that all the inhabitants of such a city are unproductive consumers. The city's existence depends primarily on the decision of those who control the bulk of the social surplus to invest this in the built environment and other associated activities rather than spending it in some other way.

It is clear from any comparative study of urbanization that entirely different processes within different societies can yield the same basic result, namely, the emergence of 'the city' in the sense of a built-up environment with a certain level of population living within a limited area. The 'city' is important not in its own right but for what it might tell us about the processes that promoted its development; simply noting the presence of such 'cities' in a society tells us nothing about the presence or absence of the sorts of processes associated with 'economic development' along the lines of early modern Europe. There is little point, therefore, in counting cities or estimating the size of their populations without a clear idea of what exactly is being

[19] Cf. Whittaker 1990.

counted and why it is held to be significant. Are we indeed quantifying, however imperfectly, the volume of non-agricultural production or the proportion of non-agricultural producers within society? Are we instead seeking to quantify the distribution of the social surplus between different sectors of society or to estimate the volume of elite investment in the urban environment? Can we take the city as a proxy for economic development, however defined, or is it primarily a proxy for the extension of the power of the political elite? In other words, we need a theory of (ancient) urbanization and of the nature of the processes that supported the development of urban centres before we can attempt to delineate and quantify the parameters of this development, let alone begin to discuss the implications of this for the economy.

3. URBANIZATION AND DEVELOPMENT

The call from sociologists like Abrams for historians to abandon 'the city' as a concept is not intended to suggest that real towns and cities should henceforth be ignored altogether. Rather, historians' tendency to take cities for granted as real and important social objects acting on their surroundings should be 'replaced by a concern to understand towns as sites in which the history of larger systems—states, societies, modes of production, world economies—is partially, but crucially, worked out'.[20] The city is not the only manifestation of and location for the wider processes of change, but it may be a crucial location. Urban development may be one of the more visible products of change and hence a useful barometer or proxy, but the urban centre may take on a still greater significance as the space where different processes come together and interact, whether to reinforce or oppose one another. Further, we need to consider how far the particular nature of urban space may in turn have influenced the trajectory of those processes and the ways in which different social groups might seek to manipulate or control that space as a means of accumulating social power.[21]

Urbanization can be understood as one of the products of the confluence of four different processes of social, economic, and

[20] Abrams 1978: 10.

[21] These ideas are heavily influenced by the sociology of Mann 1986 and Harvey (e.g. 1985, 2001).

cultural change: concentration, crystallization, integration, and differentiation.[22] These processes do not always operate at the same pace: at times they reinforce one another; at other times they may be in conflict. Most importantly, urbanization in these terms is always ongoing, something that has to be considered in its specific historical context. There is no universally valid threshold of urban status; rather, within a given society at a given point in time we need to evaluate the relative progress of, say, crystallization in order to judge how far urbanization has developed and what might be the consequences. This is primarily a qualitative rather than a simply quantitative judgement. The same four processes are visible in the development of nucleated settlements in the eighth century BC as in the urbanization of the second or first centuries AD, simply at different scales and orders of magnitude.[23] The fact that we can identify, in any given context, sites that can appropriately be labelled 'urban' is not simply a function of our modern prejudices but a reflection of the fact that the same processes are producing similar effects. However, to avoid any suspicion that what is being proposed here is another universalizing theory, it should be stressed that the motive forces behind concentration, crystallization, integration, and differentiation may be entirely different in different contexts. This is an attempt at describing the processes of social change more precisely that does not attempt the further task of explaining its underlying causes.

Concentration

This involves the concentration of people and of resources at a specific location. Concentration is of course always relative to its context; rather than focusing solely on a magic threshold of populations of 5,000 or 10,000, any shift in the physical distribution of population and resources is of interest. Within Roman Italy, for example, we would be equally interested in the establishment of new centres, the growth or decline of established centres, and the balance between the primate capital and the rest of the urban system.

[22] This approach is developed in more detail for the specific case of republican Italy in Morley 2008.
[23] E.g. Osborne and Cunliffe 2005.

Crystallization

This is a better term than 'centralization', emphasizing that it is not necessarily a deliberate process.[24] Different forms of power, political, social, religious, cultural, and economic, come to be co-located and increasingly this takes place within the space of the urban centre. This explains why the dominant social elite invests so heavily in such centres. The urban centre mediates power at different levels, serving as a means for the local elite to exert control over the locality but also for higher classes to control larger regions.

Integration

This is closely related to the ways that the elite consolidate their control over the city's hinterland but it is a separate process. Integration can take a range of forms, many of which are mutually reinforcing: political integration, drawing ever larger numbers of people into the same or similar political institutions and subjecting them to the same coercive forces; social and cultural integration, eroding differences of language, customs, and material culture, establishing similar habits of eating, dress, and behaviour, and fostering the gradual development of a social identity beyond that of kinship; economic integration, with the establishment of common means of exchange and legal frameworks, and increased traffic between individuals and regions. The urban centre plays a key role in all of these developments, as the location of the main political, cultural, and economic institutions and the place where individuals (visitors as well as permanent residents) were most likely to encounter and to be encouraged to adopt new customs, language, ideas, and norms.

Differentiation

Economic integration goes hand in hand with economic differentiation, as individuals increasingly specialize (since they can better respond to market incentives, including extra-regional opportunities) and become increasingly dependent on the economic activities of others. Political

[24] On crystallization, see Eisenstadt and Shachar 1987: 68–74.

differentiation sees the emergence of elites and their growing separation from the masses through institutions, ideology, and ritual. Within the elite further processes of differentiation occur as Italian and then empire-wide politics become ever more integrated. Such distinctions are reinforced by social differentiation, performed mainly in the urban centre, and by cultural differentiation with ever more elaborate sets of rules and expectations governing elite behaviour.[25]

The measurement of these different processes and their interaction is, as noted above, a matter of qualitative as much as quantitative judgement: measuring growth in the size (both built-up area and population) of different centres but also evaluating the degree to which resources appear to be concentrated and invested there, following the construction of public buildings in new centres as a proxy for the crystallization of institutions in urban centres but also seeking some means of charting the process in cities that already possessed the full complement of such buildings. The evidence with which the progress of integration and differentiation may be judged is all too often dominated by the literary accounts of the elite, whose writings are not objective, but there is also archaeological evidence in the form of inscriptions in different languages, the spread of coinage, and the development of trade. All this material needs to be studied in proper detail, but it is sufficient to reinforce the conventional perception that republican Italy saw an intensification of all four of these processes in many if not all regions, even if the precise chronology is still to be established and the general impression undoubtedly conceals variations in both time and space.

For the remainder of this chapter I want to sketch some of the possible economic consequences of this process of urbanization, indicating possible lines of future research. These consequences are most visible not in the area of production, where historians (blinkered, perhaps, by the search for a Roman Industrial Revolution similar to the conventional account of early modern Europe) have traditionally looked, but in consumption and hence demand. The city as consumer and as the location of consumers is not, as generally assumed by both sides in the 'consumer city' debate, economically negligible or parasitic as a result.[26] The concentration of population in the urban centre changes the location of demand. Even if the urban

[25] Cf. Habinek 1998: 34–68.

[26] Cf. Morley 1996: 13–32 on the case of Rome.

population is made up entirely of farmers, it is still necessary to invest time and resources in travel and transport. This becomes ever more important as a higher proportion of the population is involved in non-agricultural activities, whether or not these are funded through exchange with agricultural producers, or through the expenditure of surplus collected through taxes and rents. Further, urbanization gives rise to new forms of demand the fulfilment of which has implications for the development of the economy: for example, investment in the built environment (the infrastructure necessary to support the concentration of population and the requirements of 'urban life'; the material embodiment of the institutions increasingly 'crystallized' in the urban centre), new forms of behaviour, and material culture related to the processes of differentiation and integration as cities become, so to speak, machines for the production of Roman citizens and the elaboration of *Romanitas*.[27]

The reorganization of space that results from urbanization affects the conditions under which economic activity takes place. The development of urban centres and the lines of travel and communication between them affects the availability of information for merchants about market conditions and the speed with which news is disseminated, reducing the prevalent uncertainty and risk and thus, potentially, reducing marginal costs. Another factor affecting economic growth is the concentration of potential customers at a single location, both the urban population and the inhabitants of the city's hinterland, who may attend a regular market.[28] At a local level, the emergence of the urban centre as the location of the main institutions of power and control over its hinterland affects the ability of the elite to mobilize resources, and hence, we can assume, their willingness to invest heavily in its development as a means to power. Considered at a regional or national level, however, the critical relationship is not solely between town and countryside or mass and elite, but between different cities competing for influence and resources. This competition leads to the development of a more elaborate urban hierarchy between cities at different levels: the local centre opposed to the overbearing metropolis.

Understood in these terms, urbanization has significant consequences for production and distribution within society, even if this

[27] Cf. Morley 2007: 35–54 on the place of consumption in economic analysis.
[28] Cf. de Ligt 1993 and Morley 1997.

represents the redistribution of an existing surplus, rather than, as is possible but too readily assumed without argument, promoting increases in productivity and hence a larger overall surplus. The fact that the social surplus is being spent in such a way as to support increased non-agricultural production and exchange must be important. This is not necessarily to be considered as 'economic development', a problematic concept at best in so far as it tends to establish early modern European developments as the template for 'the right sort' of economic change.[29] It is equally possible to see urbanization as a problematic development for at least some members of society. It absorbed scarce resources primarily for the benefit of the ruling elite; it created conditions in which various pathogenic organisms may flourish. Finally it heightened the risks for the urban population (who increasingly cannot rely even on the city's immediate hinterland for supplies, let alone on their own efforts) even as it reduced many of the risks for traders. We might recall that, alongside the identification of urbanization with the dramatic achievements of modernity, there is an equally long tradition of associating cities with the negative consequences of modernization. What is clear is that the traditional view, that Rome was a world of cities, which is significant for our evaluation of its economy, is entirely correct, even if the definition and interpretation of that significance needs further work.

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[29] Cf. Holton 1986.

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7

City Sizes and Urbanization in the Roman Empire

Andrew Wilson

ROMAN URBAN POPULATIONS AND ECONOMIC PERFORMANCE

Why should we bother counting ancient cities or estimating their size? Neville Morley sounds several notes of caution in his chapter in this volume, and I am in agreement with much of what he says. We do need to know why we are counting cities, or estimating their size, if we are going to build any useful conclusions on top of the analysis. Yes, not all cities are alike, and their economic roles may differ; yes, there were some farmers in the city, and some craftsmen in the countryside. Nevertheless, I do not think we need to over-problematize the issue. Economic historians regularly use an urbanization index as a guide to economic performance,[1] and not only for the medieval and early modern European city, either. Regression analyses for a range of countries around the world show a close correlation between urbanization rates and *per capita* incomes.[2] These correlations are valid across cultures and across time. One would need to present a strong case for the exceptionality of Roman cities as being somehow unrelated, or inversely related, to economic performance in order to reject the exercise out of hand.

[1] E.g. Bairoch 1988; Wrigley 2004: 274–7; Temin 2006: 135. For the Roman world, cf. Lo Cascio 2009.

[2] Bloom *et al.* 2008.

Cities *are* an index of economic development in that the bulk of their population is usually engaged in non-agricultural activities; they must therefore be fed from a surplus produced by the agricultural sector. The higher the urban population as a proportion of total population, the greater the surplus, and therefore the greater the *per capita* production implied. Furthermore, cities provide large central markets, with institutions reducing transaction costs of exchange, and this concentration of demand encourages division of labour (as noted by Adam Smith on the relation between urban growth, markets, and division of labour).[3] I do not here mean the simple division of labour between agricultural and non-agricultural activities, but the division of labour within a production process. An example is given by the iconography of the funerary monument of the baking contractor Eurysaces at Rome, where the extreme division of labour, and even partial mechanization, of bread-making, with different groups of workers each carrying out a different stage of the bread-making process, is clearly related to the size of the urban context at Rome in which Eurysaces was operating.[4] The knock-on impact of the city's market role is evident in the Roman rural landscape in the clustering of villa estates within a day's journey of major cities, since the villa of course produced a bulk surplus for market sale. Moreover, since large cities also need to be supplied from beyond their hinterlands, they require organized and functioning networks of supply; large cities and long-distance trade are closely related.

We can use data on urban populations as information about the complexity and performance of the Roman economy in several ways:

1. By comparing common and maximum sizes of towns in the Roman world with those of other civilizations, to give a relative idea of the size of urban development achieved under the Roman empire.
2. By comparing the percentage of the population living in cities with other civilizations, using urbanization rates to give a relative idea of *per capita* performance. If we could calculate the total number of people living in cities across the empire as a whole—not just Italy or Egypt—then we could use the result to constrain the interplay of the related variables of total population and

[3] Smith 1776, Book I, chs 1–3; Book III.
[4] See Wilson 2008 for a development of this point.

urbanization rates, a point to which I shall return at the end of this chapter.

3. A clearer idea of city populations might cast light on the character of Roman cities—for example, what features does a Roman city of 6,000 people share with a medieval or seventeenth-century city of 6,000 people; and how do they differ?
4. By tracking urban infrastructure through building activity, euergetism, and the development of civic institutions. The fact that the city is the locus of many social processes is important for economic analysis—indeed, the reification of these processes leaves traces that we can use to gauge trends over time. The institutions that enable economic growth—security, government, a judicial system for the enforcement of contracts, supervised markets—all required physical infrastructure in the form of public buildings. The creation of these, and of other categories of public buildings and monuments, generated enormous construction activity, and this can be plotted over time. A sample of 820 building inscriptions datable to within 20 years from the *Epigraphische Datenbank Heidelberg*[5] (Fig. 7.1) shows a gradual increase over the early and mid first century BC, a sharp rise in the early Augustan period to a level that is more or less sustained over the first half of the first century AD and then dips under Nero and Vespasian to climb somewhat erratically to the mid second century. The numbers then drop dramatically in the 160s (Antonine Plague?), peak again in the 180s, and decline under the Severans, with a sharp drop in the mid third century after which they never recover; at least one of the mini-spikes thereafter, in the 360s, may be in part due to rebuilding works after the major earthquake of AD 365. Regional subsets vary slightly from this picture, but reflect some similar features: if we look just at a sample of 137 dated inscriptions connected with water-related monuments in North Africa, we can see a rise to a second- and early third-century peak, a dramatic drop-off after the Severan period, and a Tetrarchic recovery (Fig. 7.2). Here the massive peak in the 360s is composed entirely of repair inscriptions.

The processes of euergetism that enabled the construction of many of these buildings also left their own reflection. Fig. 7.3 shows a sample of 739 inscriptions composed of those honorific

[5] http://www.uni-heidelberg.de/institute/sonst/adw/edh/

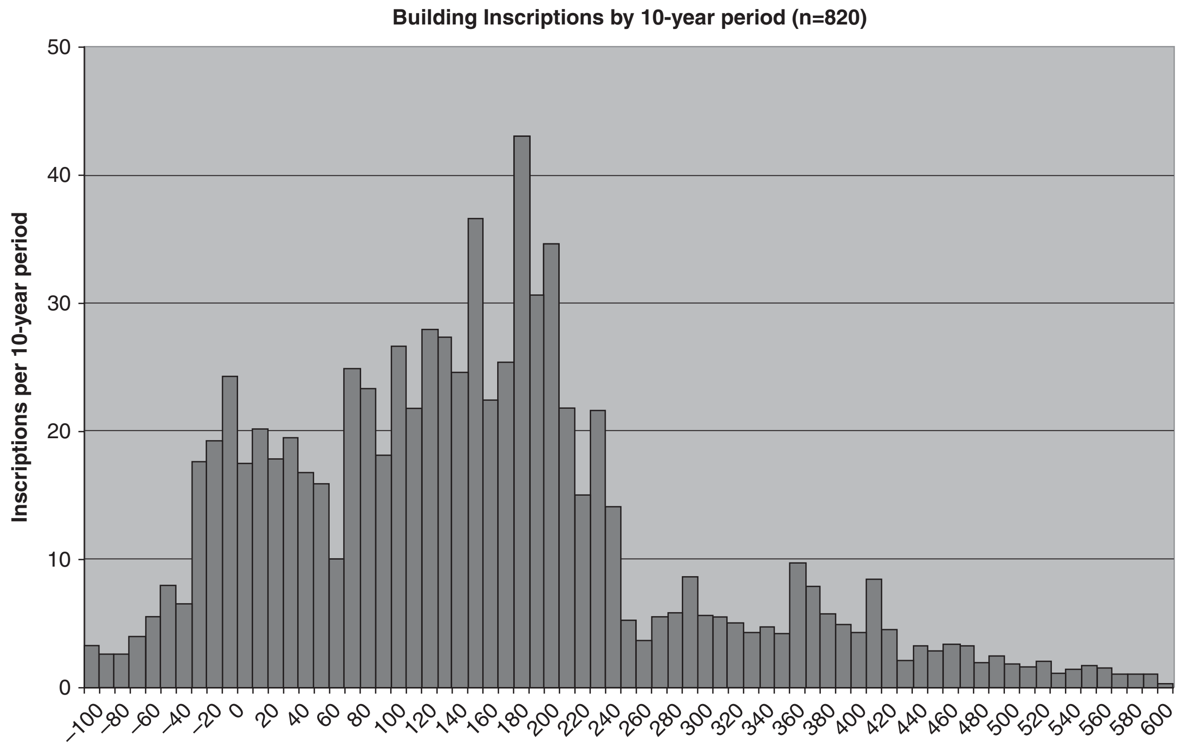

Fig. 7.1. Chronological distribution by 10-year periods of building inscriptions datable to within 20 years.

Source: Data from the Epigraphische Datenbank Heidelberg.

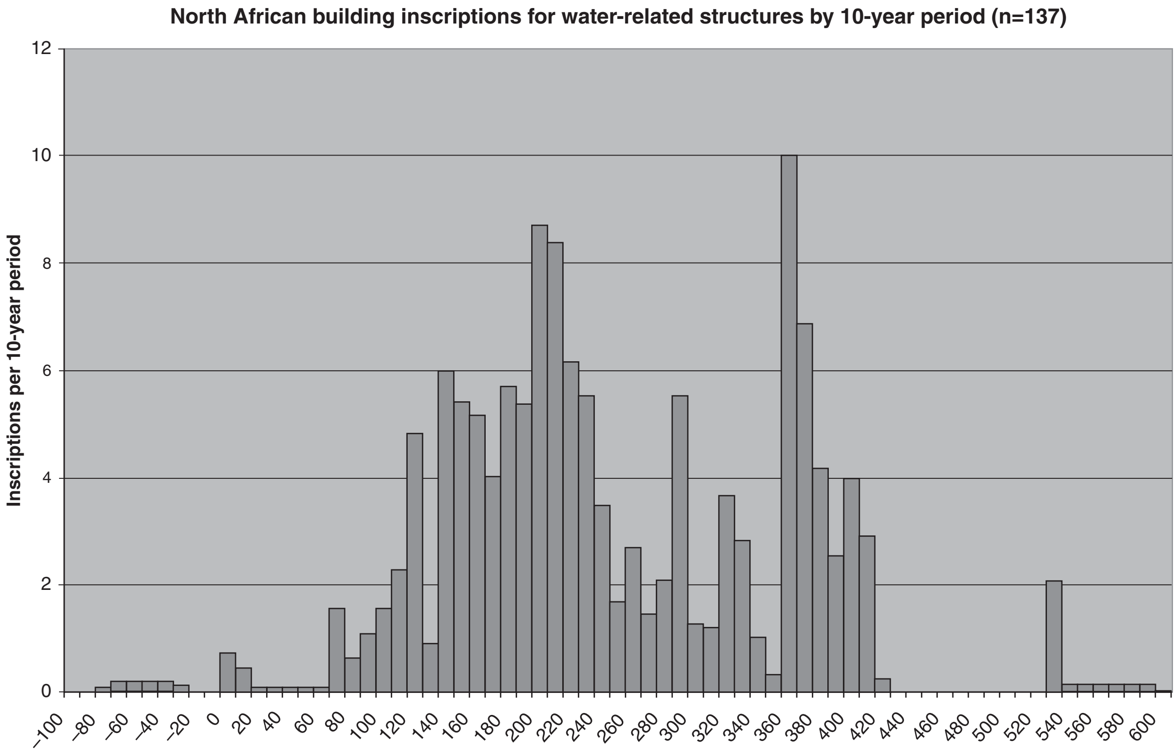

Fig. 7.2. Chronological distribution of building inscriptions relating to North African water-related monuments (aqueducts, fountains, cisterns etc.).

Source: Wilson 1997.

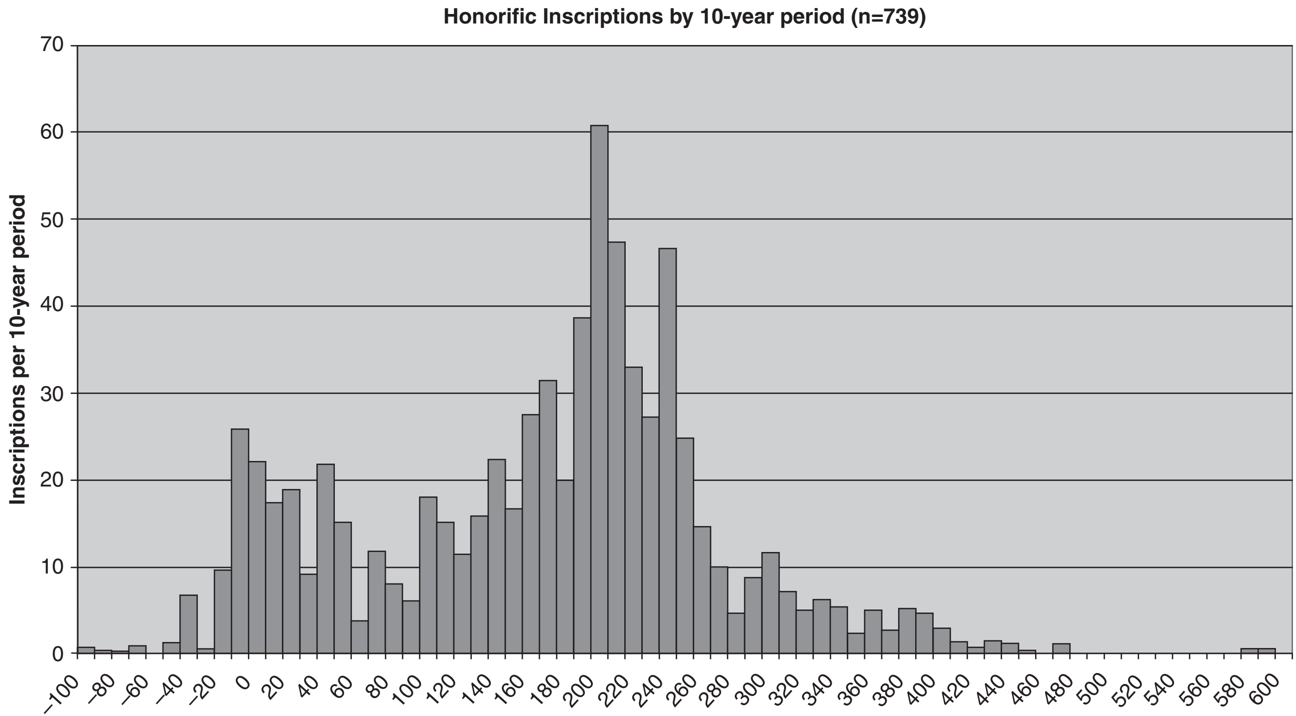

Fig. 7.3. Chronological distribution by 10-year periods of honorific inscriptions datable to within 20 years.

Source: Data from the Epigraphische Datenbank Heidelberg.

inscriptions in the Epigraphische Datenbank Heidelberg that are dated to within 20 years, throughout the empire. The pattern is similar but not quite identical to the building inscriptions. There is an Augustan peak, a Flavian low, then a rise through the second century to a Severan peak in 200–210, and a sharp drop after the middle of the third century, this time with no subsequent recovery (i.e. the fourth-century reconstructions noted in Fig. 7.2 were largely imperially funded). The lag between the building inscriptions peak in the 180s and the honorific inscriptions peak in 200–210 (representing a greater proportion of non-imperial construction) probably reflects the increasing attempts of the state in the Severan period to push the burden of urban construction onto local elites.[6] Differences in the pattern between different types of inscription suggest that there is something more at stake than a vague notion of 'epigraphic habit' that is somehow unconnected with the economy; monumental writing is expensive, and often reflects even greater expenditure on other things, and responds to wider economic trends.[7]

5. Questions of economic growth or contraction might be illuminated by, where possible, comparing sizes of individual towns at different times to trace growth or shrinkage. Urban expansion is clearly shown at Timgad in Numidia (Fig. 7.4), where the city rapidly outgrew the confines of the Trajanic colony founded in AD 100 (9.96 ha), and expanded to 47.5 ha, nearly five times its original size. Conversely, at Lepcis Magna the defended area contracts over time (Fig. 7.5): the large defensive circuit of the early empire enclosing *c.* 452 ha was abandoned perhaps in the fourth century AD, and replaced by a reduced circuit wall built of spolia and incorporating the former Arch of Marcus Aurelius, enclosing a total of 143 ha; in the Byzantine period the Justinianic fortifications enclosed merely the harbour, the Old Forum, and the Severan Forum, a total of 16.9 ha. Whilst we do not know how many people, if any, continued to live outside these reduced circuits, the successive reductions in the length of the defensive perimeter at least suggest a reduction in manpower available to man the defences.

[6] Wilson 2007. [7] *Contra* MacMullen 1982.

Fig. 7.4. Timgad (Thamugadi, Numidia): plan of the Trajanic colony and later expansion, ultimately including the area between the Temple of Saturn to the north (left) and the cemetery to the south (right).

Source: Lassus 1969, foldout plan *hors texte*.

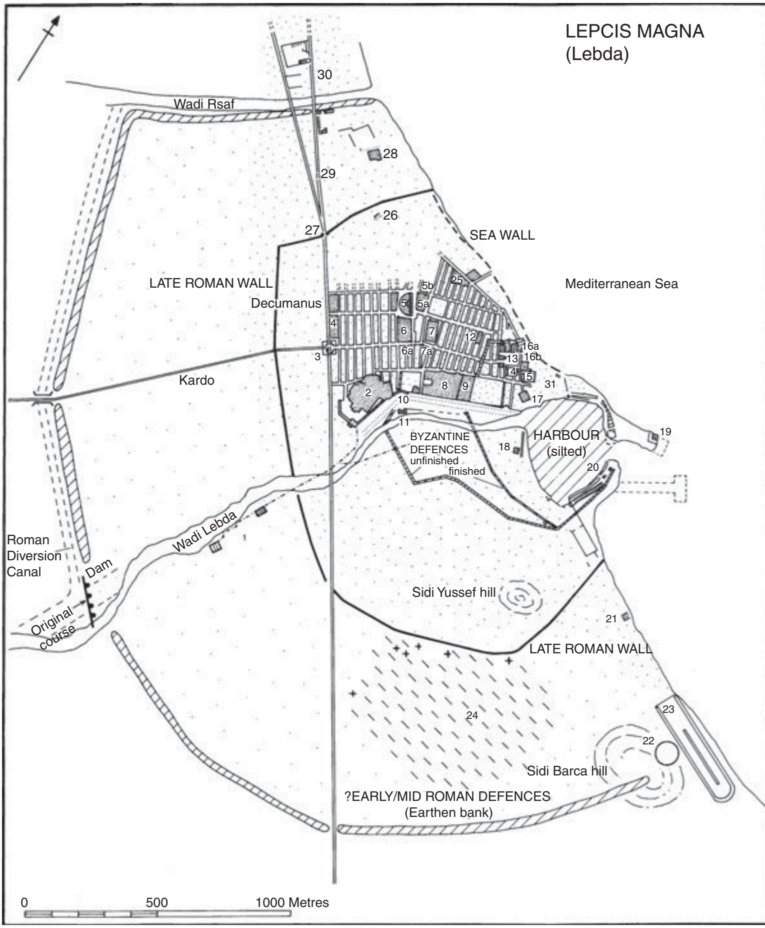

Fig. 7.5. Lepcis Magna: progressively contracting defended area: early imperial circuit; late Roman (fourth-century AD?) wall circuit, and Justinianic defences.

Source: Mattingly 1995: 117 Fig. 6.1.

6. By attempting to track the numbers of cities in the Roman world over the course of our period 100 BC–AD 350.

These indices could also be broken down by different regions, to see how the picture varied across the Roman empire.

CALCULATING CITY POPULATIONS

Beloch estimated the urban population of Roman Italy by mechanically calculating populations from the walled areas of Roman cities.[8] There is a considerable literature on estimating city populations, most of which revolves around extrapolations of density from floor areas of structures, numbers of houses, or from city areas.[9] Alternative techniques, such as estimates based on the excavations of cemeteries, or on seating capacities of theatres or amphitheatres, or on the daily delivery volumes of aqueducts, have been shown to be unworkable.[10] Extrapolations from city areas also face a number of problems—if the basis for calculation is the area within the city walls, how does one deal with areas of open space within the city (e.g. at Silchester, where parts of the enclosed area were not built up), or with extramural habitation and suburbs? What population density multipliers should be used, and how variable might these be across space and time? Nevertheless, if credible multipliers could be established, this method remains the least bad one available, and it is the *only* method for which there exist sufficiently abundant data for large numbers of cities. Moreover, since we are generally interested in establishing minimum limits of urbanization, errors introduced in some instances by omitting extramural populations will understate rather than overstate the case.

Our technique is therefore essentially a refined version of Beloch's, controlled where possible by other *comparanda*. Here the census data from Egypt are particularly important for information on household sizes and sometimes the number of houses or households in a town whose area is known, allowing cross-checking of population density estimates.[11] Generally, we take the area enclosed by walls, but excluding evidently uninhabitable terrain within this (e.g. the steep slopes of the Bülbül Dag at Ephesus, enclosed by a wall circuit following

[8] Beloch 1886.

[9] Hassan 1981: 63–77, with references to earlier literature. Floor area: Naroll 1962; Casselberry 1974; Wiessner 1974. City areas and (sometimes) household counts: Chandler 1987: 6–7; Bairoch 1988; Sumner 1989; Kardulias 1992; Zorn 1994.

[10] Water supply: Lloyd and Lewis 1976–7, with objections by Duncan-Jones 1977–8; Stephens 1984–5. On other methods and their problems, see Duncan-Jones 1974: 261–2.

[11] See e.g. Bowman, Chapter 11, this volume.

the high ground), and including archaeologically attested suburbs (but not cemeteries).

The critical point is to establish a reasonable density multiplier, or range of multipliers, for Roman cities. Much existing literature tends to use density figures of between 100 and 400 people per hectare for ancient cities.[12] Simon Price, Chapter 2 in this volume, presents data suggesting that planned classical Greek towns might have densities ranging from 110/ha (Olynthos) to 250/ha (Halieis), but makes a strong case for lower population densities of *c.* 40–60/ha in classical and Hellenistic villages and unplanned towns, at least on Crete; similar densities may apply to many villages of Roman Egypt (below), but probably not to towns. I shall work with ranges rather than absolute numbers, since I am trying to estimate reasonable orders of magnitude, not precise figures.

We cannot choose our multiplier simply by adopting estimates from better-documented cultures, e.g. medieval cities whose parish records survive, or eighteenth- or nineteenth-century Ottoman records, because we are interested in the distinctiveness of Roman urbanism. Such *comparanda* merely show possible levels of population that could be supported in an urban area in those periods, but we cannot use them as a basis for our calculations because one of the questions we want to investigate is whether Roman cities were less densely, as densely, or more densely populated than those of particular other cultures.[13]

Population densities will vary according to a number of factors, some of which may be characteristic of different settlement types, and may be identifiable in the archaeological record. Most obviously, we would expect Rome and Ostia, with a high proportion of multi-storey apartment blocks, to have a different range of likely densities from towns like Pompeii or Timgad, where most houses had one or two storeys only.[14] But different emphases on areas given over to monumental public space will further affect the density figures. Some controls may be exercised on the guessed ranges for people per hectare by comparing them with counts based on house sizes, room numbers and occupancy, as Wallace-Hadrill and Storey have done for

[12] E.g. studies summarized in Hassan 1981: 66.

[13] See Lézine 1969: 77–8 for some observations on why population densities for sixteenth- to nineteenth-century Islamic cities in North Africa may bear no relation to Roman population densities.

[14] Cf. Storey 1997: 973–5, whose estimates equate to 166/ha at Pompeii and 317/ha at Ostia. Packer's (1971) estimates for Ostia equate to *c.* 390/ha.

Pompeii.[15] Pompeii, with an estimated population of *c.* 11,000–11,500 people, on the basis of household counts, over 64–67 ha, yields a population density of *c.* 166–175/ha. For the Iron Age Near East, Zorn has used similar converging methodologies comparing area with dwelling-based estimates, arriving at a strikingly high density figure of 450/ha, but in a small overall settlement size (1.7 ha).[16] For the Roman world, in addition to Pompeii, we can gauge some idea of possible density figures from household counts of parts of Sabratha and Timgad, where sufficient areas of residential housing have been exposed to enable such a calculation.

Case Study 1: Sabratha

The city of Sabratha, in Tripolitania, allows a case study where household count can be used to check the plausibility of various population per hectare density figures. Extensive clearance excavation between 1925 and 1942 revealed residential and commercial areas around the forum, but lack of stratigraphic recording now makes it very difficult to disentangle the different phases exposed and to reconstruct the plans and numbers of individual properties. The situation is slightly clearer for the area to the north of the theatre, which was developed on a grid pattern of *insulae* (city blocks) in the late second century AD. Despite later alterations, most *insulae* preserve indications of an original division into four properties, each arranged around a central courtyard or light-well. There is structural evidence that these properties had at least two storeys.

In the city blocks north of the theatre, there are 116 houses in an area of 2.54 ha (Fig. 7.6). Household sizes will of course have varied, but two-storied houses of this size (100 m^2 ground floor area), with five to seven rooms on each floor around a central courtyard, could easily have accommodated a nuclear family plus two or three slaves—household sizes of 4 to 10 people are easily imaginable, with 4 almost certainly on the low side.[17] There is a slight variation in size among the units, with the southernmost row of *insulae* being slightly smaller.

[15] Wallace-Hadrill 1994: 91–117; Storey 1997: 973–4 calculates 11,132 people in a simulated model based on dwelling units.

[16] Zorn 1994.

[17] On household sizes, see, e.g. Storey 1997: 969–73; he and Wallace-Hadrill (1994) both use household unit sizes of between 7 and 10 for Pompeii.

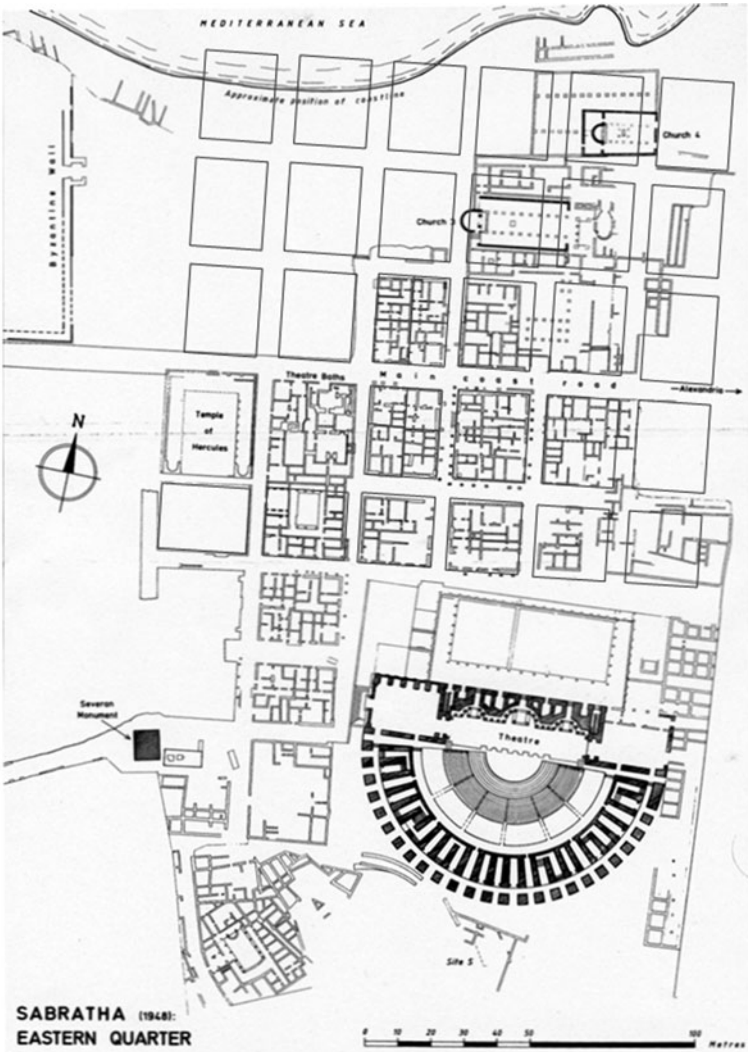

Fig. 7.6. Sabratha, plan of the area north of the theatre.

Source: After Kenrick 1985: Fig. 124, with *insula* blocks reconstructed.

Using figures of between 4 and 10 per household, this would give density coefficients of between 182 and 457 inhabitants per hectare for this part of the city (Table 7.1).

This coefficient allows for a certain amount of distributed non-residential building in the city (there is one temple in this zone), but

Table 7.1. Population ranges for the area north of the theatre at Sabratha.

People/household	4	5	7	10
Population of zone	464	580	812	1160
Density coefficient	182.9	228.6	320.0	457.1

Table 7.2. Extrapolated population ranges for Sabratha as a whole.

People/household	4	5	7	10
Total population	5730	7163	10028	14326

Table 7.3. Population density coefficients for Sabratha.

People/household	4	5	7	10
Derived density coefficient including public space	166	207	290	414

cannot be applied to the city as a whole because significant areas elsewhere were given over to public space. The main urban area of the city, to the north of the quarries in the dune beach rock, may be estimated at *c.* 34.6 ha, measuring 372 m N–S between the quarries and the sea, and 930 m at least E–W between street markings visible on air photos.[18] Subtracting 3.26 ha for the main areas within this zone known to have been given over to public space (the forum and surrounding buildings, and the theatre), we have 31.3 ha available for largely residential areas. Multiplying this figure by the residential density ranges calculated above, we obtain figures for the population of Sabratha as shown in Table 7.2.

If we now reapply these figures for total population to the full town area of 34.6 ha, we can derive density coefficients averaged across the whole town, including public space (Table 7.3).

This suggests a plausible density range of *c.* 165–415 inhabitants per hectare, and that 200/ha may still be on the low side.

Case Study 2: Timgad

The exercise can also be attempted for the initial phase of the colony at Timgad. The Trajanic foundation had 132 city blocks (*insulae*), of

[18] Wilson 2001.

Table 7.4. Estimates for numbers of houses in the original colony at Timgad.

	Insulae	Houses/Insulae	Houses
NE quarter—*cardo*	5	1	5
NE quarter—*decumanus*	4	2	8
NE quarter—non *cardo/decumanus*	23	8	184
NW quarter—*cardo*	5	1	5
NW quarter—*decumanus*	5	2	10
NW quarter—non *cardo/decumanus*	20	8	160
SE quarter—*decumanus*	4	2	8
SE quarter—Maison des Jardinières	1	1	1
SE quarter—non *cardo/decumanus*	21	8	168
SW quarter—*decumanus*	3	2	6
SW quarter—non *cardo/decumanus*	15	8	120
SW quarter—elongated *insulae* near theatre	3	12	36
	109		**711**

which up to 23 were non-residential in the original phase (Fig. 7.4). This gives a minimum of 109 residential *insulae*, in which I count 711 houses (Table 7.4).[19] The original number of housing units can be estimated for each quarter of the city—the original scheme remains clearest in the NE quarter, but is legible at other points in the city as well. The majority of *insulae* were laid out with 8 units, each with 50 m^2 ground plan but over two floors (as shown by the evidence of staircase bases, and the heights of columns on the facades fronting the *decumanus maximus*), giving 100 m^2 total dwelling area. Insulae along the *decumanus maximus* and *cardo maximus* have fewer, larger units.[20]

Because the houses are smaller than those at Sabratha, I assume the lower end of the household size range—4 to 5 people per household. At 5 people per household this gives 3,555 inhabitants for the Trajanic city as a whole (9.96 ha), or 357/ha. At 4 people per household the density is 286/ha. If the site later occupied by the theatre was originally occupied by housing, this overall density would have been greater still. The relatively small houses of the Trajanic phase (half the size of the second-century housing north of the theatre at Sabratha) imply a fairly high population density. As the city expanded

[19] Fentress 1979: 130 estimates 700 legionaries and minor officers, plus 10 centurions, totalling 710 colonists. Nissen 1902: 171 estimates 750 original colonists. See also Lohmann 1979.

[20] Fentress 1979: 129–30; fig. 9 and overlay; cf. Lohmann 1979.

physically, beyond its original limits, this high density presumably decreased, as indicated by the amalgamation of many of the original property units into larger houses, and the creation of some very wealthy peristyle houses in the late second/early third century AD, including the house of Sertius, which occupied an area equivalent to the size of six city blocks of the original Trajanic colony. The overall extent of the expanded city (some time between the late second and the fifth centuries) is some 47.5 ha, but it is unlikely that the population reached the figure of 17,000 implied by maintaining the calculated Trajanic density over this area; a more plausible range for the extended site is perhaps given by the lower to middling ranges estimated for Sabratha (166–290/ha), yielding a population range of 7,900–13,800.

ROMAN CITY POPULATIONS IN PERSPECTIVE

These exercises show considerable variation in the plausible density figures that can be estimated for some cities in Italy and North Africa. We need therefore to express populations for towns as ranges between minima and maxima; and these ranges are likely to be quite considerable—in the examples used the maxima are at least double the minima. Does this make the whole exercise so imprecise as to be pointless? I think not, because one can at least frame hypotheses based on the two extremes, and then perhaps test them. John Hanson's chapter in this volume (Chapter 9) does exactly that for several cities in Asia Minor, and demonstrates the implausibility of some commonly accepted large population estimates for cities such as Ephesus, Pergamum, and Miletus. On the other hand, even the lower ends of some of the ranges for Roman Mediterranean cities are substantially higher than population densities for medieval European cities. J. C. Russell wrote of medieval cities: 'The average population density of cities was about 100–120 persons to the hectare. The densely populated city might run past 200 to the hectare but this was rare.'[21] By contrast, the evidence of the Roman cities in the Mediterranean for which we can attempt correlations of household counts and areas suggests normal outer ranges of 100–400 people per hectare and likely ranges of 150–250 people per hectare; even more in some cities (Trajanic Timgad, or

[21] Russell 1972 (= 1969 pamphlet issue, p. 9).

Ostia and Rome).[22] Interestingly, Lohmann calculates a very similar density for the Augustan colony at Augusta Praetoria (Aosta)—360/ha—to the figure arrived at here for the Trajanic foundation at Timgad.[23] For Romano-British sites like Silchester, with considerable areas of intramural gardens or open space, we might reduce our estimates to perhaps nearer 100 per hectare. The higher densities for Roman towns compared with medieval towns may in part be explained by better water supply arrangements, with aqueducts enabling the support of a denser population than could be supported by wells alone.

Moreover, important implications emerge from either the high- or low-figure scenarios. On the high estimates of population, as we shall see later in this chapter, the level of urbanism achieved in the Roman world begins to look quite exceptional for a pre-industrial population. On the low estimates, urban population levels are still perhaps impressive in a comparative perspective, but the low estimate would accentuate a particular characteristic of Roman cities—what I would call their extraordinarily high monumental overhead. *Per capita* of population, Roman cities possessed a colossal amount of public building. If we take the low figure of 5,730 people for second-century Sabratha (which I regard in fact as much too low), the amount of public building to support that small population is truly astounding (forum, basilica, numerous temples, baths, aqueduct, and at least 12 public fountains, theatre and amphitheatre). Whichever scenario one favours, either a very high total level of urban population, or an exceptionally high level of monumental overhead, suggests an empire with an economic surplus far in excess of most other pre-industrial societies.

To illustrate this one might compare some city plans from other societies or periods. Fig. 7.7 shows a selection. The walled area of Pompeii (*c*. 66 ha) is about four times the walled area of seventeenth-century Ragusa (Dubrovnik; 14.7 ha);[24] it is also nearly twice the size of Sabratha (*c*. 35 ha). Sabratha is about twice the size of the town of Rhuddlan under Edward I, in around 1300. But the tiny town of Korcula, an outpost of the Republic of Ragusa, could fit within the area of the amphitheatre and gladiatorial *palaestra* at Pompeii.

[22] These are higher than the densities estimated by Lézine (1969) on the basis of *comparanda* from early Islamic cities, a questionable methodology.

[23] Lohmann 1979: 171, 182.

[24] Measured with Takeoff Live from the plan in Cunliffe 1990: 196.

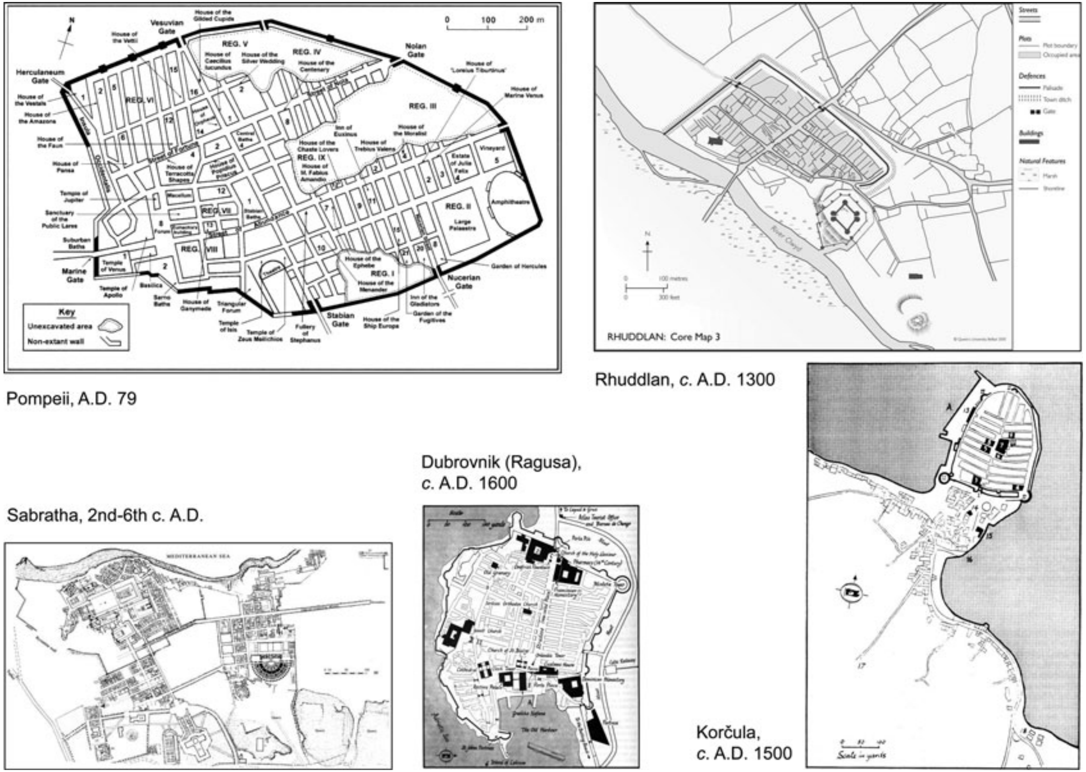

Fig. 7.7. Comparative town plans at the same scale: Pompeii, Italy (AD 79); Rhuddlan, Wales (*c.* AD 1300); Sabratha, Libya (2nd–6th cent. AD); Ragusa/Dubrovnik, Croatia (*c.* AD 1600); Korcula, Croatia (*c.* AD 1500).

Source: Cooley 2003: Fig. 1; Lilley, Lloyd, and Trick 2005; Polidori *et al.* 1998: 148; Cunliffe 1990: 196 and 199.

Table 7.5. The population of the six largest East Anglian towns in 1670.

Norwich	20,000
Great Yarmouth	10,000
Kings Lynn	9,000
Ipswich	7,900
Bury St Edmunds	6,200
Wymondham	3,100

Source: Patten 1978: 251 table 12

Where we know both the area and the population figures of some later towns, a visual comparison may incline us towards the higher estimates for the Roman period. For example, Dubrovnik is under half the size of Sabratha even if one includes the small extramural suburbs of Pile and Ploče, and the most recent estimate, which considers it to have had a population of about 6,500 in AD 1600,[25] would imply a population density close to that which produced our high estimate for Sabratha of 14,300.

Small as they seem today, such figures are significant in the context of medieval or early modern societies. H. Bechtel estimated that the vast majority of late medieval German cities had populations of 100–1,000 people, and put the average urban population at about 500—tiny by comparison with our period![26] York in the late seventeenth century had a population estimated at 12,000, a similar order of magnitude to Pompeii, or perhaps to Timgad at its most extensive.[27] Norwich, one of the largest cities of England outside London, heads the list of East Anglian towns at 20,000 in 1670—a time when the wool trade had made East Anglia one of the richest areas of England (Table 7.5).

URBANIZATION RATES IN THE ROMAN WORLD

At this point, we need to face the question of what we wish to count as a city. Juridical or administrative status? A minimum threshold for population—and if so, of 1,000 or 5,000, or what? Physical features?

25 Harris 2003: 290.
26 Bechtel 1930: 35–6.
27 Goose 2001.

First, the interplay of these variables can itself be illuminating. For example, in most Roman provinces, cities of say 5,000–10,000 people will usually have been *municipia* or *coloniae*, with a degree of administrative independence and self-government. But in Egypt most settlements of this size are technically villages. There is a considerable number of Egyptian villages covering similar areas to Sabratha (35 ha) or Pompeii (66 ha), and some have indications of denser populations, such as multi-storey buildings; many of these 'villages' also have much of the monumental overhead (temples etc.) to be found in cities elsewhere. The settlements in Egypt with true civic status look exceptionally large in terms of area by comparison with cities in other provinces. This probably also translated into larger populations—we shall see below that densities of between 150 and 270/ha are implied wherever we can cross-check areas against counts of houses or households. The abnormally large physical size of Egyptian cities is accompanied by another peculiar feature of settlement in Roman Egypt—the apparent absence of villas. Instead, the rural population lived mainly in villages, again often of large physical size (10–60 ha), but these were probably less densely populated than the towns—Rathbone calculates population densities of 40–60/ha.[28] Nevertheless, the physical extent of some Egyptian villages is comparable to that of substantial towns in other provinces (e.g. Sabratha and Pompeii).

For calculating comparative urbanization rates, I concentrate on towns with 5,000 people or more, but not on juridical status. This is (a) to facilitate comparison with analyses of other periods that have commonly taken 5,000 as a threshold,[29] and (b) because that threshold is chosen to ensure that one is counting a predominantly non-agricultural population. Naturally, there will be some farmers cultivating the land immediately outside the cities even in cities of 5,000 people or above, but these are very likely to be more than offset by the non-agricultural population of the cities in the range 1,000 to 5,000, people whom we are ignoring in this calculation, and, of course, by the rural craftsmen and non-agricultural population of the countryside. Moreover, this issue is likely to apply as much to the

[28] D. Rathbone, 'Settlement size and population in Roman Egypt', paper delivered at the OXREP conference on *Settlement, Urbanization and Population*, 10 September 2007.

[29] E.g. Bairoch 1988: 217–19; de Vries 1984; Wrigley 2004: 275.

medieval and early modern world as it does to the Roman world, so can be held to be a constant in the cross-cultural comparisons. Despite the caveats expressed in Morley's chapter in this volume, Chapter 6, this threshold does—in my view—an acceptable job in helping us estimate a *minimum* non-agricultural population for the empire.

With this in mind, I here attempt an aggregating exercise for the urban population of the Roman empire around the middle of the second century AD, shortly before the Antonine Plague, as an attempt to improve the evidence base for claims about the scale of Roman urbanization. This may seem foolhardy, but looking at the urban system of the Roman world in its entirety is clearly necessary, given the observations in this volume by Morley about whether or not to include Rome in an analysis of the urban system of Italy and the conclusions reached by Marzano and Hanson in this volume (Chapters 8 and 9) from their rank-size analyses that the urban systems of Iberia and Asia do not appear complete in themselves, but seem to be integrated into a larger Mediterranean-wide system with Rome at its head.

The methodology is necessarily somewhat rough but is aimed at giving a reasonable approximate estimate. It depends on extrapolations from city areas, the shortcomings of which we have already noted; and moreover we have area data for only a fraction of the total number of cities that once existed. We cannot measure the size of every city in the empire and extrapolate from that. But we can collect city-size data for a number of provinces, and use them as a guide to constructing a rough hierarchical model for these provinces. These hierarchical models are similar in concept to Morley's model for Italy, categorizing cities as provincial capitals, major regional centres (usually over 25,000 inhabitants), and large cities with populations in the range 5,000–25,000; but use known city areas as a guide to populating the individual categories.[30] I use the datasets of city areas collected for Britain and Spain by Marzano and for Asia by Hanson in their chapters in this volume (Chapters 8 and 9), applying a multiplier of only 100 people per hectare for Britain and Spain, and only 150/ha for Asia, although the evidence discussed above for Pompeii, Sabratha, and Timgad would suggest that higher figures could be used. I base my guesses (and they are

[30] Morley 1996: 182.

Table 7.6. Italy.

Italy		**1,547,000**
Rome		1,000,000
Ostia		40,000
Puteoli		30,000
Aquileia		12,000
Regional centres (Capua, Mediolanum, Patavium) @ 30,000	3	90,000
Major cities 5,000–25,000; avg 15,000	25	375,000

no more than that) on the number of cities in each category from the size profile of the sites for which we do have area data. I then add in the obvious big cities elsewhere, and extrapolate from the better-studied provinces to the rest of the empire. I have set fairly minimizing assumptions throughout, both in numbers of cities and in their sizes, to produce the minimum likely estimate for the urban population of the empire.

Italy

I start with Italy, using a revised version of Morley's 1996 estimate, increasing the population for Ostia as the physical size of the city is now known to be almost double what it was thought to be a few years ago,[31] and adding Aquileia, which Morley omitted because he was looking at an urban system focused on Rome and not the Adriatic (see Table 7.6). The resulting figure of 1,547,000 is therefore slightly above Morley's estimate of 1,525,000 but substantially below the two high count estimates of 1.8 and 1.9 million he offers in his chapter in this volume (Chapter 6).

Sicily, and Corsica and Sardinia

For Sicily, the known areas of Syracuse, Akragas, and Gela relate principally to the Greek-period remains at those sites, and are exceptionally

[31] Preliminary reports on the new geophysical surveys in Heinzelmann *et al.* 1997; Heinzelmann 1998. Storey's estimate (1997: 973–5) of 22,000 for the population of Ostia was based on the city area before the discovery by geophysical survey that the built-up area of the city was almost twice as large as formerly thought.

Table 7.7. Sicily, and Corsica and Sardinia.

Sicilia			**218,000**
Syracuse		1814 ha	90,000
Akragas		517 ha (Greek)	50,000
Gela		200 ha (Greek)	30,000
Panormus		47 ha	8,000
Major cities 5,000–15,000; avg 8,000 (Selinus, Catina, Messana, Lilybaeum, Termini Imerese, Heraclea Minoa)	5		40,000
Corsica et Sardinia			
Major cities 5,000–15,000; avg 6,000 (Aleria, Caralis, Olbia)	3		**18,000**

large—the 1,814 ha reported for Syracuse exceeds the sizes of Rome and Alexandria, and must include much unoccupied space within the extensive classical defensive walls linking a series of outposted forts and the harbour. Conservatively, therefore, instead of extrapolating a population range for the Roman period from this figure (which at 150/ha would imply a population of *c.* 272,000), I am guessing at a population of *c.* 90,000 based on comparison with other large Mediterranean ports (Lepcis Magna, Corinth, Caesarea Maritima). Similarly I am hesitant about simply extrapolating from the large areas of Greek-period Akragas and Gela, and prefer to guess at a model that places them in decreasing order below Syracuse, at say 50,000 and 30,000 respectively. If this approach, which may seem inconsistent, has any merit at all, it is likely to be in the avoidance of overestimation. Panormus, at 47 ha, might well be thought to house some 8,000 people, and Selinus, Catina, Messana, Lilybaeum, Termini Imerese, and Heraclea Minoa could be thought to be of a similar order of magnitude.

Corsica and Sardinia have far fewer cities, of which only three probably exceeded the 5,000 threshold, and perhaps not by much—I guess at an average less than those of the Sicilian cities in the same category, say 6,000 each (see Table 7.7).

North Africa

For Africa, an estimate constructed along the lines of Morley's model for Italy focuses on the obvious main centres and estimates a number of major cities from among the *c.* 600 cities attested in total. The larger cities are estimated using approximately 200/ha, the lower

Table 7.8. The Maghreb.

Africa (excluding Cyrenaica)			**1,029,000**
Carthage			300,000
Lepcis Magna		452 ha	90,000
Hadrumetum		155 ha	31,000
Thysdrus			45,000
Iol Caesarea		318 ha	63,000
Cirta (Constantine)			30,000
Major cities 5,000–25,000 avg 10,000[a]	47		470,000

[a] North African cities in this category whose population I consider likely to have exceeded 5,000 in the mid second century include: Tingi, Volubilis (40 ha), Cartenna, Tipasa (55 ha), Icosium, Rusicade, Tubusuctu, Sitifis, Cuicul, Cirta, Calama, Thubursicu Numidarum, Hippo Regius (60 ha), Thagaste, Madauros, Theveste (56 ha), Diana Veteranorum, Lambaesis (*vicus*), Thamugadi (50 ha), Thabraca, Hippo Diarrhytus, Utica (88 ha), Sicca Veneria, Bulla Regia (31 ha), Simitthus, Thuburnica, Ammaedara (61 ha), Thubursicu Bure, Thugga (25 ha), Althiburos, Mactaris, Uthina (120 ha), Thuburbo Maius (25 ha), Leptiminus (38 ha), Sullecthum, Thapsus (39 ha), Acholla, Thaenae, Cillium (31 ha), Sufetula (38 ha), Ksar el-Guellal (53 ha), Thelepte (180 ha), Gigthis, Meninx, Sabratha (35 ha), Oea. There may well have been many others; but the aim of this exercise is to produce a minimum estimate. (Area data taken from the OXREP cities database.)

range calculated for Sabratha (and much lower than Trajanic Timgad) (see Table 7.8).

For Cyrene, I have estimated 25,000 based on an area of 123 ha at 200/ha; Ptolemais at 217 ha is larger but surface remains may indicate that it was not entirely built up within the Hellenistic wall circuit, so I have extrapolated with a figure of somewhat under 150/ha to a guessed total of *c.* 30,000. The area of Tocra is measured at 41 ha,[32] and I use the comparatively low figure of 150/ha here because of the presence of some substantial classical-period stone quarries within the Hellenistic and Roman wall circuit. Berenice I guess to be somewhat more important, and estimate at 10,000.

The figures for towns on Crete are based on the areas given in Simon Price's chapter in this volume (Chapter 2), using a figure of 150/ha for the larger sites (over 75 ha) and 125/ha for the sites between 40 and 75 ha; these are higher densities than those he proposes for the small classical *poleis* and villages on Crete, but still at the lower range of figures he proposes for planned towns (see Table 7.9).

[32] Using Takeoff Live, from the plan in Smith and Crow 1998.

Table 7.9. Crete and Cyrenaica.

Creta et Cyrenaica		**119,250**
Gortyn	150 ha	22,500
Kydonia	85 ha	12,750
Phaistos	62 ha	7750
Aptera	42 ha	5,250
Total Crete		**48,250**
Cyrene	123 ha	25,000
Ptolemais	217 ha	30,000
Berenice		10,000
Tocra	41 ha	6,000
Total Cyrenaica		**71,000**

Egypt

For Egypt, Alan Bowman suggests in this volume (Chapter 11) that a total urban population of 1.5 million is easily conceivable, and one can arrive at such a result by the following route. Alexandria's population in the Roman period is commonly accepted to be *c.* 500,000, implying a population density of 514/ha—high, but quite conceivable given the likelihood of multi-storey apartment blocks in the capital. Ptolemais and Memphis may have had some 150,000 each; let us conservatively assume 125,000. For Memphis, this would give a population density of *c.* 185/ha, over the 675 ha of the site, comparable with ranges estimated for Pompeii and Sabratha above, and in line, as we shall see, with other evidence for Egyptian towns. Hermopolis Magna is estimated to have had some 7,000 households in the late third century AD; assuming that the second-century population was no smaller and using Bagnall and Frier's multiplier of 5.3 per household, we get a population of 37,100, yielding a population density of *c.* 232–247/ha over 150–160 ha. Thmuis, a nome capital of 80 or 90 ha with probably some 3,560 houses in the AD 170s, might have had a population of 21,360 (at 6 per house), giving a density of 237–267/ha.[33] If we accept Bowman's population estimates, based on the known size of elites, for Arsinoe (288 ha) of 45,000 and Oxyrhyncus (160–180 ha) of 30,000, population densities of 156/ha and 167–188/ha respectively are implied; these may be on

[33] Cf. Rathbone 1990: 120.

Table 7.10. Egypt.

City	Area (ha)	Demographic data (Roman period)	Estimated population	Density per hectare
Alexandria	972 ha		500,000	514
Naukratis	32–55 ha?		*5,920*	*185*
Ptolemais			125,000	
Nome capitals:				
Memphis	675/485 ha		125,000	185–258
Arsinoe	288 ha		45,000	156
Antinoopolis	200 ha		*37,000*	*185*
Athribis	190 ha		*35,150*	*185*
Hermopolis Magna	150/160 ha	*c.* 7,000 households ×5.3	37,100	232–247
Tanis	177 ha		*32,745*	*185*
Oxyrhynchus	160/180 ha		30,000	167–188
Herakleopolis Magna	150 ha		28,000	187
Syene	150 ha		*27,750*	*185*
Bubastis	140 ha (?)		*25,900*	*185*
Hibis	120 ha		*22,200*	*185*
Aphroditopolis	100/150 ha		*18,500*	*185*
Thmuis	80/90 ha	3,560 houses ×267		
Heroonpolis	40 ha		*7,400*	*185*
Apollonopolis Heptacomias		1,273 houses × 6 (AD 116)	7,638	
27 other nome capitals		27 × 14,000	378,000	
Total			**1,509,663**	

Source: Area data from Bowman, Chapter 11, this volume.

the low side by comparison with the sites with house or household data just discussed. We have area data for several other nome capitals, and in Table 7.10 I have extrapolated tentative populations using a density of 185/ha. Bagnall assumes an average of 18,500 each for the population of the *c.* 40 nome capitals, giving a total of 740,000;[34] the average of those in Table 7.10 for which we have some size data (*c.* 26,000) is much higher than his figure but it is likely that we have better data for the larger nome capitals. If his overall average is broadly correct, it would imply an average in the region of 14,000 for the remainder, which lack size data or other population estimates, which does not seem unreasonable.

Asia Minor

For Asia Minor, I use the city-area data provided by John Hanson in his contribution to this volume (Chapter 9), extrapolating with a conservative population density of 150/ha (which may well be too low). The average (10,000) for the other cities in the 5,000–25,000 range is derived from the average of the cities with known area in the same range (see Table 7.11).

Table 7.11. Asia Minor.

Asia Minor	Area (ha)	**705,750**
Sardis	356	53,400
(Col. Augusta) Alexandria Troas / Antigoneia	278	41,700
Ephesus	224	33,600
Pergamum	219	32,850
Halicarnassus	174	26,100
Cyzicus	168	25,200
Nicaea	159	23,850
Clazomenae	117	17,550
Heraclea ad Latmum / Pleistarcheia	99	14,850
Miletus	97	14,550
Cnidus	93	13,950
Aphrodisias / Ninoe	90	13,500
Laodiceia ad Lycum / Dispolis / Roas	89	13,350
Heraclea (Pontica)	78	11,700
Amorium	63	9,450
Selge	59	8,850

(*continued*)

[34] Bagnall 2009, reducing the estimate of 25,000 in Bagnall and Frier 1994: 55. Rathbone (1990: 121) suggests an average of 15,000.

Table 7.11. Continued

Asia Minor		Area (ha)	**705,750**
Nysa / Athymbra		56	8,400
Hierapolis		49	7,350
Seleucia ad Calycadnum / Tracheia		43	6,450
Col. Caesarea / Antiochia		42	6,300
Aspendus / Primoupolis		40	6,000
Cremna / Col. Iulia Augusta Felix		39	5,850
Side		39	5,850
Iasos		34	5,100
Other major cities 5,000–25,000 avg 10,000	30		300,000

The western provinces

The estimates for Britain and Spain use the datasets discussed by Annalisa Marzano in this volume (Chapter 8). For Gaul and Germany I have used lists of cities from Pliny's *Natural History* and in Bekker-Nielsen 1989, and have simply guessed populations to give a profile with, on the whole, smaller city populations than for North Africa and Asia Minor (see Table 7.12).

Table 7.12. The western provinces.

Britain		**114,000**
Regional centres		30,000
Major cities (avg 7,000)	12	84,000
Spain		**310,000**
Regional centres		22,000
Major cities (avg 8,000)	36	288,000
Gallia Narbonensis		**106,000**
Narbo Martius	*colonia*	20,000
Baeterrae	*colonia*	8,000
Nemausus	*colonia*	12,000
Forum Julii	*colonia*	10,000
Arausio	*colonia*	10,000
Valentia	*colonia*	5,000
Vienna	*colonia*	8,000
Arelate	*colonia*	10,000
Massilia		15,000
Aquae Sextiae	*oppidum*	8,000
Gallia Lugdunensis		**46,000**
Lugdunum		25,000
Lutetia Parisiorum		8,000
Senones		8,000
Turones		5,000

(*continued*)

Table 7.12. Continued

Gallia Aquitania		**47,000**
Burdigala		15,000
Major cities 5,000–15,000 (avg 8,000)	4	32,000
Gallia Belgica		**23,000**
Remi		5,000
Col. Augusta Treverorum		10,000
Augusta Raurica		8,000
Germania Inferior		**40,000**
Col. Claudia Ara Agrippina		20,000
Col. Ulpia Traiana		10,000
Ulpia Noviomagus Batavorum		5,000
Atuatuca Tungrorum		5,000
Germania Superior		**36,000**
Moguntiacum (Mainz)		15,000
Besontio (Besançon)		8,000
Argentorate (Strasbourg)		8,000
Aquae Mattiacae (Wiesbaden)		5,000

Central Europe and the Balkans

The provinces of Central Europe and the Balkans are likely to have had relatively few cities exceeding the 5,000 threshold. I have used available size data as a basis for gauging possible size profiles of other cities in these provinces (see Table 7.13).[35]

Table 7.13. Central Europe and the Balkans.

Dacia			**31,000**
Sarmizegetusa			15,000
Major cities 5,000–15,000 avg 8,000 (Apulum, Napoca)	2		16,000
Dalmatia			**60,000**
Iader		136 ha	30,000
Salona		94 ha	25,000
Doclea		24 ha	5,000
Moesia Superior			**50,500**
Viminacium		72 ha	12,500
Margum		62 ha	11,000
Scupi		40 ha	7,000
Major cities @ 5,000	4		20,000

(*continued*)

[35] For Dalmatia, Wilkes 1969: 358. For Pannonia, Póczy 1980: 247 and 251. For Noricum, Alföldy 1974: 183. I am grateful to Dragana Mladenović for estimates of the sizes of cities in Moesia Superior.

Table 7.13. Continued

Moesia Inferior			
Cities 5,000–15,000 avg 8,000	5		**40,000**
Pannonia Superior			**67,000**
Vindobona			15,000
Carnuntum		60 ha	12,000
Savaria		47 ha	10,000
Major cities (Brigetio, Emona, Siscia, Andautonia, Poetovio) avg 6,000	5		30,000
Pannonia Inferior			**28,000**
Aquincum (civil settlement)		50 ha	10,000
Major cities (Sirmium, Mursa) avg 9,000	2		18,000
Noricum			**22,000**
Ovilava		64 ha	15,000
Flavia Solva		39 ha	7,000
Total Central European and Balkan provinces			**308,500**

Eastern Mediterranean Provinces

For the remaining provinces of the Eastern part of the empire the exercise is also fairly speculative (see Table 7.14).

Four other provinces (Raetia, Epirus, Armenia, Taurica) each with perhaps one city above 5,000, at an average of 6,000, give us a further 24,000.

Table 7.14. Eastern Mediterranean and Thrace.

Syria and Judaea		**675,000**
Antioch		250,000
Caesarea Maritima		75,000
Berytus		50,000
Seleucia on Tigris		25,000
Jerusalem	112 ha	22,000
Damascus		23,000
Apamea		30,000
Major cities 5,000–25,000 avg 10,000 20		200,000
Arabia Petraea		**30,000**
Petra		10,000
Bosra		10,000
Aqaba		10,000
Cyprus		**65,000**
Paphos		15,000
Salamis		20,000
Major cities 5,000–15,000 avg 10,000 3 (Kourion, Amathus, Kition)		30,000
Achaea		**328,000**
Corinth		80,000

(*continued*)

Table 7.14. Continued

Athens		585 ha	90,000
Rhodes		200 ha	40,000
Patras			8,000
Argos			10,000
Major cities 5,000–25,000 avg 10,000	10		100,000
Macedonia			**61,000**
Beroea			15,000
Thessalonica			30,000
Major cities 5,000–25,000 avg 8,000	2		16,000
Thracia			**38,000**
Philippi			10,000
Byzantium			12,000
Major cities 5,000–25,000 avg 8,000	2		16,000

Table 7.15. Estimated minimum urban population of the Roman Empire mid second century AD.

Grand total for 5000 threshold	**356**		**7,388,500**
Minor cities 1,000–5,000, avg 2,000	1,500	2,000	**3,000,000**
Grand total for 1,000 threshold	**1,856**		**10,388,500**
Grand total for 1,000 threshold plus army @ 360,000			**10,748,500**

Table 7.16. Possible minimum urbanization rates of the Roman empire, mid second century AD.

Total population	Urbanization rate 5,000	Urbanization rate 1,000	1,000 + Army
55,000,000	13.4%	18.9%	19.5%
60,000,000	12.3%	17.3%	17.9%
75,000,000	9.8%	13.8%	14.3%
100,000,000	7.4%	10.4%	10.7%

From the figures given in Table 7.15, we can estimate possible urbanization rates depending on different estimates of the total population of the empire (Table 7.16)

The fragility both of using city areas as a basis for such calculations, and for the nature of the aggregating exercise itself, has already been stressed. However, as far as possible fairly minimizing assumptions have been chosen that are likely if anything to underestimate the reality. In particular, one might prefer a higher density estimate than the 150/ha used for Asia Minor, and more painstaking research may well suggest that more cities in the Eastern provinces and also perhaps North Africa should be included above the 5,000 threshold. The difficulty of providing even this kind of a snapshot at a particular historical moment is considerable, and this exercise makes no attempt to assess change over time, other than to note that the urban population of the Roman world must have been considerably lower at the start of the Augustan period before the foundation of numerous new Augustan colonies; and that it presumably dropped sharply for a while in the later second century AD as a result of the Antonine Plague. At the very least, the exercise exposes in more detail than any previous attempt the sorts of assumptions that need to be made to come to any estimate of the urban population of the empire. Overall, the resultant estimate may be regarded as a plausible minimum for the mid-second century AD before the Antonine Plague; it at least stands a chance of being in the right general area: some 7.3 million people living in cities of 5,000 people or more, and *c.* 10.3 million living in urban centres of 1,000 people or more. If one adds 360,000 for the army, who are also not primary food producers, we obtain a figure of some 10.6 million people who were probably not primarily engaged in agriculture. Egypt looks especially highly urbanized—perhaps *c.* 20 per cent of a high count of 7.5–8 million, or 30 per cent on Rathbone's maximum estimate of a lower total population of 5 million. This is a striking illustration of the productivity of its agriculture, all the more so since a large amount of Egyptian grain was exported to Rome. For Italy, the urbanization rate (including Rome) on a high population count of 12 million looks in the region of 13 per cent, and as much as 25 per cent on a low count of 6 million.[36] These are very large proportions for pre-industrial societies, even if they must be understood in the context of incorporation into a larger economic system with a lower overall average.

We can use the overall estimate not so much to say that the urbanization rate *must* have been a certain figure in the mid second century, but rather to see how beliefs about either total population of the empire, or urbanization rates, must interact. The low counters, who would like to see a population of around 55–60 million—i.e. Beloch's estimates for a century and a half earlier than this exercise, in the Augustan period, would need to accept an urbanization rate (for

[36] Cf. Lo Cascio 2009; Morley, Chapter 6, this volume.

the 5,000 threshold) averaged across the empire of at least 12–13.3 per cent: comparable to leading European economies perhaps in the mid- to late seventeenth century, and close to Europe as a whole around 1800.[37] Belief in a low total population therefore implies a very efficient economy. If one wants instead to take the urbanization rate down closer to the 10 per cent often assumed—still comparable to England or France *c.* 1600—then one has to take the population up considerably, to *c.* 75 million, something Beloch in his later work, with an estimate of 100 million, was tempted to do. Whichever way one looks at it, this alters our view of the size of the empire, of the size of the Roman economy, and of the performance of that economy.

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[37] De Vries 1984: 71–3; Bairoch 1988: 219; Bairoch *et al.* 1988: 253–61 (but see review by De Vries, 1989); and Wrigley 2004: 276.

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8

Rank-Size Analysis and the Roman Cities of the Iberian Peninsula and Britain

Some Considerations

Annalisa Marzano

INTRODUCTION

Modern geographers and, later, sociologists have been developing since the early twentieth century theoretical models that could be applied to the analysis of modern urban systems. These models have been developed in the attempt to go beyond the simple description of spatial distribution and to understand the process of urbanization and forces at play within and between urban centres, and have attracted the attention of archaeologists for quite some time now.[1] Indeed, although for the ancient world we lack the basic figures employed in the analysis of modern urban systems, such as census data, these models have nonetheless been seen as useful tools in understanding the mechanisms governing the interaction between society, territory, and economy in the ancient world, and ultimately, in understanding the main forces behind the growth and decline of cities. If we cannot simply apply these same models to ancient urban systems, it is nonetheless possible to offer some considerations,

[1] See a survey of the scholarship with discussion of application in archaeology dated as early as 1977: Johnson 1977; Pounds 1969 for an attempt to apply Zipf's law to the urbanization of the ancient world; Savage 1997 with previous bibliography.

however crude these may appear, about ancient settlements along the line of enquiry used for other epochs closer to us.

In this chapter I focus on two specific geographic areas of the Roman empire, Britain and the Iberian Peninsula, corresponding to the provinces of Britannia, Baetica, Tarraconensis, and Lusitania. The aim of this study is not to explain 'why' the Romano-Iberian or Romano-British settlements show certain patterns, or to develop a general model from these data that could be applied to the empire as a whole. I would like, rather, to analyse if and to what extent the rank-size rule can be applied to the archaeological data available and to offer some preliminary considerations on cities and towns in these provinces concerning their size and discuss, through the lens of the rank-size analysis, how the two provinces compare with each other and with other historical periods.[2] The choice to focus on these two geographic areas rested on two main considerations. The first, pragmatic, reason is that we know a relevant number of city-areas for these provinces; the second reason is that I wanted to compare two western provinces that had a different type of urbanism. The type of urban development observed in Iberia and Britain, in fact, differs not only in chronology, but also in its nature. For instance, in Britain the expenditure on public monuments by local elites is rather limited when compared to other provinces, and urban centres have a minimal presence of the 'monumental overhead' that regularly appears even in small towns elsewhere. Differences are observed also in building materials and building typology.

Several studies have been devoted in the past to discussing the application of the rank-size rule in archaeology, but mostly they have limited their analysis to the major cities within a given regional system rather than to a complete dataset, not least because of the difficulty of obtaining a large dataset for the ancient world.[3] Although the rank-size rule is not the only model developed in order to describe and explain the phenomenon of urbanism, it has been widely applied,

[2] For instance, for application of rank-size theory to the study of medieval cities, see Russell 1972.

[3] E.g. Pearson 1980 for prehistoric settlement systems; Johnson 1980, comparing Early Dynastic III–Diyala Plains cities (Iraq, 2800 BC), Terminal Susa A (SW Iran, 3800 BC), Early Aztec (AD 1350), Colonial America (1750), China (1843), and India (1850): the analysis takes into account only the first ten cities in these systems. By contrast, De Vries 1984 applied rank-size analysis to 379 pre-modern European cities considered over a period of 300 years.

improved, corrected, and also criticized and rejected.[4] To my knowledge, with the exception of Pounds's 1960s article (which focused on the Greek world), and more recently Tacoma (2006), who applied rank-size analysis to Roman Egypt (using nome, i.e. district, areas), no rank-size analysis of classical urban systems using city areas as proxies of population has been undertaken.[5] It seemed, therefore, worth testing this approach in order to see what kind of results one would get, and how these would compare to other pre-industrial historical periods.

CENTRAL PLACE THEORY, PRIMATE DISTRIBUTION, AND RANK-SIZE RULE

In the specialist literature on this topic a recurrent starting point for analysis is the empirical observation regarding the size distribution of cities around the world: there are a small number of large cities, a large number of small cities, and some cities in between. Since the initial expression of this regular distribution by F. Auerbach in 1913,[6] numerous models have been developed within the last century in an attempt to explain the spatial arrangement, size, and number of settlements. These models are principally based on three theoretical concepts that emphasize different aspects of rank-size distribution analysis: central place distribution, primate-city distribution, and Zipf's law, commonly referred to as the 'rank-size rule'. Although there seems to be no agreement among scholars on what exactly the analysis through the application of these models can tell us about

[4] The literature on Zipf's law and its applications is vast; an example of its application to the study of India's urban system(s) is Das and Dutt 1993; for Northern Ireland: Boal and Johnson 1965; a rejection of the rule in relation to city sizes: Rosing 1966; an implementation of the mathematical model taking into consideration the underlying economic factors in explaining the parameters of the city distribution: Roehner 1995.

[5] Millett 1990: fig. 62, p. 144, has graphed British towns according to areas, rank, and legal status, but has not presented the logarithmic graph or discussed the ranking in terms of Zipf's law; his analysis, with emphasis on distance between settlements, villas, production centres, etc., is based on central place theory. S. Keay, 'The development of towns in early Roman Baetica' in Keay 1998: 55–83 also presents a simple graph of sites according to size, but no proper rank-size analysis on a logarithmic graph is carried out. See Bekker-Nielsen 1989 for a study of urban settlements in Gaul.

[6] Auerbach 1913. For a synthetic overview of the scholarship, see Bairoch 1988: 142–52.

urban systems, they have generally been used as indicators of the degree of political unity, economic development, stability of a country, and integration of the urban system.[7] It has also been observed that there is a definite correlation between the density of settlement and the stability of a country.[8]

The central place model, elaborated by W. Christaller in the 1930s, and corroborated in the 1940s by A. Lösch,[9] focuses on the type of services a given city renders in order to determine its area of attraction. In the hypothetical case of a territory free from disruptions, the spatial distribution of cities is established as a function of their attraction zone in conjunction with the services they render. In other words, large settlements provide a wider variety of goods and services and therefore have a wider support and service area than small settlements. Central place theory bridges geography and spatial economy, and is above all relevant to the geography of production and distribution through the market, rather than to the determination of factors that govern the size of cities. For some scholars, Christaller's approach, by recognizing a certain type of relationship between settlements according to their class hierarchy, is not inconsistent with Zipf's scheme.[10]

Primate-city distribution, a concept introduced by M. Jefferson in the late 1930s, occurs when a stratum of small towns and cities is dominated by one (or more) large city several times larger than the second largest city, and when there are deficiencies in numbers of cities of intermediate sizes.[11] The presence of a primate model in a country usually indicates an imbalance in development—a progressive core and a periphery primarily engaged in agriculture, on which the primate city depends for labour and other resources.[12]

The rank-size rule is also commonly referred to as Zipf's law. It is interesting to note how G. Zipf came to develop this model, which has

[7] See, however, Johnson 1980: 240 with references for the unsuccessful attempt to relate Zipf's distribution to degree of urbanization and economic development. A useful summary of the various explanations provided by different scholars to explain rank-size outcomes that differ from log-normality is in Savage 1997: Table 1.

[8] See discussion in Berry 1961; Dziewonski 1972.

[9] Christaller 1933 and Lösch 1941, referenced in Bairoch 1988: 144, 146.

[10] Berry and Garrison 1958: 86.

[11] Jefferson 1939.

[12] Linsky 1965 for a study testing the conditions under which primate distribution occurs; this distribution is what one might expect in classical antiquity, where the agricultural sector dominated the economy.

been applied so widely to the study of urbanism. He was not a geographer, but actually a linguistics professor at Harvard University engaged in studies on phonetic changes in language, although he subsequently extended his observations from linguistic to urban geography. Zipf was interested in determining the frequency of use of the *x*th most common word in English, and in his 1935 monograph, *The Psycho-Biology of Language*, pointed out for the first time the phenomenon that would later take his name and be applied in many other fields.[13] His analysis revealed that the frequency f of a word was inversely proportional to its rank r; and that the product of frequency f and rank r was constant. These relationships can be expressed as:

$$f \sim r^{-c} \tag{8.1}$$

$$rf = c \tag{8.2}$$

Equation (8.2) can be expressed in its mathematically equivalent form:

$$\log r + \log f = \log c \tag{8.3}$$

where r = rank of a word, f = frequency of a word, and c = a constant.

Later, it was shown that the frequency of an event and its 'rank' were related for a variety of phenomena, both man-made and natural: magnitudes of earthquakes, forest fires, moon craters, biological genera by species, incomes by size, distribution of scientists by published papers, and also city distributions by population. In this last case, when the natural logarithms of the rank and of the city size (in terms of the number of people) are calculated and represented graphically, a remarkable log-linear pattern is attained, which is called the rank-size distribution. Zipf's law predicts that the slope of the line will be equal or close to −1 (a straight line).

As analytical geometry tells us that the equation of a line with a slope $-q$ can be written as:

$$q(\log r) + \log f = \log c, \tag{8.4}$$

writing this equation in the form of (8.2) will give us:

[13] Wyllys 1981, on which I depend for the following summary of Zipf's law.

$$r^q f = c \tag{8.5}$$

Without dwelling further in the realm of mathematics, let us proceed to what Zipf's law means in the context of this chapter.

Zipf's law, or the rank-size rule, which, it should be stressed, is an empirical rule, says that 'when ranks of cities, arranged in descending order, are plotted against their populations (rank 1 being given to the largest, and so on) in a doubly logarithmic graph, a rank-size distribution results',[14] or to put it much more simply: 'In an ordered set of cities representing a given country, the product of the rank and size of a city is constant.'[15] If we change the values in the equations (8.2), (8.4), and (8.5) in order to reflect population size (*P*), we can express these as:

$$Pr = k \tag{8.6}$$

$$q\log r + \log P = \log k \tag{8.7}$$

$$Pr^q = k \tag{8.8}$$

and we can write equation (8.7) as:

$$\log P = \log k - q\log r \tag{8.9}$$

where r = rank of a city, P = population of a city, and k and q = constants. Zipf believed that the size and number of settlements in any country were determined by two forces: diversification and unification. These are basically 'two opposite ways in which economical location of producers-consumers can be found out'.[16] On the one hand, a large number of small, scattered settlements near the source of raw material (this can also be land, generating small settlements within walking distance from each other) save on the transport to production; on the other, the more the entire population is concentrated in a fewer large settlements, the less the cost of moving the finished products to the consumers.

14 Das and Dutt 1993: 125.

15 Dziewonski 1972: 73; however some geographers have queried the use of the largest town as a reference point for the sizes of all other towns, since rarely is the second largest town half the size of the largest: Conway 1979: 33.

16 Das and Dutt 1993: 126.

RANK-SIZE ANALYSIS AND ANCIENT CITIES

We face a considerable difficulty in wanting to apply the principles illustrated above to the ancient world. Modern geographers have been elaborating these models and mathematical formulae working with the *population of cities*, a datum that we do not have; at best, we know the city area, usually as indicated by the circuit of fortifications,[17] and even these data are problematic. It is well known that city walls do not necessarily encompass the whole settlement, and that towns in many instances stretched beyond the fortifications.[18] The contrary is also true: the fortified area was not always completely built over. For instance, plots used for cultivation located inside the city walls have been archaeologically attested for some Romano-British towns.[19] Lastly, we do not know city sizes at the same point in time, nor can we follow, except in a few instances, variations in size through time, and this is a serious handicap to interpreting a given urban system. Nonetheless, city areas are the best data at our disposal regarding ancient city sizes.

Because we can work only with city areas and not with population figures, I am resting the following rank-size analysis on the assumption that within one urban system featuring in its settlements roughly the same kind of urbanism (i.e. type of housing, urban fabric, etc.), a larger urban area will reflect a larger population according to a constant proportion. So rather than taking city areas and attempting from there a population estimate (with all the problems that this entails), and then apply a rank-size analysis to the results, which would build into our reasoning an increasing number of assumptions, I tested the rank-size analysis directly on city areas and not population figures. A similar approach has been employed by Tacoma in his recent work on Roman Egypt. In order to attempt relative ranking of *metropoleis*, he focused on the area of their district, thus assuming that 'the size of these districts can be taken as indication of the

[17] Pounds 1969 attempted the rank-size analysis of Greek cities using as indicator of relative population city areas and the amount of their tributes listed in the Athenian tribute list.

[18] See Esmonde-Cleary 1987 for Romano-British cases and similar observations on the nature of the data by Carreras Monfort 1995–6 (with bibliographical references for cases of extramural quarters in Roman towns of Spain).

[19] Millett 1990: 134.

population size of their capitals'.[20] Tacoma's hypothesis rests on central place models, since the basis for his proposition is that the urban population was dependent on rural production, which depended on the district size. In my analysis, I am focusing exclusively on city areas;[21] I assumed that if a town's area measures x and another one measures twice as much ($2x$), also its population will be roughly twice as much. This can be expressed mathematically as:

$$P = DA \tag{8.10}$$

where P = population of a city, D = population density, and A = surface area of a city. However, it needs to be stressed that this linear relation between population size and inhabited area is not proven. If we apply equation (8.10) to equation (8.8), we have:

$$\begin{aligned} (DA)r^q &= k \\ \log[(DA)r^q] &= \log k \\ \log D + \log A + q\log r &= \log k \\ \log A &= \log k - \log D - q\log r \end{aligned} \tag{8.11}$$

$$\log A = \log(k/D) - q \log r \tag{8.12}$$

where D = population density, A = surface area of a city, r = rank of a city, and k and q = constants. As the constant q (the slope of the line) stays unchanged, and the fraction (k/D) in equation (8.12) represents the y-intercept, we can say that using the surface area of cities instead of their population will not affect our evaluation in determining if ancient cities followed the rank-size rule or not, nor will the fact that we ignore population density have a bearing on our reasoning since D is in mathematical relation with a constant value.

In other words, there will be no difference between the graphs obtained by ranking the cities by population—which we need to calculate by multiplying the city area by an assumed population density in the first place—and the graphs obtained by ranking the cities by area alone. The difference will be where the graphs intercept the y-axis; e.g. for Londinium, the population-only graph would

20 Tacoma 2006: 50.

21 For a different epoch, but using area in hectares (ha) as data, see Savage 1997, who applied rank-size analysis to the Levantine coastal plain from the Chalcolithic to the Middle Bronze IIB/C period.

intercept the *y*-axis at 28,728 for a population density of 216 people/ha, while the area-only graph would intercept the *y*-axis at 133; but the resulting normal distribution and the log-linear graphs would have the same shape and slope in both cases, thus allowing us to draw similar conclusions. Of course one could argue that the hypothesis that a town with a larger area will have the same population density than a smaller one is flawed. Cities with larger areas may have had, and in some case we know they did have, higher population densities than the smaller ones. Using different population densities for different sizes of cities would indeed alter our charts, and hence our interpretations. Fig. 8.1 illustrates, for comparative purposes, the diagrams of both hypotheses applied to the urban centres in Britannia: the application of a uniform population density of 216 people/ha to all settlements (upper part); the application of varied population densities to different sizes: 216 people/ha for settlements measuring above 40 ha, 180 people/ha for settlements between 10 and 39 ha, and 130 people/ha for smaller settlements (lower part).

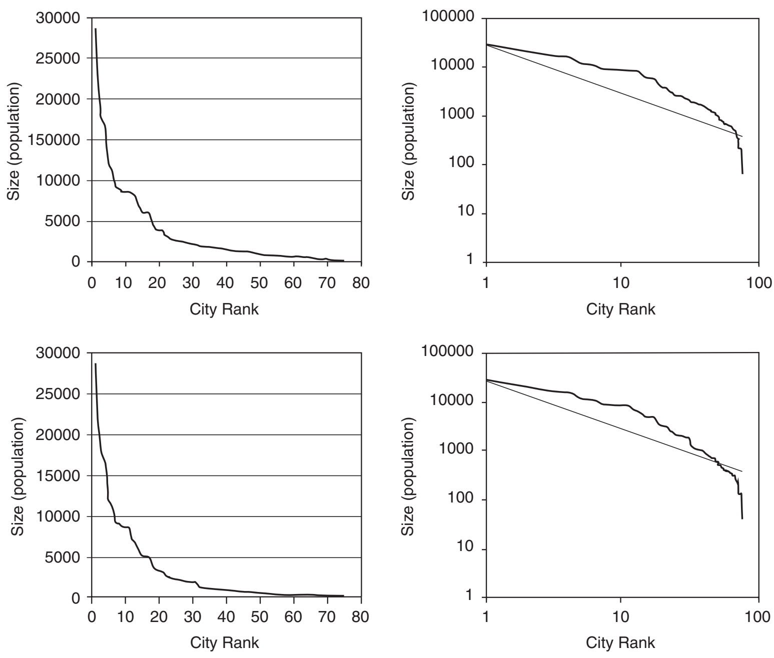

Fig. 8.1. Rank-size distribution for Romano-British towns using uniform population density (top, 216 people/ha) and varied population densities (bottom, 216, 180, and 130 people/ha).

However, we lack any archaeological evidence for clusters of multi-storey tenant housing similar to those known for Ostia, Rome, or Egypt in the regions we are investigating. Furthermore, as long as we lack any literary or archeological evidence on what the differences in population density were, the application of different population densities is an entirely arbitrary process.[22]

In addition to using surface areas instead of population figures, a second issue to be addressed is how we are going to define 'city'. What threshold are we considering? Are we looking at legal status alone, at urban appearance, or at both? Most modern studies concentrate on large cities, and population thresholds used for calculations of the rank-size rule are over 100,000.[23] When looking at ancient urbanism, we are clearly dealing with very different orders of magnitude; with the exception of a few large cities such as Rome, Alexandria, Carthage, and Ephesos, most of the ancient cities were small by modern standards.[24] In some cases, studies on pre-modern societies have used a purely administrative definition, excluding places that may nonetheless have had considerable population or economic prosperity, but not an administrative status.[25]

As pointed out by Woolf, in the ancient world it is difficult to distinguish between most small towns and villages in terms of architecture, size, and economic function, so that the 'architectural

[22] At this point it is sufficient to say that the resulting doubly logarithmic diagram of the application of varied population densities to different sizes of urban centres shows slightly less convexity (q=) than the doubly logarithmic diagram of a uniform population density (q=) (see further discussion in the Conclusions). As we can see, the real effect of using varied population densities is on smaller urban centres. Applying different population densities within the limits suggested by scholars to different settlement areas in the regions under investigation would result in different degrees of convexity, but would not dramatically alter the graphs and our conclusions.

[23] For instance, Das and Dutt 1993: 128; however, they refer to studies that took as their threshold a population of 500 (for the American Midwest).

[24] Lo Cascio 2009; Morley, Chapter 6 in this volume.

[25] Roman Egypt offers an interesting example: most of its 'villages' were much larger than the 'towns' of most of the Western provinces and displayed considerable monumental overhead. Tacoma (2006: 29) used administrative criteria in his study of urbanization of Egypt, not economic complexity and/or size. In order to account for pre-modern societies characterized by mostly small urban centres, some scholars have preferred the central place model, and defined 'urban' according to various levels of marketing and administrative functions. Rozman 1978: 71 pointed out that for pre-modern societies even a cut-off of 10,000 inhabitants as the threshold for a 'city' would be too high, and that 'a definition requiring 10,000 residents . . . would exclude all but eight English settlements and all but thirty-four Russian settlements' (for the year 1800). He discusses a model where central places with populations of 3,000 or more qualify as cities, whereas intermediate marketing settlements with fewer than 3,000 rank as semi-urban.

approach' to defining ancient cities, as expressed in the often quoted passage of Pausanias (10.4.1) about Panopeus and its lack of proper 'urban' monuments, is insufficient.[26] The importance of not limiting one's enquiry to the legal status of settlements was stressed in the case of studies focusing on modern cities, since this allows observing the threshold below which the rank-size curve no longer applies.[27]

To offer an idea of the size of settlements we are here considering, in Britain the largest attested urban centre was Londinium, measuring *c.* 133 ha (the area enclosed by the walls, but how much of this space was actually built over is not clear), whereas one of the smallest, Alfoldean, measured only 1 ha. If we apply to these areas the same coefficient used by Millett[28] for population densities—216 people/ha as maximum and 137 people/ha as minimum—we would have for Londinium a hypothetical population ranging between 18,000 and 28,000 versus a population of *c.* 150–200 people for Alfoldean. The order of magnitude of Romano-Spanish urban centres is the same, and therefore we are clearly dealing with a different scale of urbanism than that taken into consideration in most of the analyses carried out for modern cities, but in line with the medieval period.

The geographer Dziewonski stressed that in order to analyse urban systems it is important that the data belong to the whole and the same 'region', usually equivalent to a country in modern analysis.[29] The fact that one may actually end up considering under one system more than one regional system has been emphasized by Johnson in his study devoted to exploring the reasons behind the deviation, empirically attested, from Zipf's law (i.e. convex or concave distribution curves). This needs to be remembered, and in this analysis I tested different combinations, rather than limiting the enquiry to the geographical boundaries. For instance, Britannia might in reality

[26] Woolf 1997: 2. See Keay and Earl, Chapter 10 in this volume, for discussion of the relationship between towns of Baetica, their urban 'attributes', and legal status.

[27] Allen 1954 included all settlements above a threshold of 2,000 rather than only those with legal urban status.

[28] Millett 1990: 182–3, derived from Hassan 1981, who took as typical of pre-industrial eras the density of the old quarters in Middle Eastern towns; while these figures may be used for certain areas of the Roman empire such as Asia Minor and North Africa, in my opinion they might be too high for settlements in Roman Britain; however, as the calculation of the population is not the scope of this chapter, the same figures are retained. Mattingly 2006: 356 suggests that the total urban population of Roman Britain was probably never much more than 200,000.

[29] Dziewonski 1972.

encompass two or more systems (and indeed from the administrative point of view in AD 197 it was divided into two administrative regions, Britannia Superior and Inferior). For the Iberian Peninsula, an analysis of the three provinces together has been carried out first, and then by province; however, the Guadalquivir and Rio Tinto valleys in Spain, with their agricultural and mining resources mostly destined for export, might constitute a contained urban system within the remainder of the Iberian Peninsula.

THE DATA: THE IBERIAN PENINSULA

The dataset for the towns and cities of Spain and Portugal was derived from the article on the demography of Roman Spain by Carreras Monfort (1995–6). The dataset encompasses a total of 107 urban centres, ranging in size from 120 ha—the largest attested town, Emerita Augusta—to only 1.5 ha. Despite the small size of the settlements at the lower end of the scale, compared with the size of Egyptian villages, which could measure up to 30 ha or more (cf. Andrew Wilson's contribution in this volume, Chapter 7), their inclusion in the list is motivated on the basis of legal status and/or existence of proper street planning, public buildings, and so on.[30] This number represents only the *known* urban perimeters, not the totality of Spanish Roman towns. Indeed, if we are to follow Pliny the Elder, these amounted to 399.[31] The urban areas, as mentioned in the Introduction, are those enclosed within city walls; in the case of Spain, most urban fortifications seem to date to the third century AD, but the dataset is by no means homogeneous in this respect.[32] In

[30] The figure of 1.5 ha is the size of the Iberian–Roman *oppidum* of Beligio, identified with modern Azeila. The settlement, which ceased to exist in the mid first century BC, had proper street planning, an acropolis, and a temple *in antis* where bronze statues were discovered; Lucentum, measuring only 3 ha, was a *municipium*. In his text, Carreras Monfort discusses 106 cities, but his table reports areas for 107; there are no evident duplicate entries in the tabulation, and the possibility that 106 in the text is an error is to be excluded since he gives as the number of cities with unknown area 293 (Pliny's 399 towns minus 106).

[31] Pliny, *NH* 3.3.7–17; 4.4.18–30.

[32] Carreras Monfort 1995–6 indicates that most fortifications date to the third century and are a response to the turmoil and invasion affecting Spain in the period; however, only 17 out of 40 city walls conventionally dated to either the third or fourth

the case of Lusitania, most towns seem to have been provided with ramparts as early as the early imperial period.[33] If we first graph our data simply according to number of centres occupying a given area in hectares (Fig. 8.2), we observe that most of the settlements fall into the range 0–19 ha (65.4 per cent). The number of towns in the range 10–19 ha is higher than the 0–9 ha group (38 versus 32, respectively), and this is contrary to the expectations of settlement hierarchy, where area and number of settlements show an inverse proportion. As we shall see, this fact reflects the partiality of the data and those *c.* 290 towns whose area is unknown.

Since various studies cited above have discussed rank-size distribution focusing only on the largest cities of a given region, before proceeding to plot all the towns available in our dataset, for comparison it seemed worth generating a graph with the first ten cities only (Fig. 8.3). The index of primacy, or the population of the largest city divided by the population (in our study: the city area) of the second city for Spain is 1.7143, indicating that the conditions for a primate-city model are not met.

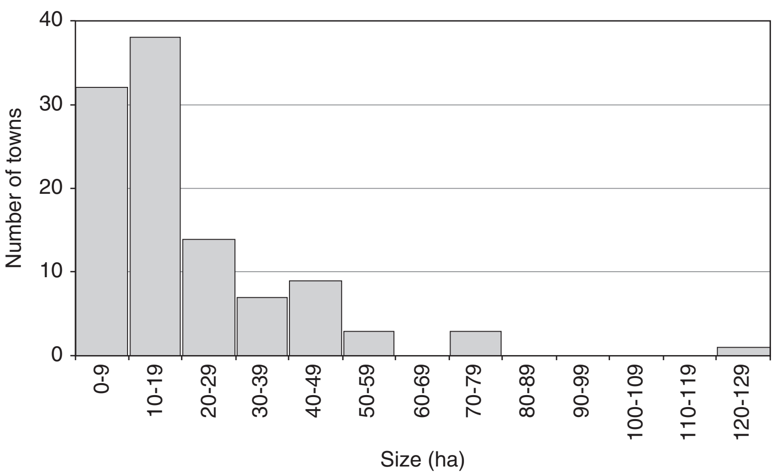

Fig. 8.2. Iberian Peninsula, distribution of towns according to city area.

century can be confidently assigned to that period, according to a recent study: see Curchin 2005.

33 Hourcade 2004; also Keay and Earl, Chapter 10 in this volume, on the fortification of some towns of Baetica in the imperial period.

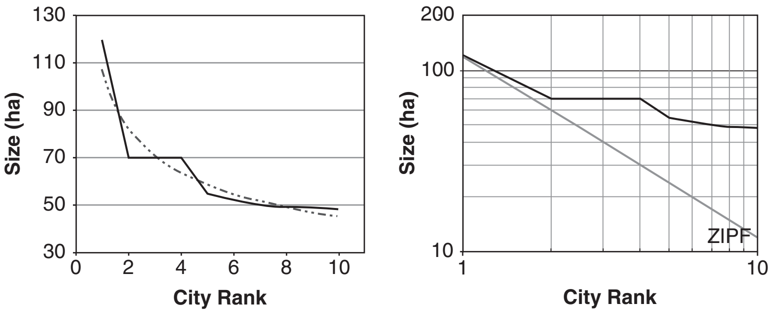

Fig. 8.3. Iberian Peninsula, rank-size distribution of top 10 towns.

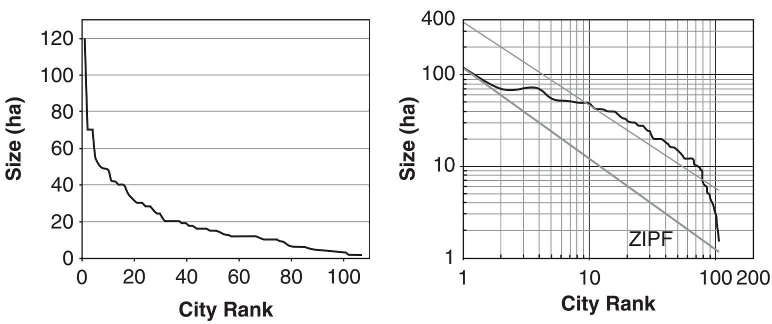

Fig. 8.4. Iberian Peninsula, rank-size distribution (all towns).

The first graph plots the towns simply according to their rank (on the *x* axis) and area (on the *y* axis), whereas the second represents the same data distribution on a log-log graph. The line labelled 'Zipf' in the graph represents the shape and inclination that our line would have *if* the dataset followed Zipf's law. When we plot all the cities at once on a logarithmic scale (Fig. 8.4),[34] the general trend shows a considerable convex deviation from Zipf's law.

Table 8.1 presents the calculated regression equations for the curves illustrated in Figs. 8.3–8.4; the data have also been analysed grouping the towns according to area in increments of 10 ha, to investigate for which range a better fitting function can be obtained. The value R^2 quantifies the goodness of fit of the estimated regression

[34] From Fig. 8.3 onwards, the figures showing logarithmic plots present, besides the plot of Zipf's line, also the plot of the regression line.

Table 8.1. Analysis of Spanish towns.

Spain	N	Power function	Logarithmic function	q	R^2
Top 10	10	$A = 106.99\ x^{-0.3753}$	$\log(A) = 2.0293 - 0.3753 \log(r)$	–0.3753	0.9161
Town > 50 ha	6	$A = 110.92\ x^{-0.4197}$	$\log(A) = 2.0450 - 0.3761 \log(r)$	–0.4197	0.8848
Town > 40 ha	13	$A = 107.04\ x^{-0.3761}$	$\log(A) = 2.0295 - 0.3761 \log(r)$	–0.3761	0.9402
Town > 30 ha	20	$A = 108.62\ x^{-0.3859}$	$\log(A) = 2.0359 - 0.3859 \log(r)$	–0.3859	0.9571
Town > 20 ha	31	$A = 119.40\ x^{-0.4446}$	$\log(A) = 2.0770 - 0.4446 \log(r)$	–0.4446	0.9517
Town > 10 ha	74	$A = 176.09\ x^{-0.6279}$	$\log(A) = 2.2457 - 0.6279 \log(r)$	–0.6279	0.9399
All towns	107	$A = 376.42\ x^{-0.9099}$	$\log(A) = 2.5757 - 0.9099 \log(r)$	–0.9099	0.7892

functions for the given data. As we can see, the best fit of the estimated regression function is for towns over 30 ha in size. This might indicate that the threshold we should be considering in this kind of analysis is over 30 ha or over 20 ha when the difference is minimal, as in this case.

The *q*-values represent the slope of the line of best fit. In Zipf's model, when *q* is greater than 0 and less than 1, it is assumed that forces of diversification dominate, and the decline of population with rank is gradual; when *q* is more than 1, it is assumed that forces of unification dominate. The *q*-value estimated regression function for all towns, although close to the −1 predicted by Zipf's law, fits the available data poorly, whereas regression functions with *q* less than –0.4 show a better fit. The convex trend and less steep slope indicate that evidently the distribution pattern does not follow Zipf's law.

A convex 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 rule would predict.[35] We can also note that at the lower end of the scale, starting approximately at 10 ha and below, the sharp drop in our distribution line is explained by the many missing settlements whose area we do not know (cf. Pliny's total of 399 towns). The small towns are, indeed, those more easily 'missed', especially when later urban developments obliterated completely the Roman phases, or if the settlement was not fortified.

Carreras Monfort, quoting earlier studies, estimated that, according to the expectations of the rank-size distribution, 93 of the 'unknown urban centres would measure 10 ha and 200 would measure 5 ha on average'.[36] To have an idea of what effect these missing towns would have, 200 random numbers in the range of 1 to 9 and 93 random numbers were generated in the range of 6 to 14, whose average corresponds to respectively 5 and 10 (ha).[37] The distribution according to their sizes is illustrated in Fig. 8.5, and the rank-size distribution including the 'projected' small towns is provided in

[35] Johnson 1980: 234.

[36] C. Carrera *et al.*, *Trabajos prácticos de Geografía Humana*. Madrid 1988 and H. Capel, 'El poblamiento urbano', in M. de Terán *et al.*, *Geografía general de España*. Barcelona 1989: 293–302, quoted in Carreras Monfort 1995–6. I could not access these works.

[37] Using the resources available at: http://www.random.org/integers/ (accessed October 2007).

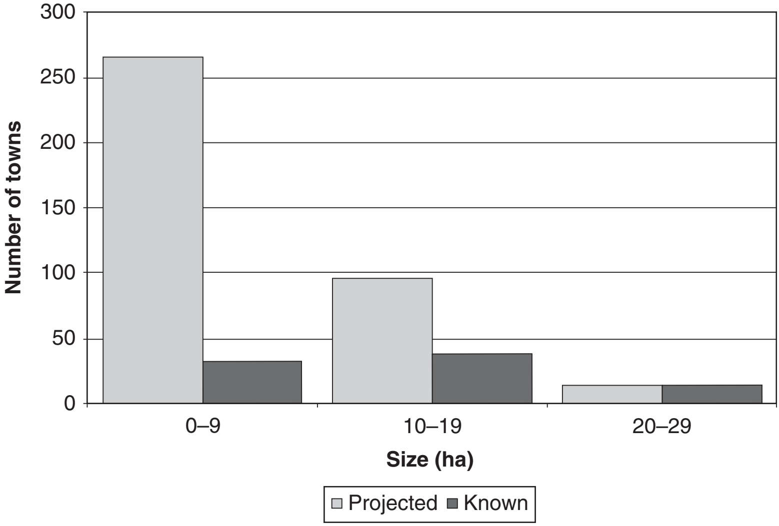

Fig. 8.5. Iberian Peninsula, comparison of projected and actual distribution of small towns.

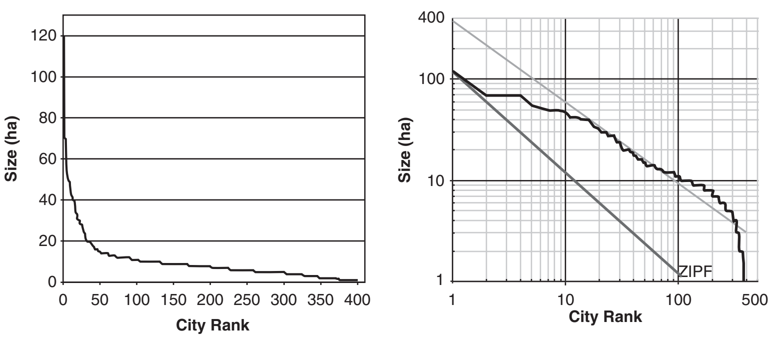

Fig. 8.6. Iberian Peninsula, projected rank-size distribution (all towns).

Fig. 8.6. Also in this case the estimated regression line log(A)= 2.5782 – 0.803 log(r) with R^2 = 0.7953 does not provide a better fit than in the case examining only the known 107 urban perimeters. Hence the shape of our curve is not the result of incomplete data, but of the nature of the urban system under examination.

THE DATA: BRITAIN

The British dataset was derived from Millett (1990).[38] In eight instances the area was calculated directly from the plans published in Burnham and Wacher (1990).[39] In this case, too, the sample does not represent the totality of towns existing in Roman Britain. We have the areas for 75 settlements out of 126.[40] The areas listed reflect those enclosed by fortifications, but the dating, when this is possible, varies

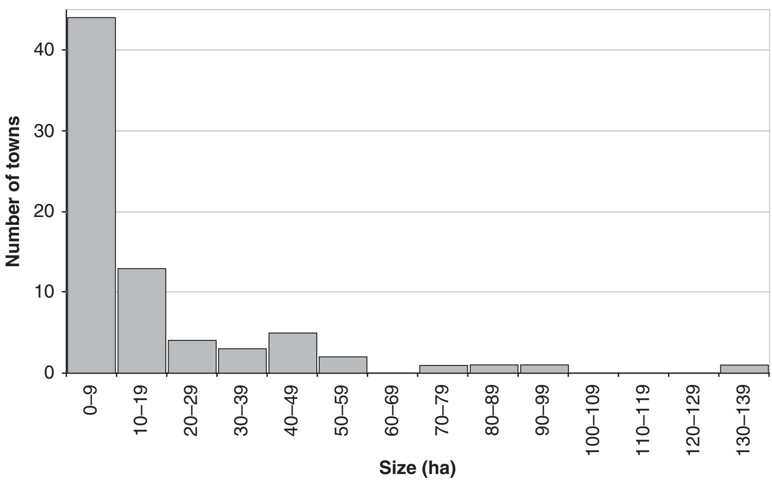

Fig. 8.7. Britain, distribution of towns according to city area.

[38] For the areas corresponding to modern England and Wales; data from Millett 1990: Tables 6.4 and 6.5.

[39] Corbridge, Towcester, Camerton, Kettering, Whilton Lodge, Alcester, Dorn, and Littlechester. In some cases there are differences between the area given by Millett and that mentioned by Wacher 1995 in the text. For the time being it seemed appropriate to consider a 'homogeneous' dataset (i.e. Millett's table) and supplement the few missing areas with calculation from the plans, rather than proceed to the calculation of all the areas from drawings.

[40] In the case of Britannia, it is perhaps even more difficult to determine which settlements to count as 'towns'. Here all those settlements listed in Millett 1990: Table 6.5 (towns and small towns of Britain) have been considered, corresponding to those appearing in Wacher 1995 and Burnham and Wacher 1990; however, as is clear in the sub-categories created in this latter study, they encompass settlements of very different nature (specialized religious, industrial, etc.). See also discussion in Mattingly 2006: 263; 286–91.

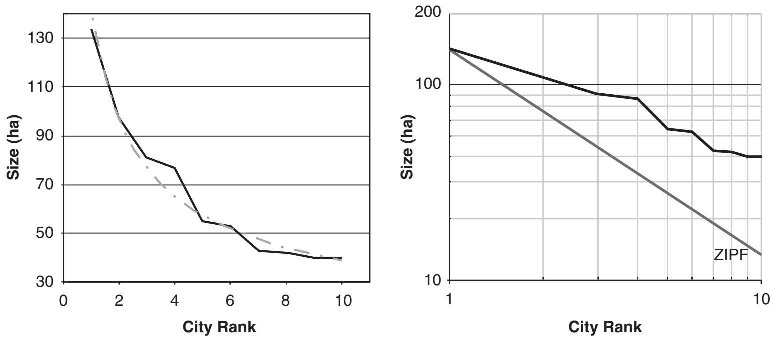

Fig. 8.8. Britain, rank-size distribution of top 10 towns.

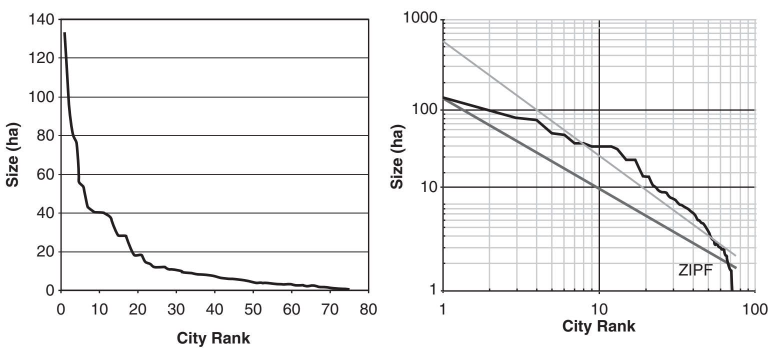

Fig. 8.9. Britain, rank-size distribution (all towns).

greatly, from the first to the fourth century AD. Graphing the dataset according to rank versus size (Fig. 8.7) shows that in this province also most of the settlements measure below 20 ha, but with a higher presence of 0–9 ha towns. The index of primacy, 1.3762, indicates that in this case also the conditions for a primate-city model are not met. Fig. 8.8 represents the analysis for the top ten cities. The graph showing all towns on a logarithmic scale (Fig. 8.9) also shows for Britain a convex deviation from Zipf's law. The calculated regression equations, again for towns arranged in 10 ha groups, as done in the case of the Iberian Peninsula, are shown in Table 8.2.

As for the Iberian Peninsula, the best fit is obtained for towns measuring >30 ha, with the >20 ha group showing a minimal difference in the regression function.

Table 8.2. Analysis of British towns.

Britain	N	Power function	Logarithmic function	q	R^2
Top 10	10	$A = 143.10\ x^{-0.5678}$	$\log(A) = 2.1556 - 0.5678 \log(r)$	−0.5678	0.9685
Town > 50 ha	6	$A = 138.08\ x^{-0.5145}$	$\log(A) = 2.1401 - 0.5145 \log(r)$	−0.5145	0.9540
Town > 40 ha	11	$A = 141.37\ x^{-0.5552}$	$\log(A) = 2.1504 - 0.5552 \log(r)$	−0.5552	0.9679
Town > 30 ha	14	$A = 139.36\ x^{-0.5411}$	$\log(A) = 2.1441 - 0.5411 \log(r)$	−0.5411	0.9705
Town > 20 ha	18	$A = 147.25\ x^{-0.5848}$	$\log(A) = 2.1681 - 0.5848 \log(r)$	−0.5848	0.9630
Town > 10 ha	31	$A = 211.97\ x^{-0.8211}$	$\log(A) = 2.3262 - 0.8211 \log(r)$	−0.8211	0.9119
All towns	75	$A = 571.25\ x^{-0.2665}$	$\log(A) = 2.7568 - 0.2665 \log(r)$	−0.2665	0.8601

ANALYSIS AND INTERPRETATION

Johnson stressed the variability in rank-size distribution, which can range from a concave curve (indicative of a primate model) to log-normal (Zipf's law) to convex, and pointed out the importance of explaining the factors behind these deviations.[41] An examination of the reasons determining a convex distribution can be found in Johnson's 1980 study. He first examines the hypothesis that if Zipf's law shows, from the economic point of view, an integrated urban system, then the convexity should be related to the effects of low system integration. This hypothesis is well tested in the case of the United States (from 1750 to 1850), where rank-size convexity and *per capita* trade volume show an inverse relationship (internal trade is used as indicator of relative system integration).[42] However, Johnson notes that 'while the evidence suggests that low system integration inhibits materials flow, there is no suggestion that high integration causes them'.[43]

An explanation for convex rank-size distributions put forward by various analysts has seen them as the result of system pooling, that is to say, combining in the same analysis two or more autonomous or semi-autonomous settlement systems. Another situation in which this type of distribution occurs is when the area under examination is located on the periphery of a dendritic settlement system.[44] In this case, if the study area does not contain the core of the dendritic system, that is, if important boundaries of the settlement system are outside the examined area, we have a case of 'partitioning' resulting in the convex distribution.[45]

This scale problem in examining either too large or too small a region (i.e. pooling or partitioning) has particular relevance in the analysis of

[41] Johnson 1977: 498. [42] Johnson 1980: 239. [43] Ibid.

[44] Johnson 1980: 241; I am reporting here Johnson's explanation of a dendritic system, a term used in anthropology to describe 'a primate settlement system which exhibits decreasing settlement functional size with decreasing distance from the primate center and weak horizontal articulation among settlements at lower levels of the settlements' hierarchy. Dendritic systems are often found in countries which were former members of colonial empires.'

[45] In this respect Johnson states that the example of the United States discussed by him fits well as a case of partitioning since the thirteen colonies were a peripheral area of the (dendritic system) British empire.

archaeological and historical data, as observed by Johnson: there are good chances of system pooling given the small average size of early settlement systems, while the difficulties of archaeological interpretation increase the chance of inadvertent omission of a system primate centre.

The distribution curve that can be observed by plotting the (known) areas of all the cities of the Iberian Peninsula is, therefore, mathematically showing a low degree of system integration. This is not a surprising result if one considers what we know archaeologically of the distribution patterns of certain goods within specific regions, and the variegated geography of the land, which contributed with its physical boundaries to the creation of various systems. But what exactly is referred to in using the term 'system integration'?

Various proxies are used as indicators of system integration where data are available on a variety of elements: internal trade volume, as we have seen in the United States example put forward by Johnson, population movements, information flows, route connectivity; these, however, cannot be used to define integration 'in such a way that the concept is applicable over the great variety of settlement systems available in the archaeological, historical, and contemporary record . . . due to the variability in system scale and type of social, economic, and political organization embodied in this record'.[46]

We ought to consider whether we are looking at either pooling or partitioning of our data, whether in other words we have looked at only part of an urban system or we have grouped together more than one system. It is undeniable that the Roman empire was a dendritic system with Rome as a primate centre, and although the degree of interdependence varies according to areas, it certainly applies to a portion of Spain, much of whose agricultural production (mostly olive oil, but also wine and we may include processed fish in this category) and metal resources was destined for the capital.[47]

[46] A possible direction of enquiry towards a definition of integration was to define it 'in terms of statistical interdependence of change in the population sizes of the settlements [because high integration presupposes a high degree of interdependence] of a system, such that the probability of change in a given settlement is conditionally related to the probabilities of change in other settlements of the system' (Johnson 1980: 245). See also the discussion on economic integration in the Introduction in the first volume of this series.

[47] For an overview of the exports of olive oil as indicated by Monte Testaccio in Rome, see Remesal Rodríguez 1998: 183–99; see also Mattingly 1988.

I turn now to the rank-size distribution of the cities divided by Iberian provinces (Baetica, Tarraconensis, and Lusitania), although I am aware that this administrative division may not necessarily coincide with the possible urban systems to be found; geographic divisions may instead be more important.

The most notable difference from the results obtained by the analysis of the dataset as a whole regards Lusitania (Fig. 8.12); while Baetica and Tarraconensis (Figs. 8.10 and 8.11) still show a marked convex deviation, although in different degrees, Lusitania displays an almost log-linear distribution. In the upper part the curve is slightly concave, then slightly convex between 30 and 15 ha; at the lower end it drops sharply, indicating that, as in the previous cases, we are missing many settlements at this end of the scale. Lusitania then appears to have been a much more integrated system than the rest of the peninsula, for which the reasons may be mainly topographical. In fact, recent research work conducted by Carreras Monfort and De Soto on the road network of Iberia in Roman times and degree of mobility between its centres has shown how the communication system of Lusitania was, on the whole, more capillary than the networks of Baetica, which was nonetheless one of the most urbanized provinces of the Roman West,[48] and Tarraconensis.[49] The reasons are clearly geographical. In Baetica and Tarraconensis, if we move away from the coastal zone, where the best road network can be observed, and from the river systems of the Guadalquivir and Genil, we find a rather mountainous landscape, which obviously made transport more difficult. Therefore the areas that allowed the highest degree of mobility were the whole eastern coastal zone, the Ebro and Guadalquivir valleys, where the navigable rivers constituted a major means of transport, the area connected by the road Emerita–Salmantica–Asturica in the southern-central part of the peninsula and the region encompassing Porto, Braccara Augusta, Brigantium, Lucus, Asturica-Legio in the north-east.[50] Although inland central Lusitania had a relatively low degree of mobility, the region, which could also

[48] Keay 1998; Keay and Earl, Chapter 10 in this volume.

[49] De Soto and Carreras 2006–7; Carreras and De Soto 2009; De Soto and Carreras 2009. I am grateful to Cesar Carreras for sending me a copy of the last two articles in advance of publication.

[50] As noted by Carreras and De Soto, however, the Roman road network on the whole Iberian Peninsula reached levels of connectivity/communication unsurpassed until the advent of railways.

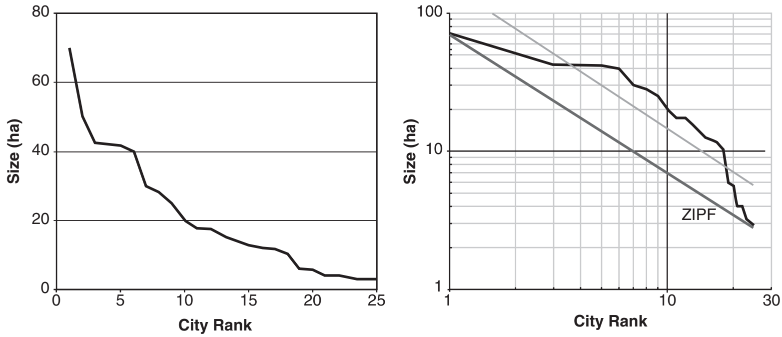

Fig. 8.10. Baetica, rank-size distribution (all towns).

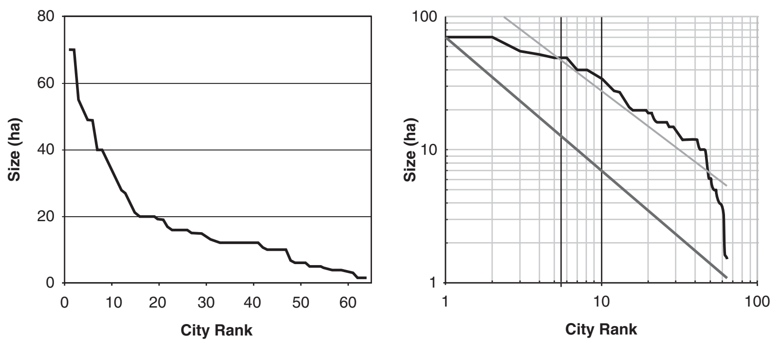

Fig. 8.11. Hispania Tarraconensis, rank-size distribution (all towns).

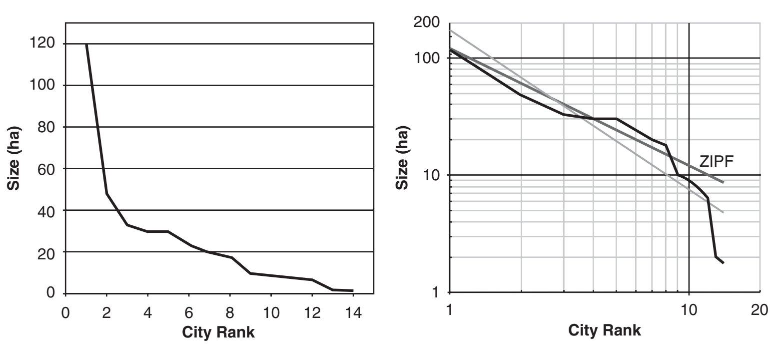

Fig. 8.12. Lusitania, rank-size distribution (all towns).

count on navigable rivers,[51] had on the whole, because of its geomorphology, a good system of transport that must have allowed for a better distribution of resources and therefore for the development of a relatively integrated urban system. This is not to say that Lusitania had fewer commercial relations outside the province compared to the other two regions. On the contrary, one may note that Lusitania was not only part of the Mediterranean commercial system through its privileged connection with the Gulf of Gades, but also of the Atlantic façade, whose commercial route linked the ports of Olisipo, Brigantium, Burdigala, and Londinium (Lisbon, La Coruña, Bordeaux, and London).[52]

Further considerations are possible. Researchers working on explaining situations that do not conform to the expectations of the rank-size relationship have determined the expected site-size fall-off applying the rank-size rule to the largest site, as we also have done in this discussion. It is in comparison with the largest cities' sizes that the size and ranking of the other settlements in the dataset are assessed as deviating, in our case towards convexity. But perhaps we should reverse our perspective and ask not why the smaller towns are larger than expected, but why the largest ones are smaller. This seems to me to be a more fruitful line of enquiry with wider-reaching implications.

Indeed, all the estimated regression lines on log-log graphs indicate a much higher y-intercept; in other words, the largest city in that urban system should have occupied a larger area. If we consider the distributions of Baetica and Tarraconensis, the ranking of the middle part of the curve indicates that the largest cities are much smaller than expected. For instance, an urban system like that of Tarraconensis and its mid-rank towns 'should' have had a largest city measuring 213 ha, rather than 70 ha. It seems logical to relate this 'missed' urban growth to the fact that considerable resources were siphoned away from the system of these two provinces. These resources comprise not only goods destined for export, mainly to Rome, but also taxes and capital that the senatorial

[51] Curchin 2004.

[52] This maritime route is considered normal by Pliny, *NH* 2.167 and Ael. Arist., *Or. Rom.* 36.91: Mantas 2004. Exports from this region were in particular salted fish (see various contributions in Lagóstena *et al.* 2007) and probably wine, although for the Roman imperial period the silence of literary sources about Lusitanian wine and the use of perishable containers (barrels) makes the identification of exports difficult; Brun 2004: 284–97 for an overview of the evidence.

Spanish elite residing in Rome may have diverted there (renting houses in Rome, buying villas in the *suburbium*, keeping a lifestyle adequate to their social standing, etc.). Furthermore, in the case of Baetica, the high degree of urbanization meant that towns had relatively small territories (Keay and Earl, Chapter 10 in this volume), and the consequent level of resources at their disposal is likely to have affected urban growth.[53] In this respect it seems relevant that on the contrary Lusitania has a largest city very close in size to what one would expect; more resources remained within the province and very likely the flow of internal trade was higher. There also seems to have been a not negligible trade flow between Baetica and Lusitania, although it is difficult to assess its role in respect to the urban development of the two regions.[54]

It is regrettable that we do not have sufficient secure data on the size of the Iberian cities in different periods. It would have been very interesting to be able to compare rank-size distributions for the first and second century AD with the one we have derived from mostly third-century AD city areas (but see the remarks above on the dating of city walls). Indeed, by the third century, because of those invasions and disorders that caused the fortification of the Iberian towns to be built, the exploitation of the mines had ceased and the export of olive oil and salted fish had dropped: would the curve for the earlier period have been even more convex?

The observations made above about the possible meaning of the convex distribution in the case of the Iberian Peninsula apply to Britain as well. I would add that in this case the deviation towards convexity occurs immediately, although we have a less convex curve than for Spain (as shown in Figs. 8.4 and 8.9). If the studies that relate the degree of convexity with the degree of system integration (with all the problems, as we have seen, about defining 'integration') are correct, this means that the towns of Britannia were part of a more integrated urban system than those of the Iberian Peninsula. The difference in morphology, and hence in communication routes, and in exploitation of economic resources may in part account for this variation. From the steep inclination of the distribution curve at the

[53] Stewart 1958: 233 noted that: 'Even with a given population density and a given urban–rural ratio, the size of a town is only an indirect index of its distance from similar towns and of its place in the hierarchy of towns. For size is incidental to function.'

[54] Muñoz 2004; in the third century AD the emperors devoted considerable attention to the improvement of the road network between Baetica and Lusitania (ibid.: 213).

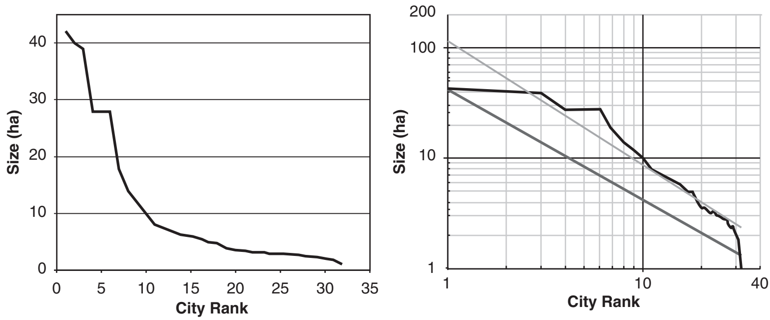

Fig. 8.13. Britannia Superior, rank-size distribution.

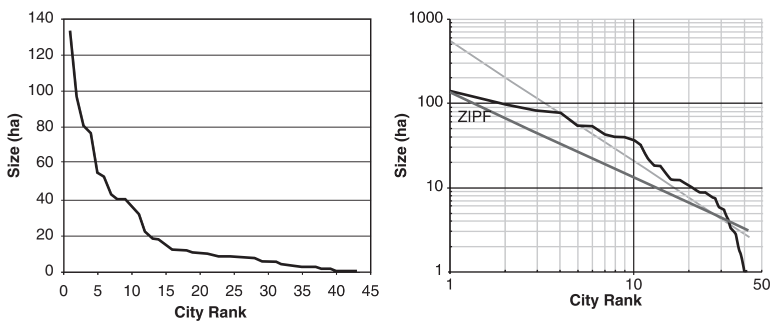

Fig. 8.14. Britannia Inferior, rank-size distribution.

lower end of the scale it appears that we are missing sizes for small urban centres in a greater number than for the Iberian Peninsula.

If we divide our dataset according to the administrative division into Britannia Superior and Inferior (Figs. 8.13 and 8.14), we do not observe major differences from the trend displayed by all towns (Fig. 8.9). The deviation is still convex, with a sharp drop at the lower end of the curve. In this case, too, it appears that the system did not allow the development of the largest urban centres to the degree 'implied' by the mid-sized centres. The presence of large military garrisons in the less urbanized areas of northern and western Britain, with the constraints they imposed on the form of civil administration and extraction of surplus, must have influenced urban development in these areas.[55] Perhaps, in the case of this

[55] Mattingly 2006: 291; 495.

province, it would be better to analyse regional systems taking into account the military settlements as well—especially when these fulfilled many of the functions of towns—rather than the administrative divisions.

But regardless of the suggestions one can put forward to explain the results of the rank-size analysis, it is important to stress that the type of curve obtained in this case study has parallels in other epochs. Urban systems in Europe from 1300 to 1800, as graphed by De Vries, also show that the largest cities are smaller than expected; it is only starting in 1850 that the size of the largest cities increases to, or above, the expected level.[56]

One important issue needs to be raised at this point. In a 1997 article, Savage discussed the importance of applying statistical tests to rank-size plots, because the visual assessment of whether a distribution is log-normal or not might actually be incorrect. This is especially important in archaeology (particularly for data derived from field survey), where data are incomplete. In some cases, sampling error may be the cause of the observed deviations; once statistical tests are run, the observed data turn out to be not significantly (in statistical terms) different from the expected data.[57] No such test was carried out in the case of the distribution curves here presented, as this is something well beyond the author's abilities and knowledge.

CONCLUSIONS

Zipf's rule is the name given to a remarkable log-linear pattern that results when the population size of urban centres within a geographic (or political) area is ranked, the natural logarithm of the rank and of the population of the urban is calculated, and the results are plotted on a graph. This regularity, also known as the rank-size distribution, is a mathematical statement of, to put it very simply, various empirical observations and by itself does not tell us the reasons for deviation

[56] Graph reproduced in Woolf 1997: Fig. 2.

[57] Savage 1997 discussed two types of statistical tests, the Kolomogorov–Smirnov (K-)test, and the Monte Carlo simulation, which 'describes a process for the solution of deterministic sets of equations with the aid of random numbers used as stochastic variables' (p. 237).

from the rule, nor the forces at play within and between urban centres, for which various explanations have been suggested.

The rank-size analysis carried out on cities of Britannia and the Iberian provinces (Baetica, Lusitania, and Tarraconensis), using the city areas rather than estimated population figures, shows, in all but one case (Lusitania), a convex deviation from the log-normal pattern of Zipf's rule. This type of deviation has been attested in studies focusing on other periods and geographical areas, such as urban systems in Europe from 1300 to 1800, or Chalcolithic sites in the Levantine coastal plain. The explanations put forward in the literature to account for a convex distribution curve have seen it as result of: (a) a low level of system integration (where 'integration' has a socio-economic meaning that varies according to the system under consideration); (b) system pooling (erroneously considering more than one system as one); (c) system partitioning (not considering the whole system, applicable to the periphery of dendritic systems).

It has been here suggested that, especially in the case of the Iberian Peninsula, the convex deviation indicates that we are looking at the periphery of a dendritic system, whose primate city was Rome. The results of the rank-size analysis are, in other words, compatible with what we know about the political, administrative, and social structure, the exploitation of natural resources, and export trade flow from Baetica and Tarraconensis in particular. What is surprising is rather the fact that Lusitania shows an almost log-linear distribution and not the convex deviation, given the frequency of this deviation in pre-modern urban systems. This result suggests that the province, which had a capillary road network system, was more 'integrated' than the neighbouring ones, and that therefore the forces of diversification and unification were almost balanced. It is also probable that the internal trade volume was higher than the external.

It has also been suggested that it might be more fruitful to consider the expected system ranking from the point of view of the mid-sized centres rather than starting from the largest attested city, which may not be the best reference point to assess all the other towns in the system.[58] If we focus on the regression line generated in the various cases we have discussed, this means that we should consider the largest cities as too small for an urban system with that kind of

[58] Conway 1979: 33.

mid-sized towns. Why so? As a tentative and preliminary suggestion it has been proposed that the diversion of resources outside these systems did not allow for the development of larger cities, and therefore for the development of larger commercial markets within the given system, because the forces of attraction of another, even larger, market were at play. The contrast between Britannia, Tarraconensis, and Baetica versus Lusitania, where we find a city as large as expected, may be seen as supporting this view. However, surely other factors need to be considered in greater detail, such as distribution of resources, morphology of the land, communication routes, relationship of urban versus rural settlements, human mortality and mobility, among others.

I would like to conclude with one remark; if such scholars as Vapnarsky are right in seeing in the *q*-value a quantification of the level of interaction between a system and the external world (1 = no interaction; 0 = all interactions initiated within the system are completed outside it),[59] in the two case studies presented we are seeing a high degree of interaction with the external world, which in our case is the empire as a whole and its capital, Rome. If the interpretation of the regions here examined as part of a dendritic system headed by the *urbs* is correct, it would indicate also the degree to which various parts of the empire were integrated in an empire-wide system in terms of its economy, markets, social mobility, and so on.[60] Therefore the rank-size analysis, notwithstanding the divergent opinions about how to interpret the results highlighted earlier, seems a promising approach that contributes to addressing the question of the nature and extent of the integration of the economy in the Roman empire.[61]

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59 Vapnarsky 1969.
60 See also Hanson on Asia Minor, Chapter 9 in this volume.
61 See Bowman and Wilson 2009: 15–28.

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9

The Urban System of Roman Asia Minor and Wider Urban Connectivity

J. W. Hanson

INTRODUCTION

> When were there ever so many cities both inland and on the coast, or when have they ever been so beautifully equipped with everything? Did ever a man who lived then travel across country as we do, counting the cities by days, and sometimes riding on the same day through two or even three cities, as if he was passing through one only? . . . Now all the Greek cities rise up under your leadership, and the monuments which are dedicated in them and all their establishments and comforts redound to your honour like beautiful suburbs. The coasts and interior have been filled with cities, some newly founded, others increased under and by you.
>
> Aelius Aristides, *To Rome*: 93–4.

In Aristides' *To Rome*, there is a certain sense of excitement, real or rhetorical, about the apparently considerable changes brought about in the urban system of Roman Asia since the coming of Roman rule in the Late Republic. The impression given not only by Aelius Aristides, but also by a range of other authors including Strabo, Ptolemy, Pliny, and Dio Chrysostom,[1] is of a dramatic increase in the number of cities within Asia and an increased level of urban life. Scholarly

[1] Aelius Aristides, *To Rome*, *passim*; Strabo, *Geography*, esp. Book XII; Ptolemy, *Geography*, Book V; Pliny, *Natural History*, Book IV; Dio Chrysostom, *The Thirty-third, or First Tarsic Discourse* and *The Thirty-fourth, or Second Tarsic, Discourse*; cf. Broughton 1938; Magie 1950; Mitchell 1993 (esp. 241).

interpretation of this has added that whilst old sites continued to flourish, a significant number of new towns and cities were founded, along with the imposition of military colonies, a network of new roads, and a new political and administrative system.[2] It is claimed that a number of these cities rose to new-found prominence, developing populations of as many as 225,000.[3] The settlement pattern of the region also seems to have become increasingly nucleated, moving away from a system geared largely towards subsistence agriculture and based around a scatter of hamlets and small villages, to a more heavily urbanized system, concentrated around a smaller number of large towns and cities. Alongside this, *poleis*, with their emphasis on local self-sufficiency and focused on their own territories, ceased to exist as separate political entities. In tandem, and partially, if not entirely, as a result of these changes, the region also seems to have come by a new prosperity. This changing urban system is explained both by Aristides and his contemporaries, and by modern scholars, as a direct result of Roman rule and as a direct result of being connected to the wider system of the Roman empire.[4] While the process of Romanization seems slow, it is also clear that by the third century the cultural and political *milieu* of the region had become 'indivisibly bound up' with that of Rome and entangled in her political and economic fortunes.[5]

This picture of Asia's urban system has not received adequate treatment, however, despite the fact that an examination of the urban system has great potential to inform us about the impact of Rome on the region and the effects of wider connections offered by integration into the Roman empire. No recent systematic study of the urban system of Roman Asia has been undertaken, based on a comprehensive catalogue and distribution map of sites. Pounds's distribution map is a particularly striking example, since it has often been deployed as the fullest study of the urban system of the Roman empire, despite neglecting the whole of Asia, Syria, Arabia, and North Africa (Fig. 9.1).[6] While Scheidel supplements Pounds's map with a more detailed map of the eastern provinces, his illustration is essentially an adaptation of Jones's study of 1937 (Fig. 9.2).[7] In this context, our understanding of the phenomenon of urbanism within Asia is generally poor. Lacking a more recent

[2] E.g. Mitchell 1993.
[3] Broughton 1938: 812; Magie 1950: 585; Mitchell 1993: 244.
[4] Mitchell 1993: 69.
[5] Mitchell 1999: 433.
[6] Pounds 1973; e.g. Scheidel 2007.
[7] Scheidel 2007; Jones 1937.

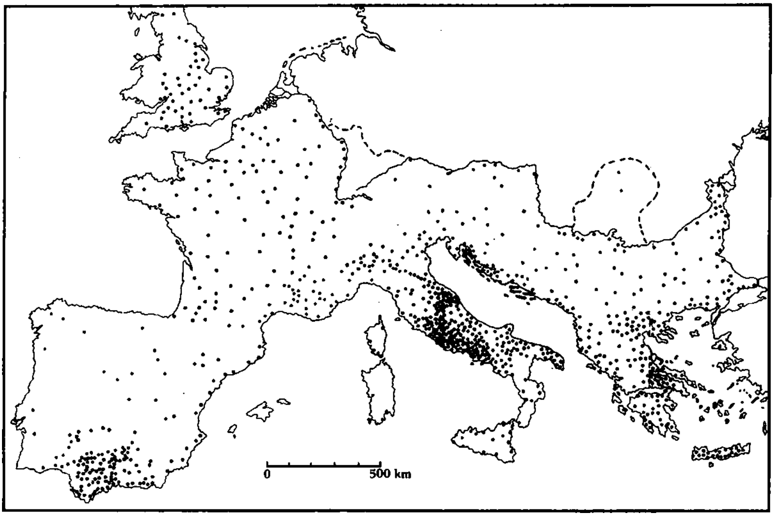

Fig. 9.1. The distribution of Roman towns and cities in Europe.
Source: (Pounds 1973, fig. 3.6).

archaeological study of the region, our understanding is based on travellers' accounts from the early nineteenth century to as late as the 1980s, a handful of 'biographies' of individual cities, a few surveys of small areas, and a number of largely out-of-date historical accounts, loosely integrating archaeological material.[8] Our picture of the urban system of Asia as a whole has also tended to be drawn to a large extent from primary sources, such as those detailed above, and the extrapolation of trends perceived in the wider Roman empire.[9] The impression of the urban system of Asia derived from these sources has been accepted uncritically and has attracted very little examination or explanation, making re-evaluation essential.[10]

[8] Radt 1999; Blanton 2000; and Bean 1984a, 1984b, 1989a and 1989b are good examples of these.

[9] Our main travellers are Textier, Hamilton, Humann, Ramsay, Hogarth, Chante, Keil, Wilhelm, Buckler, Bean, Calder, Cuthrie, Cox and Cameron, and Lloyd (for more detail: Lloyd 1989: 199). For examples of an approach based on literary sources and these travellers, see Magie 1950 and Mitchell 1993.

[10] For example, Mitchell 1993 relies predominantly on literary sources and epigraphy for his impression of urbanism within Asia, but does not have access to a catalogue or distribution map of sites, leading to the acceptance of a number of unreliable estimates.

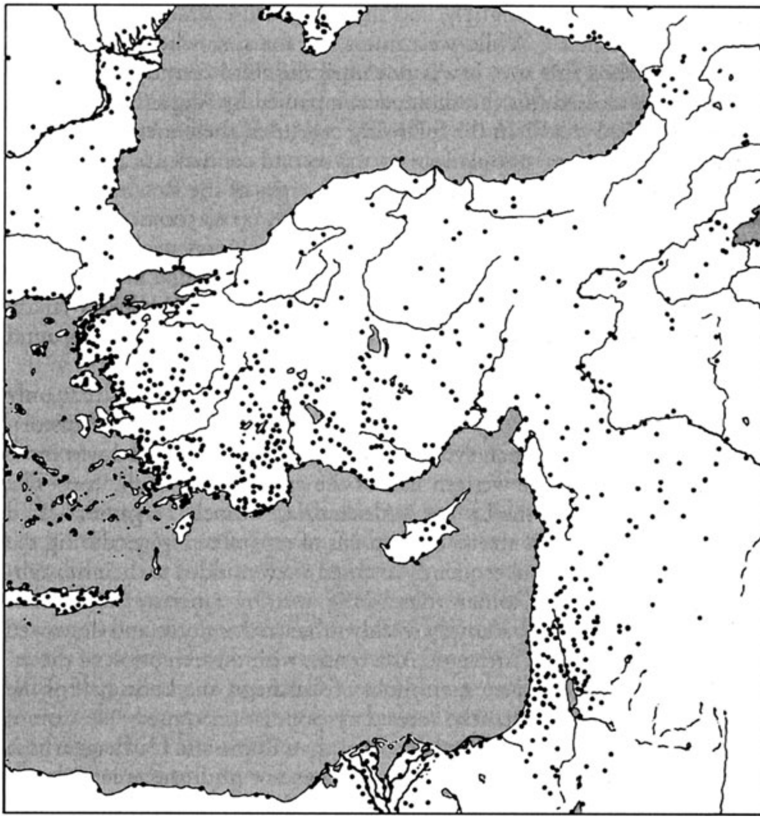

Fig. 9.2. The distribution of sites in the eastern Mediterranean.
Source: (Scheidel 2007, map. 3.3 (based on Jones 1937, maps II–IV)).

An investigation of the density and nature of an urban system can be extremely informative since there is a strong correlation between rates of urbanism on the one hand and the performance and level of development of the economy on the other.[11] In a city beyond a certain size, the bulk of the population will be engaged in non-agricultural activity, and will therefore depend on a surplus produced by the agrarian sector. The higher the rates of urbanization and the populations of cities within a region, the greater the surplus that must be generated and supplied, and therefore the greater the *per capita*

[11] Wilson, Chapter 7 in this volume.

production implied, and thus the greater the prosperity of the region. Large cities are particularly economically significant, since they will exert a strain on the economy by drawing individuals from the countryside and placing them in a position where they rely on the surplus of others (although in turn enabling greater division of labour and greater productivity). An extra facet of the Roman urban system is that such urban centres will also display high 'monumental overheads', which will also need to be funded.[12] Furthermore, a dense urban system, with large cities, requires a relatively complex economy, including the organization and tapping of a large and productive hinterland, the extraction of resources from a wide region, and effective transport. The characteristics of an urban system and its levels of connectivity will therefore have far-reaching implications for our understanding of the society and economy of the region.

This study adopts the methodological stance put forward by the Oxford Roman Economy Project (OXREP) and its attempt to advance theoretical debates by working from bodies of quantifiable data that can then be interpreted and analysed as indicators of the performance of the Roman economy. This chapter thus starts from first principles to collate data that can be analysed by reference to a series of models, many of which have only seldom been applied to archaeological material. By looking at the entire urban system of a region and what the system might tell us about its wider connectivity, especially towards Rome, this study also responds to an increasing appreciation of the level at which the ancient world enjoyed connectivity and integration—an approach derived from Braudel, but which has most recently been championed by Horden and Purcell and emphasized by Wilson.[13] This chapter is also a preliminary part of an ongoing investigation by the author into the ways in which the urban system of the Roman empire might function as a single entity.

This chapter focuses on the period from the establishment of Roman rule in Asia in the Late Republic until the beginning of the third-century 'crisis', and particularly on the high imperial period, although, of course, the prior urbanism of many sites and the considerable developments in the third and fourth centuries must be taken into account. This chapter will demand a broad chronological framework, since the aim of the

[12] Wilson, Chapter 7 in this volume.

[13] Braudel 2001 (original ideas and interpretations 1968, but unpublished until 2001); Horden and Purcell 2000; Wilson 2002.

study is to examine the urban system of Asia as a whole. Even where desirable, the subject often does not allow for a sharper chronological resolution. The geographical scope is that part of modern Turkey from the Aegean coast to a rough latitudinal line drawn from just east of ancient Sinope to just east of ancient Tarsus. The region is described as Asia, Asia Minor, Anatolia, as a list of regions, including Ionia, Caria, Lycia, Pamphylia, Cilicia, Cappadocia, Paphlagonia, and Bithynia, or as a list of Roman provinces, including Asia, Bithynia-Pontus, Galatia, and Cappadocia (Fig. 9.3).[14] The problem of definition is encapsulated by the fact that Strabo uses the term 'Asia' to describe both the province specifically and the region more broadly. Here 'Asia' will be used to refer to the geographical unit defined above. The provinces further east and south, including Syria, Pontus, and Armenia, have been excluded to keep the scope manageable, following boundaries of the natural geography of the region and the lines of Roman rule and administration.

Despite a concentration on areas that are better archaeologically understood, the pool of archaeological and historical information is still limited, and lack of data means that many of the questions one would like to pose simply cannot be answered. Many sites remain unexplored, such as Cyzicus, where we rely on patchy evidence from the early twentieth century.[15] Although a number of important sites are

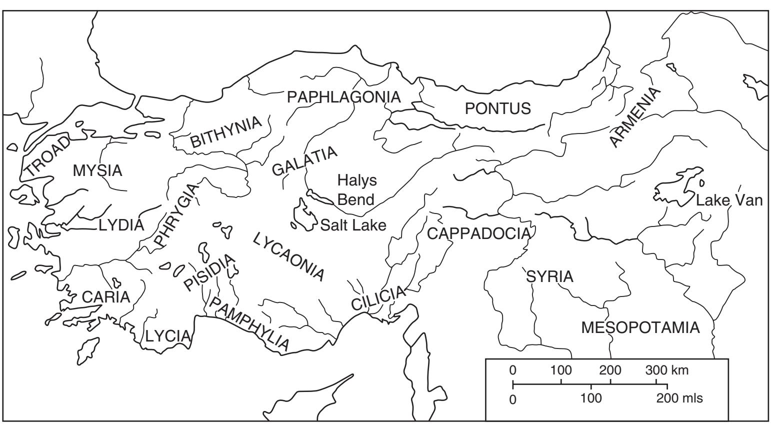

Fig. 9.3. The regions of Roman Asia, AD 14.
Source: (Lloyd 1989: Fig. 3).

[14] Georgacas 1971; Horden and Purcell 2000.

[15] Hasluck 1910.

now being more fully understood (for example Aphrodisias, where geophysical prospection has revealed the plan of great swathes of the site), the effects of this progress have only just begun to filter through and have not yet formed a substantial body of information. Partial access to plans, as we shall see, also proves to be a major problem, as a result of limited and sometimes uneven publication of archaeological work.

While there is much debate over what we can define as 'towns', 'cities', and even 'settlement', in this study a working definition of urban centre must be accepted, defined as sites displaying nucleated settlement, central functions and services, and a minimum size (10 ha as a minimum seems reasonable). In this investigation more emphasis will also be placed on the upper end of the settlement hierarchy for several reasons. This chapter focuses on larger urban centres as they will be more informative about the urban (rather than agricultural) system and urban connectivity. Since small farms and agricultural establishments are tied to the land, we would expect them to conform to an even scatter around productive land; the distribution of larger sites, however, might depend on a number of other factors, including wider connections. The top of an urban hierarchy also defines the limits and range of the system, and by examining the top of a hierarchy we may be able to extrapolate for the wider system, since the largest cities often collate and intensify the economic functions of the other towns in the system. Finally, larger sites are more likely to be preserved, found, and recorded, and a focus on larger urban centres will avoid a partial and thus anomalous set of data at the lower ends of the settlement hierarchy. This should avoid the problems detected by Marzano in her study of Britain and Spain, in which the hierarchy seemed to conform to the Pareto effect, where the few largest sites provided vital data and the many smallest sites proved ultimately more trivial and tended to distort the analysis.[16]

THE CHARACTERISTICS OF THE URBAN SYSTEM OF ROMAN ASIA: SITE DISTRIBUTION AND ANALYSIS

Primary and secondary sources offer an initial impression of the urban system of Roman Asia. The opening quotation from Aristides highlights the number of cities and the dense nucleation of

[16] Marzano, Chapter 8 in this volume.

settlement. According to the geographer Ptolemy, Asia contained some 140 cities,[17] whilst Josephus and Philostratus are both in agreement over a much higher figure of 500.[18] Pliny offers no regional total, but explicitly mentions some 176 cities in the regions he calls Asia, Cilicia, Lycia, Lydia, Caria, and Phrygia.[19] Broughton and Magie repeat a number of these estimates, although Mitchell arrives at a total of 130 cities in Asia.[20] Unfortunately, however, these figures must be treated with extreme caution. The figures used by primary sources are not based on accurate census or cartographic data, but are almost certainly derived from rough estimates (the figure 500 is particularly suspect) and are prone to hyperbole and influenced by the concerns of panegyric (particularly Aristides). Furthermore, what constitutes a city is never clearly defined, nor is the area being described. The use of the term *polis* also raises problems, since large villages or small towns might well be included within these lists due to their traditional or historic status. These sites might, however, have been relatively insignificant, in decline, or might have been synoikized prior to Rome's coming. Colophon and Lebedus might well count as two *poleis*, whilst they were in fact synoikized into Ephesus. Furthermore, a '*polis*' is not synonymous with a Roman *oppidum*, *civitas*, or *colonia*, and raises issues pertaining to our own translation and interpretation of the term. Secondary sources have often followed these estimates too faithfully.

A more empirically grounded list of sites can be drawn up using the *Barrington Atlas* with *The Princeton Encyclopedia of Classical Sites*,[21] the first of which offers the most comprehensive and up-to-date catalogue of sites. The *Barrington Atlas* classes sites into five ranks defined by criteria such as size, physical remains, literary references, and civic status (historical importance has only been used to a limited extent).[22] Rank 5 represents isolated villas, farms, baths, or hamlets, rank 4 small villages, ranks 2 and 3 towns and cities, and rank 1 extremely large cities (of which none exists in Asia), giving a total of

[17] Mitchell 1993: 243.

[18] Josephus, *The Jewish War*: II.xvi.4.366, *τί δ αἵ πεντακόσιαι της* ᾿Ασιας *πόλεις*; Philostratus, *Lives of the Sophists*: ii.1.548, *πεντακοσίων πόλεων*.

[19] Pliny, *Natural History*, Books IV and V, *passim*.

[20] Mitchell 1993: 243, Bithynia 13, Pontus 11, Paphlagonia 6, Galatia and Lycaonia 20, Phryia about 45, Mysia 11, Lycia 20.

[21] Talbert 2000: maps 51, 52, 56, 61, 62, 63, 65, 66, and 86; Stillwell 1976.

[22] Talbert 2000: xxv.

1,381 sites of ranks 2–5 in Asia. The site list derived from the *Barrington Atlas* can comfortably be used as the backbone of this study, since when checked against a number of alternative atlases and the *Princeton Encyclopedia*, it was clear that the *Barrington Atlas* was by far the most complete.[23]

In this study, only ranks 2 and 3, which constitute major urban centres, will be considered, giving a list of 176 urban sites (see Appendix). These can be plotted over relief, topography, river systems, and road networks, and the nature of their hinterlands can also then be examined (Figs 9.4–9.6).[24] The simplest method is to draw a radius of a given distance around each site. Bekker-Nielsen, drawing on both Roman literary references and comparative studies of transport in the eighteenth century, gives a maximum figure of 37 km for a day's travel, either by foot, or by pack animal.[25] Given the difficulties of the terrain of Asia, it might be more appropriate to reduce this figure by as much as half. Accordingly, radii of both 18.5 km and 37 km have been plotted (Figs 9.4 and 9.5). The total area covered by these circles can be examined to approximate the amount of territory in Asia surveyed by an urban centre of some kind. Alternatively, a Voronoi diagram, bisecting the distance between each city to produce a pattern of polygons, can be produced to show the theoretical hinterlands of each city (Fig. 9.6).[26] The relationships between these can then be examined.

[23] Calder and Bean 1957; Droyser 1886; Grundy 1904; Hammond 1992; Kiepart undated a and b; Putzgers 1910; Stier *et al.* 1978.

[24] Coordinates were calculated using the *Getty Thesaurus of Geographic Names* for major sites, and manually from the *Barrington Atlas* for the remaining sites. The *Getty Thesaurus* gives accurate coordinates; coordinates from the *Barrington Atlas* are accurate to ± 30 seconds. Topography was generated in *MapInfo*, with Roman roads plotted by the creation of a schematic diagram using coordinates from the *Barrington Atlas* and using relief as a guide, with significant reference to Ramsay 1890 (preferred over French 1974, 1981 simply because *MapInfo* tolerates a single plan better).

[25] Bekker-Nielsen 1989: 30. This gives 37 km in one day of eight hours (19 km in a half-day of four hours) from *comparanda*, compared to the 20–30 Roman miles or 30–45 km covered in literary sources, making 37 km a reasonable estimate.

[26] There is a substantial corpus of archaeological literature dealing with the analysis of spatial patterns that has developed a number of sophisticated methodologies. In this study, buffers and Voronoi diagrams are used to give an immediate impression of the spatial location and territory of sites, and to offer some preliminary considerations in the context of the broader study. Further work to refine this picture will clearly be profitable and is the subject of ongoing work by the author in a more detailed study of the Roman urban system as a single entity.

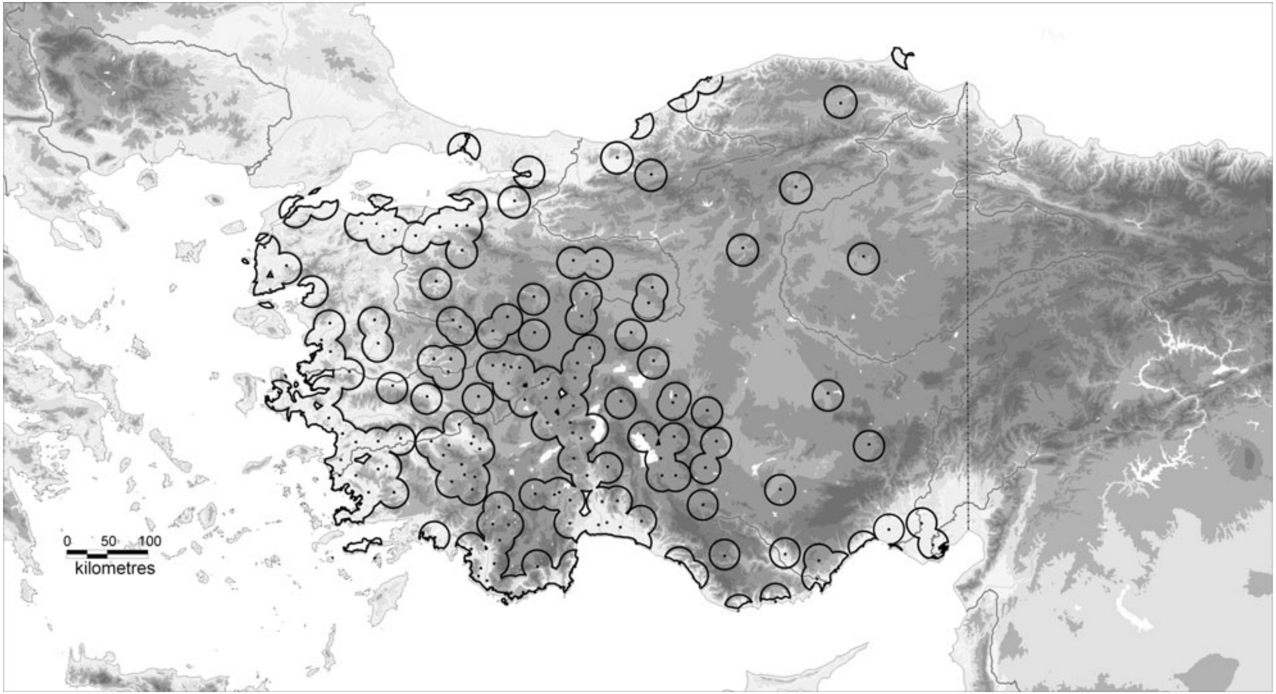

Fig. 9.4. The distribution of sites with aggregated radii of 18.5 km.

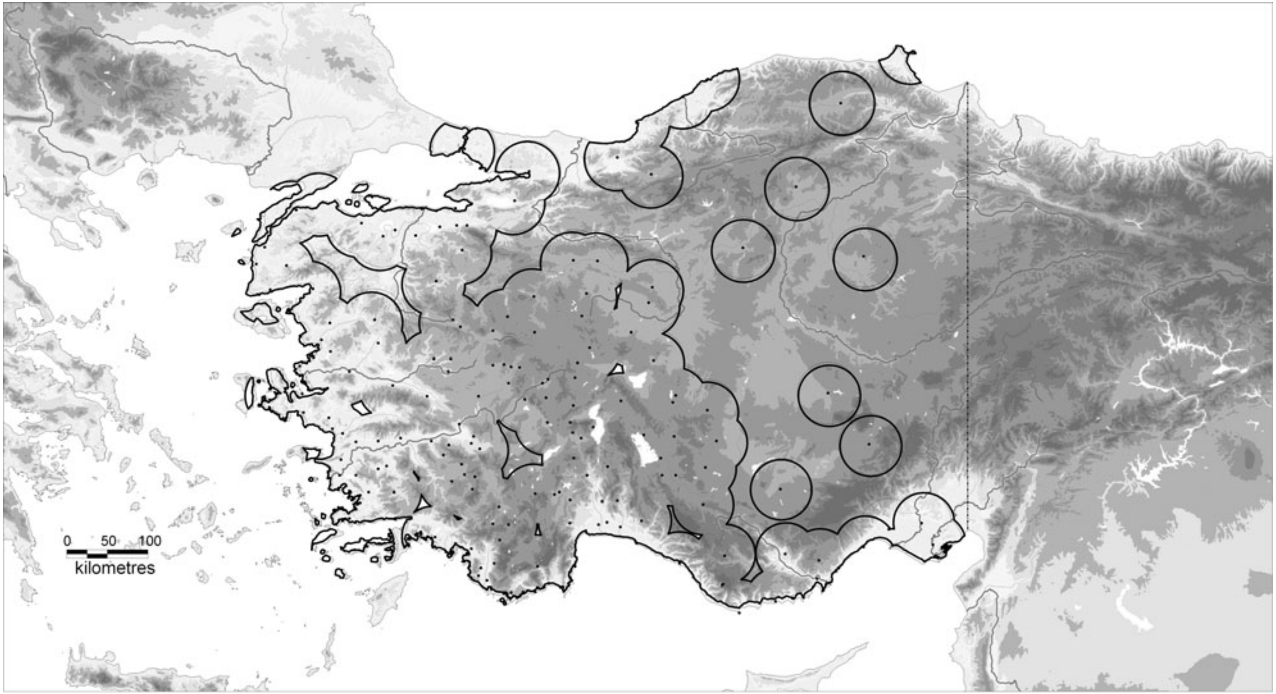

Fig. 9.5. The distribution of sites with aggregated radii of 37 km.

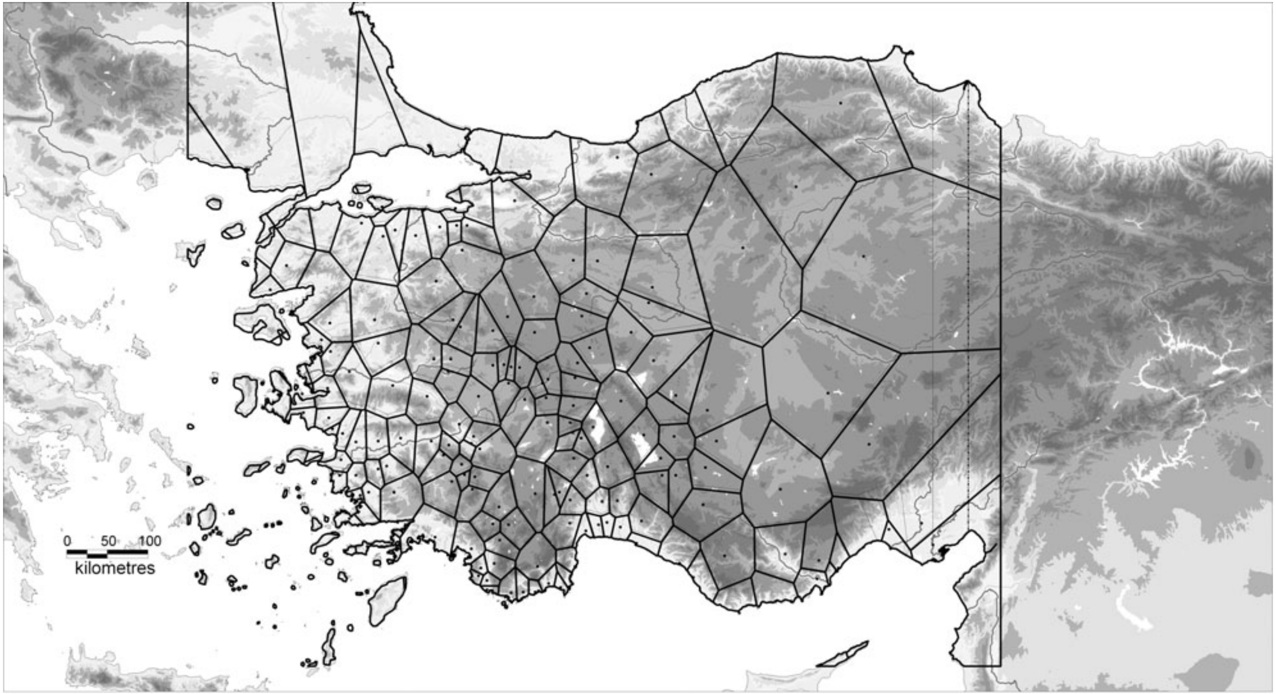

Fig. 9.6. The distribution of sites with a Voronoi diagram overlaid to suggest possible city territories or hinterlands.

In analysing these distributions, we should note a number of important approaches and models. A recurrent starting point is the observation that there are a small number of large cities, a large number of small cities, and some cities that sit in the middle. Since this initial observation, made by Auerbach in 1913,[27] we can see that a number of interpretive models have been developed to explain the size and distribution of urban centres. Those relevant to this study can be divided into two main concepts: central place distribution and primate-city distribution.

In the first of these models, it is argued that, on an isotropic, homogeneous, and unbounded plain, with an even distribution of resources, an even distribution of settlement will result. There will be a small number of large cities, offering high-order goods to a large region and spaced at large distances from one another, and underlying this will be a greater number of small sites, offering low-order goods to a small region, and spaced more closely together. Both orders will be evenly distributed across the territory to serve the whole region, creating a lattice of hexagons or triangles when a Voronoi diagram is created. This distribution results from the trade-off between distance and the profit from sale. Low-order goods will only offer sufficient return over short distances, resulting in a large number of sites over the region, whereas higher-order goods will offer return over longer distances, creating a small number of sites for their marketing. Both products and services can be included among these goods. This is the central place model elaborated by Christaller in 1933 and corroborated by Lösch in the 1940s.[28]

The primate-city model assumes the same conditions and the same consequences as much of central place theory, but it is argued that one city will be a significant order of magnitude greater than the rest of the settlement hierarchy, the largest city being two or three times the size of the second-largest city in the hierarchy. There will be a large number of small cities, dominated by the largest city, and a deficiency in the number of cities of intermediate size. Such is the model proposed by M. Jefferson in 1939.[29] This model is particularly

[27] Marzano, Chapter 8 in this volume.

[28] Christaller 1933; Lösch 1967 (first edn 1946). While commentators have questioned the empirical existence of Christaller's model on the ground, it is nonetheless clear that the model is an extremely useful and informative heuristic tool.

[29] Jefferson 1939.

important given its influence on French scholarship, which identified a phenomenon of '*hypercephalie*', or the growth of a single large city in several pre-industrial and developing countries, with the virtual impoverishment of the remaining region.[30] In contrast to Jefferson's reasonably positive model, the concept of '*hypercephalie*' implies a 'polarised economy',[31] whereby by being plugged into wider systems, one city reaches an extreme level of growth, whereas the countryside remains at a subsistence level or even becomes increasingly impoverished. This is seen as a result of colonial rule or intervention. Given the existence of allegedly very large cities (with up to 225,000 inhabitants) and a colonial backdrop, the model of '*hypercephalie*' might appear to be particularly important for Roman Asia.

From the distribution maps in Figs 9.4–9.7, it is clear that the distribution of sites is heavily weighted to the west and towards the Mediterranean and Rome. Sites occupy the lowland regions of the western and southern shores, the higher regions of the central plateau, and even up to an altitude of 1,500 m above sea level. Although the number of sites at this altitude falls off slightly, relief alone seems to have had a relatively negligible influence. The distribution, however, starts to fall off heavily in the northern and eastern parts of the region, towards Paphlagonia and Cappadocia, where altitude, infertile land, and, crucially, lack of accessibility and distance from the Mediterranean become significant factors. This indicates a general overall pull towards the Mediterranean and towards Rome.

The maps also indicate that a high proportion of Asia is surveyed and controlled by an urban centre of some kind. The sheer number of sites relative to the area of the region is interesting. Dividing the area of the region (*c.* 310,000 km^2) by the number of sites gives an estimate of one city per 1,760 km^2 and a theoretical average radius of 23.7 km.[32] On the basis of Bekker-Nielsen's figures, even with a lower estimate taken for difficult or strenuous relief and terrain, this implies that many sites were easily within a day's travel and that they could have acted as market centres, service centres, and centres of administration and politics. Aelius Aristides' comment about the sheer density of sites,[33] while rhetorical and not necessarily implying

30 Marguérat 1982 and Johnson 1970.
31 Johnson 1970.
32 Numbers are given to three significant figures throughout.
33 Aelius Aristides, *To Rome*: 93–4 (cited at the start of this chapter).

Fig. 9.7. The distribution of sites over relief, river systems, and road networks.

contiguous urbanism (as read by Mitchell[34]), does also suggest the scale to which Asia might have been urbanized in this period and the novelty of the huge increase in urbanism in the region.

The figures arrived at by imposing radii of 18.5 and 37 km seem to support this picture (Figs 9.4 and 9.5). Here the area included by the circles covers some 40.5 per cent of the land in the first case and some 83.7 per cent in the second (*c.* 126,000 km^2 and *c.* 260,000 km^2). The limited increase between applying the first and second radii itself implies a dense and well-distributed settlement pattern—doubling the radius should nearly quadruple the area (a multiplication by 3.98), unless the number of circles that are contiguous with 18.5 km radius is already high and the distribution of sites is already dense. The regions not included within these radii lie at more than 2,000 m above sea level or are situated within Paphlagonia and Cappadocia—the least accessible and least exploited regions. Their inclusion does of course distort the figures given above, reducing the proportion of land surveyed by an urban centre, although to a limited extent. The average intercity distances also support a picture of high levels of control, with a median distance of 24.5 km. Despite the fragmented nature of the region and the limited lines of visibility (Fig. 9.8), most of the region might not be within a line of sight but *is* within a line of communication from an urban centre. This implies a highly controlled and heavily exploited landscape, although again there is a significant Mediterranean bias and a falling off towards the east.

The distribution also demonstrates the importance of connectivity, since a large number of sites lie on points of access (Fig. 9.7), and many (perhaps one-third) lie towards the Mediterranean coast, especially in Ionia, Caria, and Lycia. The comparative lack of sites on the Black Sea is intriguing, suggesting that the urban distribution is not influenced simply by proximity to the sea, but specifically to the Mediterranean, and perhaps Rome. A great number of sites also seem to be positioned on riverine routes, which form the main conduits of access inland, following the Caicus, Hermus, Cayster, and Maeander and their tributaries into the east. Further concentrations are seen on Roman roads, as is clear from Fig. 9.7, which shows three main lines of roads along the north, centre, and south.[35] New colonies were clearly founded along with this network of roads,

[34] Mitchell 1993: 80.
[35] Charlesworth 1924; French 1974, 1981; Winfield 1977.

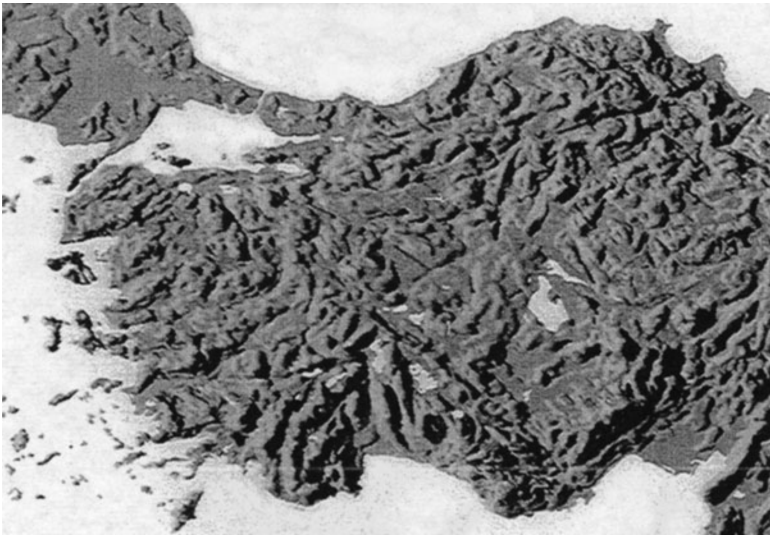

Fig. 9.8. The overall relief of Asia, showing the limited number of lines of visibility and fragmented relief.

Source: (Blanton 2000: Fig. 2.1).

although we can also see a large number of older sites positioned along these routes, suggesting the entwined growth of urban centres and road networks. Only some thirty of the 176 sites examined are not on major road routes, although it must be stated that our knowledge of road networks is far from complete. The cumulative evidence indicates that a strong premium was placed on communication and access, with road and river systems complementing each other.

These systems should be seen as being attached to wider trade routes over land and sea (Fig. 9.7). As Broughton put it, nature seems to have put the western coast of Asia in line with almost all major trade and communication routes.[36] Literary sources also attest the high level of traffic in this period, both within the Mediterranean and within Asia. In particular, an inscription from Hierapolis records a merchant's claim to have rounded Cape Malea in Greece 72 times on journeys to Italy (perhaps 72 single journeys twice a year, or more

[36] Broughton 1938: 857.

likely 36 round trips annually), although there is no evidence for how exceptional this might have been.[37]

The region itself forms an avenue of communication (of people, goods, information, and ideas) between east and west, connecting to wider Mediterranean networks. Following Ramsay's metaphor, we can see the peninsula as a high suspension bridge, running east–west, with high parapets and a rough road surface.[38] Connections are difficult north–south, due to the terrain, lack of riverine routes, and the road system, which follows the former two conditions. East–west lines of access are far easier, creating a kind of tunnel, or conduit between the east and the west. This system seems to have acted as a further extension of the conduit identified by Horden and Purcell in the Mediterranean.[39] Certainly, the iron-filing distribution of sites seems to confirm the idea that Rome can be viewed as a central magnet, pulling sites towards the Mediterranean and creating dendritic networks of communication towards the east. The *Tabula Peutingeriana* might leave us with a striking visual impression of Asia as a conduit between east and west, with Rome at the centre, pointing to high levels of internal and external connectivity.

The Voronoi diagrams (Fig. 9.6) suggest a well-distributed network of sites, with a large number of evenly sized hinterlands and a small range between the smallest and the biggest hinterlands in the centre of the system (Fig. 9.9). Large hinterlands are found only in the less densely urbanised regions of Paphlagonia and Cappadocia, reflecting once more the Mediterranean pull of the system. While including these regions gives a broad range of hinterland sizes from 211 km^2 to 25,800 km^2, the large hinterland of Tabia and a handful of other large hinterlands distort the picture; the mean is a far lower figure of 2,310 km^2, and the median 1,460 km^2. When represented graphically, this information also indicates a well-organized control of the land, corresponding to a relatively even hierarchy, although fairly small hinterlands are most common (Figs 9.9 and 9.10). We might well expect this of a highly organized and intensively exploited landscape.

Underlying this system we should posit a denser network of small sites. The chances of reconstructing a full hierarchy down to the smallest ancient sites are limited, but both a rough calculation and supporting evidence seem to indicate a relatively densely inhabited

[37] Casson 1974: 128.
[38] Ramsay, quoted by Broughton 1938: 599.
[39] Horden and Purcell 2000.

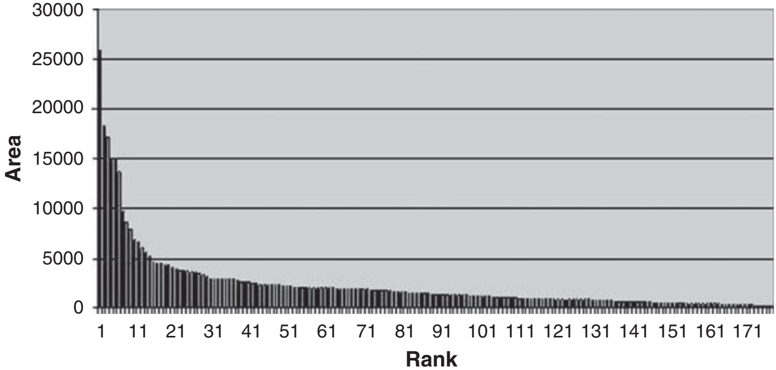

Fig. 9.9. The area (km^2) of theoretical hinterlands when ranked, displaying a relatively narrow inter-quartile range.

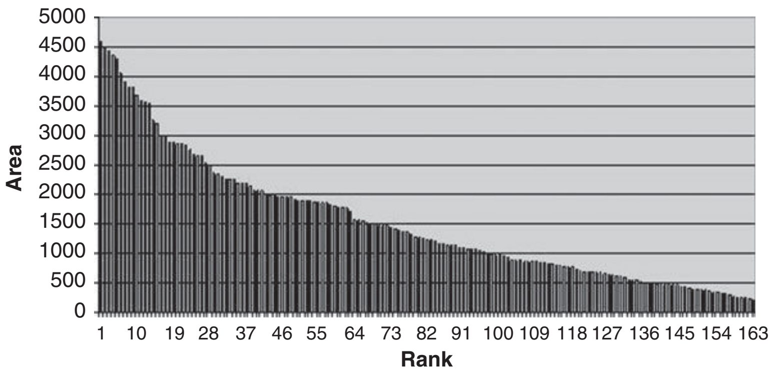

Fig. 9.10. The area (km^2) of theoretical hinterlands of ranks 9–177, removing hinterlands of 5,000 km^2 plus (i.e. those of Paphlagonia and Cappadocia). Rank 9 has become rank 1. The result displays a relatively even hierarchy.

lower order supporting the upper order. A theoretical calculation (subtracting the 173 largest sites from the 1,381 known sites in the *Barrington Atlas* to give small and medium sites) gives an average village or hamlet per 221 km^2, with a radius of 8 km, and surveys of Sagalassos and Cilicia support this figure or imply denser habitation.[40] Systematic field survey might be expected to increase this figure.

[40] Blanton 2000; Vanhaverbeke and Waelkens 2003.

These data illustrate that Roman Asia was both internally and externally well connected. On the one hand, the region is internally well connected since we might imagine that most farmers did not travel far beyond their land or did so only to the nearest urban centre.[41] This is perhaps reflected in the sheer density of sites in the archaeological record. On the other hand, we can also interpret the system as a whole as well organized for the control, administration, and exploitation of the region for the profit of the region and of Rome. It is clear that Roman cities functioned as more than market and service centres and acted as centres for the extraction of taxes, both in kind and in cash, and as centres for the organization and extraction of several forms of wealth.[42] A seldom-cited, but telling, comment of Galen also points to the role of cities as points of extraction of grain, in this case leading to impoverishment and malnutrition in the countryside:

> The city dwellers, as it was their custom to collect and store enough corn for the whole of the next year immediately after the harvest, carried off all the wheat, barley, beans, and lentils, and left to the peasants various kinds of pulse—after taking quite a large proportion of these to the city. After consuming what was left in the course of the winter, the country people had to resort to unhealthy foods in the spring; they ate twigs and shoots of trees and bushes and bulbs and roots of inedible plants . . .[43]

In this, Galen appears to be describing an unusually dire consequence of a regular practice.

It seems clear that there was agricultural surplus with the potential for extraction within Asia. Indeed, as Cicero describes Asia, 'in the richness of its soils, in the variety of its products, in the extent of its pastures, and in the number of its exports, it surpasses all other lands'.[44] As Mitchell notes, it is in the Roman period that we see the changing of agricultural patterns from rough pasture and grazing to settled arable farming, and the increasing exploitation of this land, potentially in parallel with technological change.[45] From literary sources, we can also note the trading of olives and olive oil, figs and other dried fruits, wine, wool and textiles (including dyed wool), hides, timber, metals (especially

[41] Erdkamp 2005.
[42] Mitchell 1993: 256.
[43] Galen, *On good and bad diet*, quoted in Millar 1981: 208.
[44] Cicero, *On Gn. Pompey's Command*: 14.
[45] Mitchell 1993: 245.

copper), marbles, pigments, and fish.[46] Finally, as Mitchell notes, we can also note the importance of grain supply (and especially the supply of grain to the army) at least in the third century from a wealth of epigraphic and numismatic evidence, and in particular the displaying of ears of corn on coins.[47] Further research will no doubt emphasize this picture. In this light, the concentration of sites in the Mediterranean climate of the west and south and the Northern European climate of the north, but not in the arid desert climate of the central plateau, seems to imply a system established for a thoroughgoing exploitation of the land and extraction of agricultural, among other, resources. This might be seen as the effects of Roman colonial exploitation, or equally, if we accept the essentially fractal nature of the Mediterranean, we could see such a phenomenon as a chosen strategy for survival, given the necessity of exchange and redistribution, as well as a choice for basic profit.[48]

The implications of this are important. Rather than seeing a region that is under-populated and under-exploited, save for a number of large cities, which might imply '*hypercephalie*', alongside rural destitution, we can see that the sites are structured in such a way as to correspond to a central place distribution, implying well-distributed control and even exploitation. Compared to other regions of the empire, plotted by Pounds (Fig. 9.1 and Fig. 9.11), the number and distribution of sites is closest to Italy, rather than the less heavily urbanized regions of Spain and Gaul. This implies a high degree of urbanism and a more even distribution of sites relative to other regions of the empire. Although more evidence is required, this might indicate a highly exploited landscape more comparable to the economic experience of North Africa. It certainly seems clear that Asia did not follow the downturn experienced in Greece in the first centuries of Roman rule.[49] If we accept the use of urbanism as a proxy for the economy, such a picture also seems to indicate substantial economic prosperity.

46 This list is derived in essence from Broughton 1938, Magie 1950, and Mitchell 1993, working on Strabo and Cicero. Comparanda with Ottoman Turkey seem to support this. For metals see De Jesus 1978.

47 Mitchell 1999: 426–7.

48 Horden and Purcell 2000.

49 Alcock 1993.

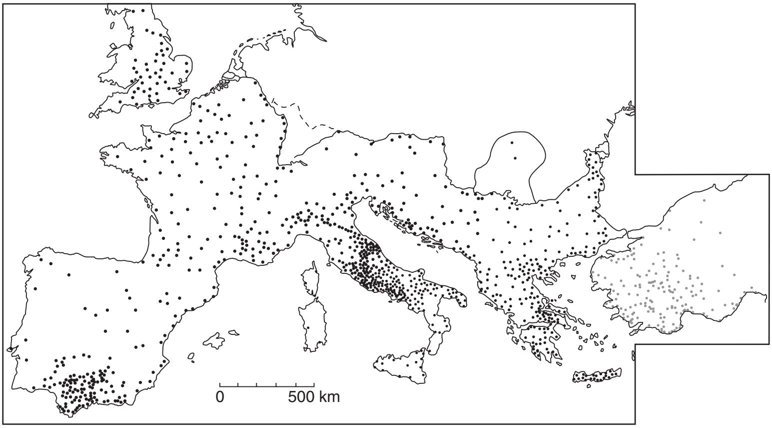

Fig. 9.11. The distribution of sites in Asia overlaid on Pounds' map.

SITE POPULATION SIZES, DISTRIBUTION, AND ANALYSIS

The size of cities is important in examining the level of urban connectivity, since above a certain population threshold a city will rely on contacts for its sustenance and prosperity. Previous estimates have gauged a handful of cities at above 200,000 and postulated an average city size of 5,000.[50] If a correlation can be detected between large cities (where scale is used as a measure of prosperity) and situation on points of connectivity, this would indicate the importance of connectivity and links to the Roman empire within the settlement system of Asia.

There is a substantial corpus of scholarship, from Beloch onwards, aimed at calculating ancient populations and a wide range of methods for doing this. However, as Wilson notes in Chapter 7 of this volume, the most productive estimates originate from a definition of the area involved and then the application of sensible population densities (Beloch's original method, in fact). Ancient sources are notoriously difficult to interpret, especially since children, women, and slaves are not counted (indeed, the very economically dependent population that we are interested in). Such sources have a variable, alien, and not fully understood definition of a city limit, and often fail to define

[50] Mitchell 1993: 242.

areas, or define them very loosely. Rhetorical and 'patriotic' considerations may also affect such figures. As Wilson notes in this volume, there are similar problems with the use of civic facilities, water supply, and so on.[51] Despite the inherent problems, the application of estimates of population density ranges to city areas seems the least inaccurate available method.

The area of a city can be worked out with relative ease, being calculated by computer program from a scanned plan.[52] Although a low threshold of error is introduced by the user in selecting the scale, the main difficulty lies in the definition of the area. In the following, various estimates were arrived at using the area circuited by walls, the area on which a street grid had been imposed, and archaeological remains (particularly where a survey has been executed). It is clear, however, that wall circuits do not always reflect the true inhabited area, either taking a broad circumference (as at Ephesus) or excluding further inhabited space (as with the Aurelian walls of Rome). Grids are not always fully inhabited and archaeological remains do not reflect the sum of what was there. The extent of excavation or survey also has serious implications, particularly with older excavations. However, tombs, amphitheatres, and stadia, as well as topography, can give a reasonable maximum extent from which to extrapolate, although it is wise to note the case of Ostia, which clearly outgrew its extramural cemeteries. A calculation of area derived from the archaeology itself, as opposed to estimates based on literary sources, does, however, give a concrete figure whose basis can be established and which can be checked or submitted to later scrutiny.

Since scaled and accurate plans are required for this method, the area could not be calculated for all the sites, and therefore a population could not be estimated for all the sites under consideration. Although a number of sources give plans, for a calculation of area a scale is

51 Wilson, Chapter 7 in this volume.

52 For this chapter, the program *Takeoff Live* was used. The user sets the scale by selecting either end of the scale bar on the plan and by telling the program the distance selected. The user can then define a polygon following the city limits, whose area is calculated by the program. The accuracy of this method is largely determined by the accuracy of the plan and the quality of its scale bar, and the number of points the user clicks to define the boundary of the area to be measured. While higher resolution plans are more accurate since they are larger, making the scale bar more legible, a plan scanned from A4 at a resolution of 300 DPI will give an error, when checked manually, of less than 1 per cent.

required, which is lacking in many publications. Given this flaw, most archaeological guides could not be used as a source for plans, most notably Akurgal's *Ancient Civilisations and Ruins of Turkey*.[53]

A broad population density range of 100 to 400 people per hectare will be used, with a refined range of 150 to 250. The former range represents the absolute likely minimum and maximum, and the latter the probable range of population density. The broader range can be said to incorporate a realistic absolute margin when compared to other pre-industrial societies with similar scales of economic and social development, and is identical to the range arrived at by Mols in his investigation of population in Europe between the fourteenth and eighteenth centuries.[54] Basic factors of human geography and anthropology also support this range. The narrower range corresponds more precisely to estimates of the population density of Roman cities. This is based on the work of the Oxford Roman Economy Project and is derived from estimates of the areas, densities, and populations of several Roman cities, including Pompeii and several North African cities and the work of Engels on Corinth.[55] These ranges are applicable to an entire city, including uninhabitable space such as roads and public and civic space (which generally can be estimated at roughly 12.5 per cent), and take account of the vertical axis of the city in terms of potential multiple storeys. The advantage of these ranges is that they should give a more realistic estimation of the population, while also displaying potential error and margins. Using this method, the area of sites with available accurate and scaled plans can be calculated to give the population ranges in Table 9.1 and Figs 9.13 and 9.14. The largest sites (above 50 ha) can then be plotted on a distribution map over relief, river systems, and road networks (Fig. 9.12).

These area-based estimates call a number of long-held views in the existing literature into question regarding the population of the larger cities in Asia (and in particular the figures given in the *Economic Survey*).[56] The population of Pergamum has been estimated on the basis of a remark by Galen to the effect that 'if... our citizens amount to as many as 40,000, likewise if you add their wives and slaves, you will find yourself admitting that you are richer than

[53] Akurgal 2002. [54] Mols 1954–6.
[55] Wilson, Chapter 7 in this volume; Engels 1990.
[56] Broughton 1938.

120,000 people'.[57] If we follow Broughton and assume 'an average of two children per adult citizen', we would reach a total population of 'about 200,000'.[58] Radt, however, prefers to estimate a population of around 160,000, growing from 25,000–40,000 in the Attalid period.[59] Broughton states that Cyzicus can be estimated at something like 200,000, but this is based only on the speculation that it was not far behind Pergamum in size.[60] The population of Ephesus has been estimated at 225,000; however, this figure is based predominantly on Beloch's comparison of the areas of Alexandria and Ephesus, using the 'known' population of Alexandria to suggest an estimate for Ephesus.[61] Interestingly, Broughton notes that this figure could be expanded further given the large extent of Ephesian territory. The figure of 225,000 is supposedly supported by the epigraphic evidence that Aurelius Barenus entertained 40,000 adult male citizens, since if women, slaves, and children were to be factored in we might arrive at a similar order of magnitude.[62] This figure is, however, a mistranslation of the inscription honouring Barenus which, as Warden and Bagnall point out, refers to only 1,040 citizens, not 40,000.[63] Moreover, the theatre is estimated to contain barely 25,000. Wiegand estimated Miletus to have contained some 100,000 people, based on grain allowances (a foundation of 30 talents is thought to have supplied 9,000 portions of grain at six *hemihecti* per person; he extrapolates from this making allowances for families, slaves, etc.).[64] Finally, the populations of Side and Smyrna have been estimated at 12,000 and 200,000 respectively,[65] based on the sizes of their theatres, although the population of Smyrna is scaled up artificially based on comparison with Pergamum. No estimates for the population of the other sites could be found.

[57] Galen, *On the Natural Faculties*: V.49, Kuhn, quoted in Broughton 1938: 812–13, *εἵπερ οὖν ἥμιν οἵ πολιται πρὸς τοὺς τετρακισμυρίους εἰσίν, ὅμου ἐὰν προσθῃς αὐτων τὰς γυναικας καὶ τοὺς δούλους, εὑρήσεις σεαυτὸν δουκαίδεκα μυριάδων ἀνθρώπων οὐκ ἀρνούμενον εἰναι πλουσιώτερον.*

[58] Broughton 1938: 813.

[59] Radt 1999: 175.

[60] Broughton 1938: 815.

[61] Beloch, quoted in Broughton 1938: 813.

[62] *Inschriften von Ephesus* 951; Broughton 1938: 813.

[63] Warden and Bagnall 1988; cf. Price, Chapter 2 in this volume.

[64] Wiegand, quoted in Broughton 1938: 813.

[65] Ibid.: 813–14, 816.

Table 9.1. The areas and estimated populations of the sites that have published city plans.

City	Area (ha.)	Population at 100/ha.	Population at 150/ha.	Population at 250/ha.	Population at 400/ha.
Sardis	356	35,600	53,400	89,000	142,400
(Col. Augusta) Alexandria Troas / Antigoneia	278	27,800	41,700	69,500	111,200
Ephesus	224	22,400	33,600	56,000	89,600
Pergamum	219	21,900	32,850	54,750	87,600
Halicarnassus	174	17,400	26,100	43,500	69,600
Cyzicus	168	16,800	25,200	42,000	67,200
Nicaea	159	15,900	23,850	39,750	63,600
Clazomenae	117	11,700	17,550	29,250	46,800
Heraclea ad Latmum / Pleistarcheia	99	9,900	14,850	24,750	39,600
Miletus	97	9,700	14,550	24,250	38,800
Cnidus	93	9,300	13,950	23,250	37,200
Aphrodisias / Ninoe	90	9,000	13,500	22,500	36,000
Laodiceia ad Lycum / Dispolis / Roas	89	8,900	13,350	22,250	35,600
Heraclea (Pontica)	78	7,800	11,700	19,500	31,200
Amorium	63	6,300	9,450	15,750	25,200
Selge	59	5,900	8,850	14,750	23,600
Nysa / Athymbra	56	5,600	8,400	14,000	22,400
Hierapolis	49	4,900	7,350	12,250	19,600
Seleucia ad Calycadnum / Tracheia	43	4,300	6,450	10,750	17,200
Col. Caesarea / Antiochia	42	4,200	6,300	10,500	16,800
Aspendus / Primoupolis	40	4,000	6,000	10,000	16,000
Cremna / Col. Iulia Augusta Felix	39	3,900	5,850	9,750	15,600
Side	39	3,900	5,850	9,750	15,600
Iasos	34	3,400	5,100	8,500	13,600
Alinda / Alexandria ad Latmum	26	2,600	3,900	6,500	10,400

Elaiussa / Sebaste	26	2,600	3,900	6,500	10,400
Perge	26	2,600	3,900	6,500	10,400
Pinara	22	2,200	3,300	5,500	8,800
Sillyum	21	2,100	3,150	5,250	8,400
Sagalassus	20	2,000	3,000	5,000	8,000
Termessus	19	1,900	2,850	4,750	7,600
Xanthos	18	1,800	2,700	4,500	7,200
Oenoanda / Termessus Mikra	17	1,700	2,550	4,250	6,800
Tlos	16	1,600	2,400	4,000	6,400
Diocaesareia	14	1,400	2,100	3,500	5,600
Ariassos	11	1,100	1,650	2,750	4,400
Metropolis	8	800	1,200	2,000	3,200
Cyme	8	800	1,200	2,000	3,200
Arycanda	7	700	1,050	1,750	2,800

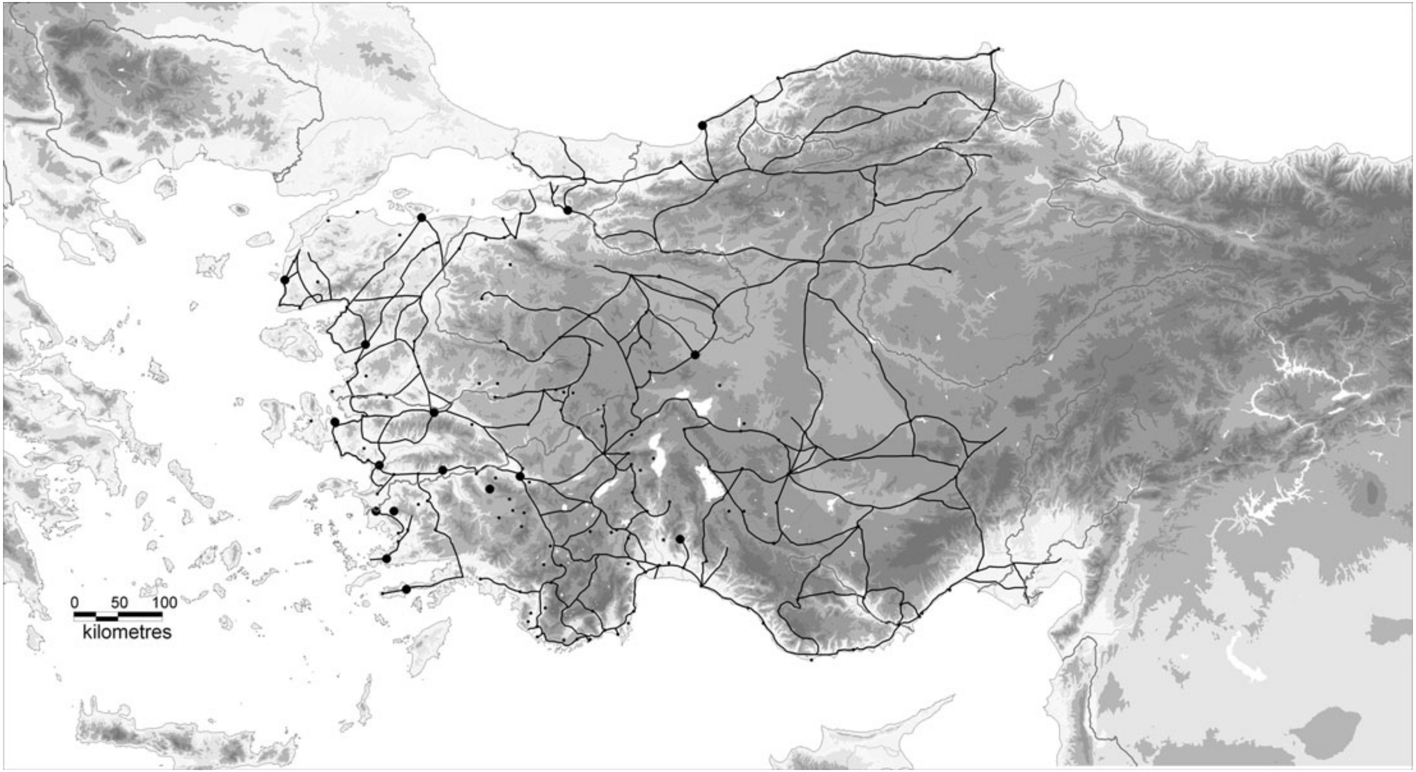

Fig. 9.12. The distribution of larger sites over relief and communication routes such as river systems and road networks. Sites of 50 hectares or more are marked with a larger dot.

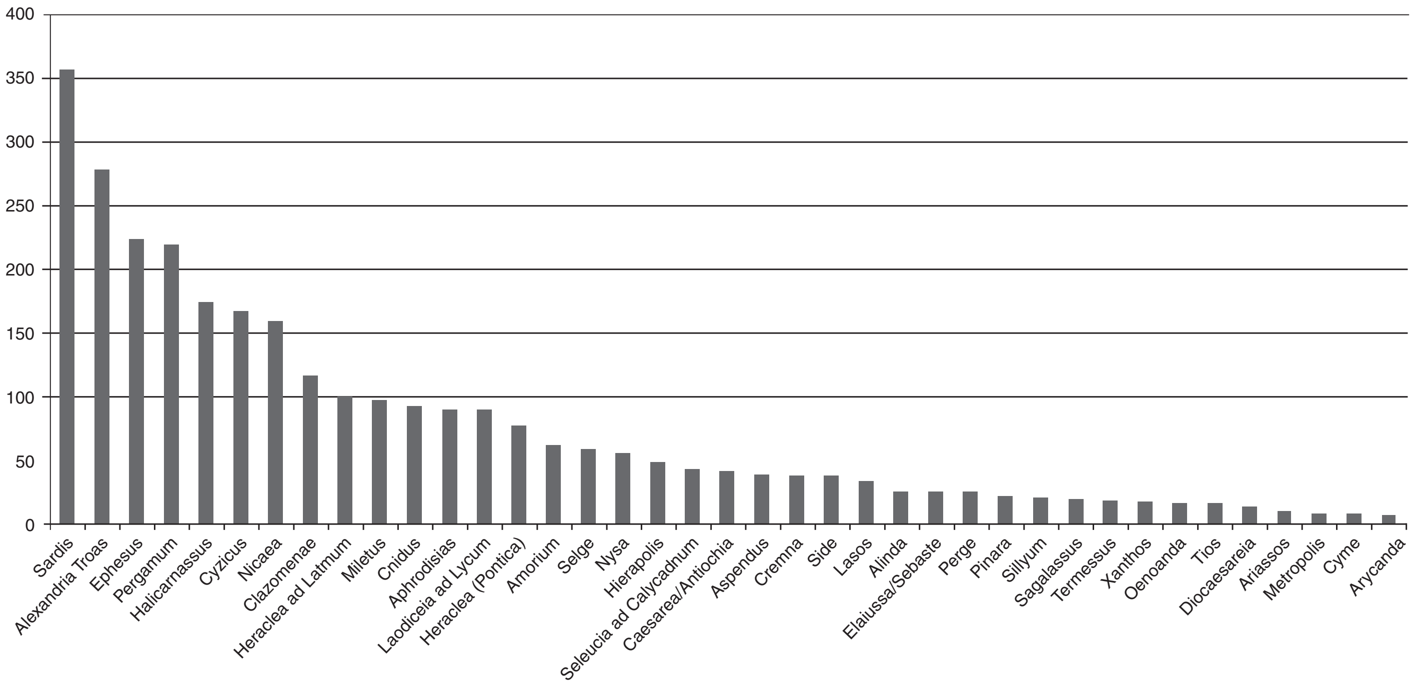

Fig. 9.13. The estimated areas of the selected cities.

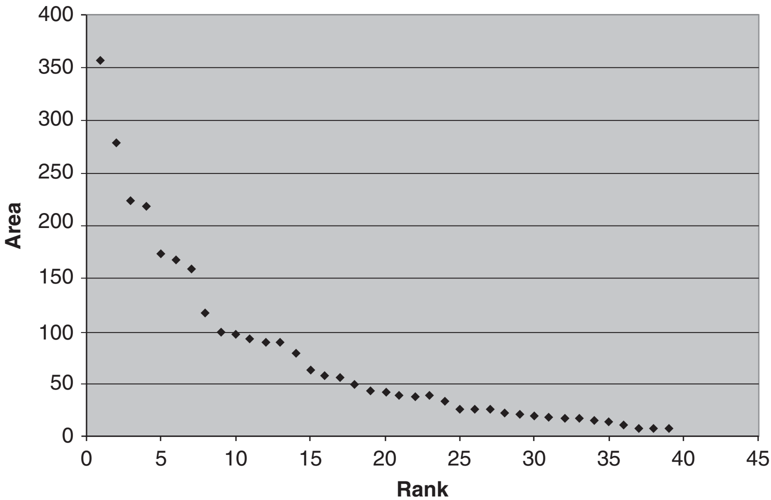

Fig. 9.14. A linear graph to show rank of selected cities against area.

The area-based estimates reduce these figures to smaller but more realistic scales. Far from seeing populations of up to 225,000 in the case of Pergamum, Ephesus, and Smyrna, we can in fact reduce these figures to a probable range with a minimum of 50,000 and a maximum of 90,000.[66] At Pergamum, previous estimates would call for over 900 people per hectare within the city (a density only known in modern cities), or would require really quite substantial extramural habitation. At Ephesus, such estimates are clearly not possible, since the scope for extramural settlement is limited by the inland mountain range, the ancient coastline, and the region's quarries; even allowing for some suburban settlement, the total population figure could not be increased to anything like estimates of 225,000.

Nevertheless, the scale even of these figures indicates quite certainly that such cities would have to look beyond their immediate hinterlands and must have relied on wider contacts, since a farmer will on average travel only 4–6 km between his land and a city. This gives a maximum area of land connected to the city that could simply not support sites of this scale. Moreover, the largest sites of this hierarchy (50 ha or more) lie on nodal points and lines of access (Fig. 9.12). Of the seventeen sites plotted, six lie on the coast and four within immediate

[66] Ibid.: 812; Magie 1950: 585; Mitchell 1993: 244; above.

proximity, and a further two lie on river networks close to the coast. All (bar one site) are situated on major road networks. This is most of all evidenced by Sardis, Ephesus, and Alexandria Troas, all of which act as nodal points between road systems from the east and maritime routes to the south and west. The picture would almost certainly be reinforced by further study of sites such as Nicomedia, Ancyra, and Sinope, for which plans could not be accessed. Based on literary and secondary descriptions of the sites, it is most likely that these sites would have had large populations. The position and size of all of these sites, as ports or major nodes on road networks, thus also indicates the importance of connectivity, both to sustain large sites and as potential reasons for their prosperity.

THE SETTLEMENT HIERARCHY AND A RANK-SIZE ANALYSIS

A rank-size analysis of the hierarchy of sites, using their area as a proxy for population, can also be used to explore the level of integration of the hierarchy and to identify the pooling or partitioning of systems. This study responds directly to the use of the method by Marzano (Chapter 8 in this volume) for cities in Britain and Spain, and largely follows her methodology.

According to Zipf's law, otherwise known as the rank-size rule, 'when ranks of cities, arranged in descending order, are plotted against their populations (rank 1 being given to the largest, and so on) in a doubly logarithmic graph, a rank-size distribution results'.[67] This will in theory give a straight line, indicating that the size or population of cities when ranked is inversely proportional to their rank, and that the product of their size or population and rank is constant. By examining deviation from this line, various inferences can be drawn about the nature of the urbanism of the region.

While the existing literature on the subject is complex and interpretations are often at variance despite being derived from the same data, in general the following interpretations are accepted. A straight line (log-normality) is interpreted as 'normal'—an even settlement

[67] Dziewonski 1972: 73.

hierarchy, with a small number of large cities and a large number of small cities, with a fair number of intermediate cities in between.[68] Zipf interprets this as reflecting an even balance between the forces of unification and diversification. If, however, a concave deviation is displayed, the hierarchy is said to be primate.[69] Here there is more emphasis on the forces of unification, leading to a pooling of resources in one city. This would indicate a complete settlement system with a leading central city, dominant over the rest of the territory.[70] This can be related to the ideas of '*hypercephalie*' noted above. If a convex distribution is displayed, this may be seen as the forces of diversification acting on the system, pointing to low levels of system integration. However, it has also been noted that such a distribution can also be the result of excluding the primate centre from the distribution, or the result of system partitioning, where only one part of a wider system, and in particular the periphery of a system, is examined. On the other hand such a system can also be interpreted as the result of system pooling, where several urban systems are mistakenly grouped as one.[71]

The available dataset for Asia represents a limited number of sites and will not form a complete hierarchy, since (as stated), we are limited by the availability of accurate and scaled plans from which area figures can be derived. A greater number of plans would result in greater accuracy, but currently this is simply not possible. Without a full hierarchy we can only make the best of matters and so all available plans have been used. This chapter also follows Marzano in assuming that area can be taken as a proxy for population.[72] Given that our populations have been derived as a product of our area, to use population estimates for rank-size analysis would produce the same spread, only multiplied and at a higher range. The question is, of course, whether a stable population density can be assumed throughout the hierarchy.

When ranked and plotted against their size, the sites being studied seem to represent a convex deviation from the line given by Zipf's law (Fig. 9.15). The resultant distribution might be a consequence of applying a fixed population density to a set of sites that might have varying

[68] Berry 1961.
[69] Savage 1997.
[70] Linsky 1965.
[71] Savage 1997.
[72] Marzano, Chapter 8, this volume.

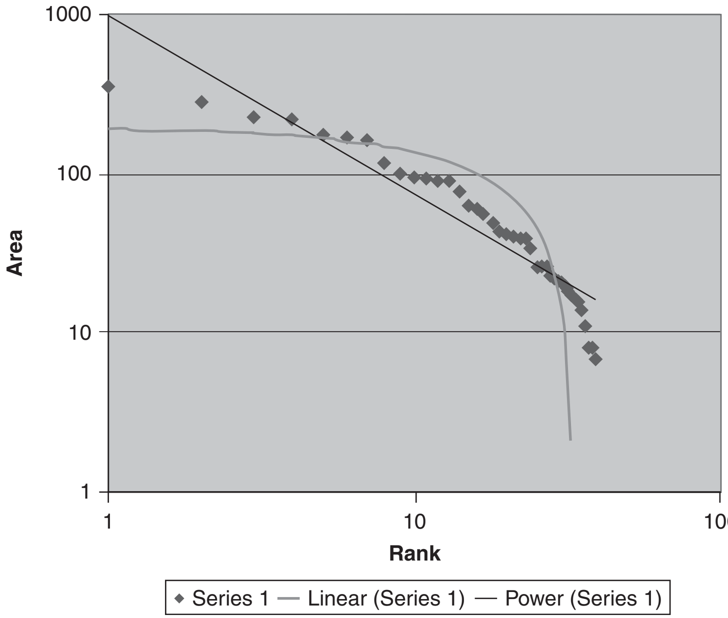

Fig. 9.15. A doubly logarithmic graph to show rank of selected cities against area, with linear and power trend-lines.

population densities. In this case, it is important to explore the possibilities of differing densities across the hierarchy. Larger sites might well be given greater densities (they should be larger than we expect), medium sites smaller densities (the inverse), or a combination of the two. This might affect the distribution sufficiently to return it to the theoretical line given by Zipf's law. To test this, the data were re-plotted with varying ranges, including the probable range of 100–400 people per hectare and a highly improbable range of 100–1,000 people per hectare. Fig. 9.16 shows a decreasing scale from largest to smallest city of 1,000 to 100 people per hectare, Fig. 9.17 the inverse (from largest to smallest, of 100 to 1,000 people per hectare), and Figs 9.18 and 9.19 the consequence of using first the mean and second the median and assigning to both a population density of 1,000 people per hectare, decreasing towards 100 at the largest and smallest sites. These figures indicate that adjusting the range does not account for the nature of the original distribution, since a similar concave distribution is detected even when applying highly improbable ranges, although the effect is lessened. It must be stressed that, since the plot is logarithmic, increasingly large

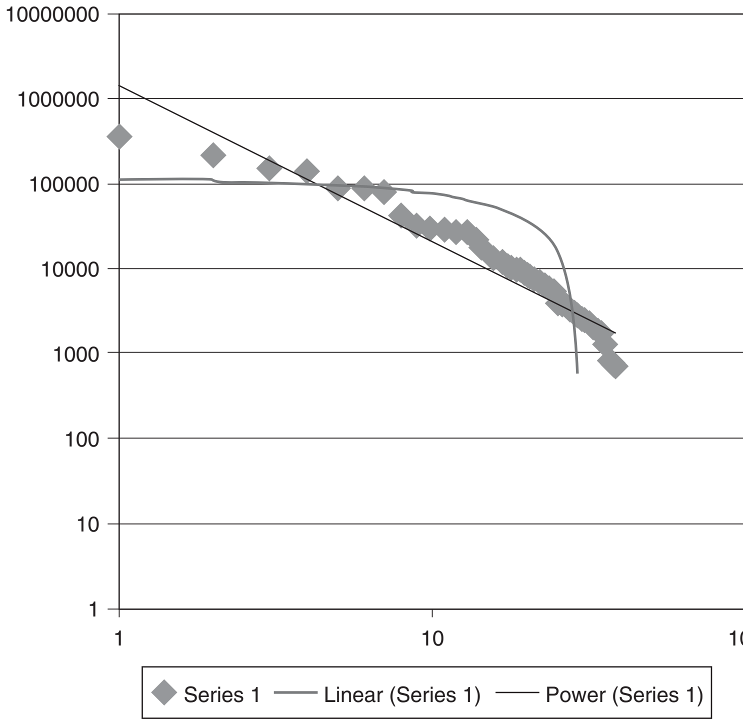

Fig. 9.16. A doubly logarithmic graph to show rank of selected cities against estimated population, applying a sliding population density from 1,000 to 100/ha from greatest to smallest, with linear and power trend-lines.

population densities at the upper end of the hierarchy would need to be postulated to return the line to Zipf's law, particularly with the largest sites, which we would expect to be semi-primate. Since it is clear that higher figures cannot be accepted on a purely intuitive level, let alone taking into account the anthropological and archaeological reasons for the ranges given above, the concavity of the distribution must be a reality, rather than a factor of differing population ranges across the dataset. What is more, the peculiar distributions seen in Figs 9.18 and 9.19 seem to indicate that relatively discrete and fixed population density ranges are more probable. Although area cannot be taken as a direct proxy for population, the substitution can be said to have a relatively negligible effect. The concave nature of the distribution can thus be accepted as genuine.

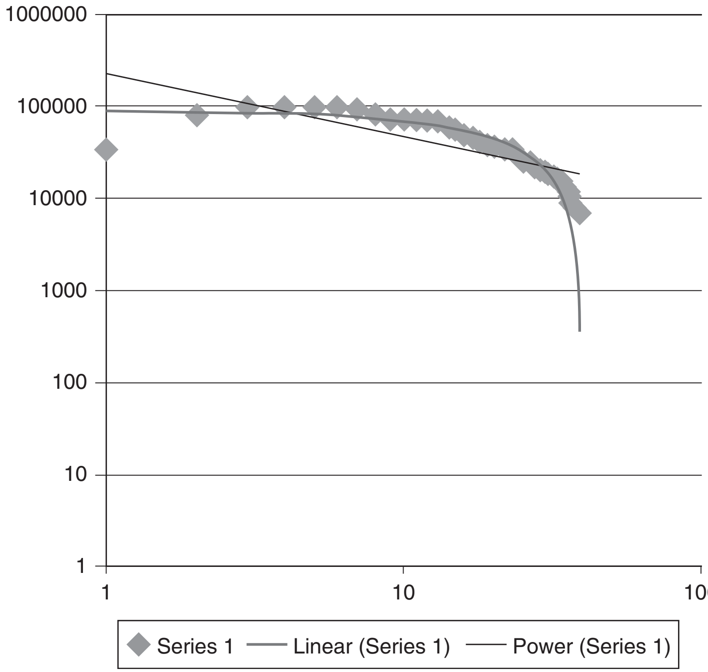

Fig. 9.17. A doubly logarithmic graph to show rank of selected cities against estimated population, applying a sliding population density from 100 to 1,000/ha from greatest to smallest, with linear and power trend-lines.

Accepting this, such a distribution could be interpreted either as system pooling (if the intermediate sites are larger than we would assume), or system partitioning (if the largest site is not of the scale that we would assume). The favoured hypothesis is that such a distribution is the result of system partitioning. The preceding analysis has shown the strong bias of sites towards the Mediterranean and the distribution of sites on nodal points and points of access. This seems to indicate that the urban system of Roman Asia looks towards the wider Roman empire and should be seen as part of a pan-Mediterranean system, part of the highly integrated and highly connected administrative and political system created by the Roman empire. It would also be extremely unlikely that such a distribution were the result of several independent systems being pooled, since central place theory dictates that it is unlikely for sites to be grouped together in the way found (and particularly with the observed coastal

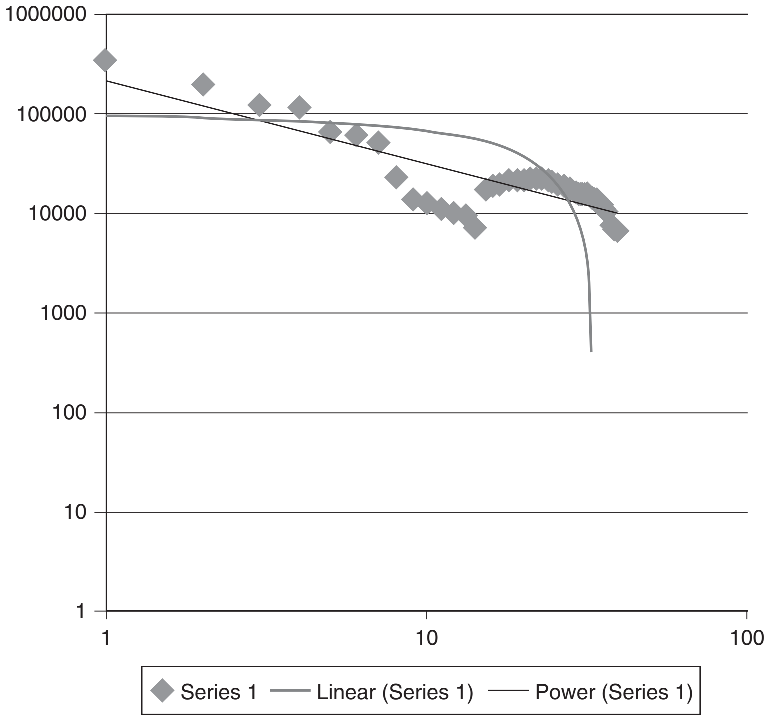

Fig. 9.18. A doubly logarithmic graph to show rank of selected cities against estimated population, applying a sliding population density from 100 at the mean to 1,000/ha at the greatest and smallest, with linear and power trendlines.

bias), unless they are part of a single system. Such an interpretation is also in line with Marzano's interpretation for Britain and Spain, based on two regions and a larger dataset. The hierarchy is also certainly far from primate, consonant with the exclusion of a capital (i.e. Rome) from the dataset. Interestingly, this refutes the possibility of '*hypercephalie*' and rural destitution, and points to a relatively healthy settlement hierarchy, but lacking a primate centre. In conclusion, then, the nature of the hierarchy should best be interpreted as the effect of system partitioning.

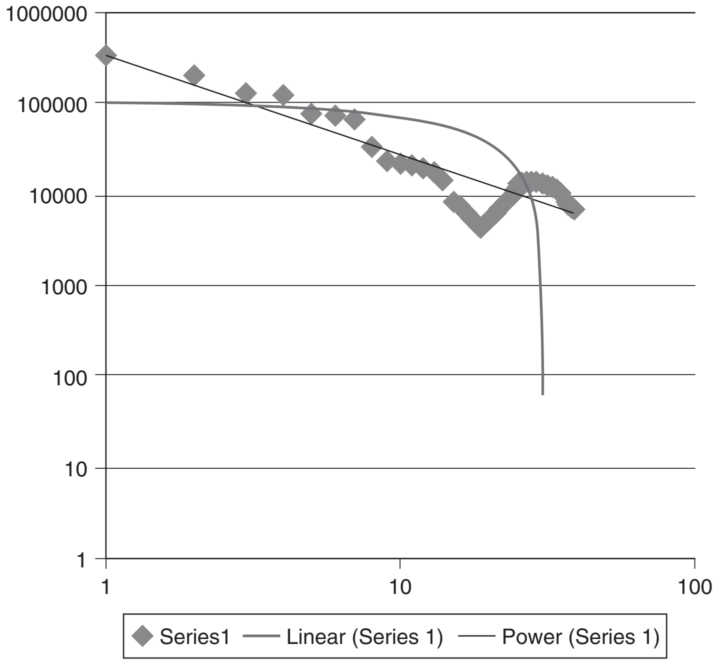

Fig. 9.19. A doubly logarithmic graph to show rank of selected cities against estimated population, applying a sliding population density from 100 at the median to 1,000/ha at the greatest and smallest, with linear and power trendlines.

CONCLUSION: THE URBAN SYSTEM AND URBAN CONNECTIVITY

The distribution of urban sites indicates that a large proportion of Roman Asia was surveyed and controlled by urban centres, fairly evenly distributed across relief, but not across space, becoming sparser in the central plateau and east. The dense clustering of cities seems to reduce the span of control of individual cities within the region considerably, resulting in an average intercity distance of 24.5 km. Supporting this is a far denser network of agricultural sites. This arrangement seems to tally reasonably precisely with central place theory, since sites seem to have functioned as nodes of control (military and political) and as centres of administration and justice, as well as service centres. In addition, while most of the agricultural wealth of the region must have remained local, we can also postulate a thoroughgoing system for the exploitation of agricultural wealth in the form of taxes in monies or kind or in the form of agricultural surplus, and the extraction of a number of other resources. Road and riverine networks integrate this system all the more fully and allow for extraction. This reveals a good degree of basic urban connectivity and integration, emphasized by higher urban densities located in areas with good road and river access.

This system of exploitation within Asia seems to have been extremely well connected to the rest of the Roman empire. There is a basic weighting of sites towards Rome, with a larger number of sites along the western and southern shores compared to Cappadocia. The natural positioning of sites is distorted, pulling them away from a classical, even, central place theory distribution towards a distribution focused towards Rome. In addition to this, the position of sites on access routes, which tend to lead east–west towards the Mediterranean, also seems to confirm high levels of connectivity and integration with Rome. In general, the region functions as a conduit running east–west. While analysis of the population size and distribution of sites has reduced the estimated population of a number of the larger sites from estimates of as high as 225,000 to more realistic figures, nevertheless the population estimates for these sites (up to 40,000–90,000) still indicate their reliance on wider contacts. Indeed, the position of large sites on lines of communication formed by rivers and by roads, or along the coast, seems to indicate that they flourished as a result of the new opportunities provided by Rome and relied on the connections provided by her empire.

Finally, an analysis of the settlement hierarchy and its rank-size relationship also indicates that the system should not be viewed as an isolated entity and that the sample is only one part of a larger pan-Mediterranean system headed by Rome. Although conflicting views are present as to whether convex deviations represent system pooling or partitioning, it seems unlikely that more than one urban system could have been in operation within Asia during the Roman empire, discounting system pooling. The evidence presented above, and the analogy with Marzano's study of Britain and Spain, also seems to suggest the integration of Asia with wider networks.[73] The deviation of the hierarchy from log-normality is thus taken as an indication of system

[73] Marzano, Chapter 8 in this volume.

partitioning, with the exclusion of a primate centre, and thus as an indication of the high level of integration and connectivity between Asia and the wider Roman empire. In this context, the recent evidence of the Ephesus Customs Law might well be brought to bear as a further piece of evidence for the social, political, and legal connections between Asia and Rome, and for Asia's own level of integration.[74]

In this light, Aristides seems to have been quite correct in ascribing to Rome the changes being made to the urban system of Asia. With the coming of Rome, a system based on the (largely) self-sufficient *polis* appears to have broken down in favour of new connections offered by Rome and her empire, leading to settlement nucleation, urban growth, and the rise of a number of fairly large sites. As Rostovtzeff noted long ago, with the coming of Rome came new opportunities, based on the unification, peace, safety on the seas, roads, and new markets Rome offered.[75] Recent scholarship has returned to support many of these statements, pointing in addition to the availability of travel, the distribution of ceramics, and the integrative forces of money and taxation.[76] Temin has also made a claim for an integrated market economy.[77] Set in this context, the changing nature of the urban system of Asia appears to be a favourable response to the opportunities offered by Rome. While it is not clear (without further research) to what extent Asia produced for the Roman market, and while it is unlikely that Asia ever produced the quantities of grain or oil for export produced by Egypt or Africa, the evidence does seems to indicate the importance of a number of important products that might have been circulated within the Roman economy (see above)—perhaps most notably agricultural produce and raw materials and minerals. It is certainly clear that Asia managed to escape the relative decline experienced in Greece as a result of Roman rule and seems on the contrary to have reached high levels of prosperity, especially if levels of urbanism can be taken as a proxy for economic prosperity. The preceding analysis of site distribution, population estimates, and hierarchy analysis thus indicates quite clearly that Roman Asia was not only well connected with and integrated into the Roman empire, her 'suburb', as Aristides has it;

[74] Cottier *et al.* 2008.
[75] Rostovtzeff 1957: 66.
[76] Laurence 1998; Paterson 1998; Peacock and Williams 1986; Hopkins 1980.
[77] Temin 2001.

but that the region also responded favourably to the opportunities offered by Rome, leading to substantial urban growth and economic prosperity, emphasized by the sheer numbers and sizes of her cities.

ACKNOWLEDGEMENTS

This chapter would not have been possible without the help of a great many people. In particular I would like to express my gratitude to Professor Andrew Wilson for his supervision of the dissertation from which this study arises, to Dr Annalisa Marzano for her help with rank-size analysis, and to Nigel James and the staff of the Bodleian Map Room for their patient help with mapping. A more general note of gratitude is also owed to my parents and friends.

APPENDIX: CATALOGUE OF URBAN SITES IN ROMAN ASIA MINOR

A list of sites in Asia Minor of ranks 2 and 3 in the *Barrington Atlas* (rank 2 is shown in bold), totalling 176 sites. Coordinates are given in degrees:minutes:seconds, to an accuracy of ±30 seconds. More detailed data are currently being compiled by the author and the OXREP.

Site	Eastings	Northings
(Col. Augusta) Alexandria Troas / Antigoneia	26:09:00E	39:46:00N
(Col. Iulia Augusta Felix) Germa	31:37:00E	39:31:00N
Acmonia	29:47:00E	38:39:30N
Adada	31:00:00E	37:35:30N
Adana	35:20:00E	36:59:00N
Adramyttium	26:56:00E	39:30:00N
Aegae	27:10:30E	38:49:30N
Aezanis	29:37:00E	39:12:00N
Alabanda / Antiocheia Chrysaoron	27:57:00E	37:36:00N
Alinda / Alexandria ad Latmum	27:50:00E	37:34:00N
Amastris	32:22:00E	41:45:00N
Amblada	31:45:00E	37:30:00N
Amorium	31:19:30E	39:02:00N

Ancyra	32:52:00E	39:56:30N
Ancyra	28:52:00E	39:10:00N
Anemourium	32:49:00E	36:01:00N
Antiocheia ad Maeandrum	28:34:00E	37:52:00N
Apameia / Kelainai / Kibotos	30:10:00E	38:04:00N
Apameia / Myrleia / Col. Iulia Concordia / Brylleion	28:54:00E	40:22:00N
Aphrodisias / Ninoe	28:44:00E	37:43:00N
Apollonia / Mordiaion / Sozopolis	30:29:00E	38:04:00N
Apollonia ad Rhyndacum	28:41:00E	40:10:00N
Apollonia Salbakes	29:01:30E	37:30:20N
Appia	29:59:30E	39:02:00N
Ariassos	30:29:00E	37:14:00N
Arycanda	30:02:00E	36:31:00N
Aspendus / Primoupolis	31:10:30E	36:56:30N
Assus	26:20:30E	39:29:30N
Attaleia	30:42:00E	36:54:00N
Attuda	28:48:30E	37:49:30N
Bagis	29:40:00E	38:40:00N
Balbura	29:38:00E	36:58:00N
Bargylia	27:35:00E	37:12:00N
Blaundus	29:13:00E	38:21:00N
Bruzus	30:10:30E	38:32:00N
Bubon	29:25:00E	36:58:30N
Cadi	29:25:00E	39:03:00N
Caesarea Germanice / Helge	28:55:00E	40:11:00N
Caunus	28:37:00E	36:50:00N
Celenderis	33:19:00E	36:08:30N
Chalcedon	29:01:30E	41:00:30N
Cibyra	29:30:00E	37:09:30N
Claudiocaesarea / Mistea	31:44:00E	37:41:00N
Claudiopolis / Bithynion	31:36:00E	40:44:00N
Claudiopolis / Col. Iulia Augusta Felix / Ninica	33:27:00E	36:39:00N
Clazomenae	26:47:00E	38:22:30N
Cnidus	27:23:00E	36:41:30N
Cnidus	27:41:00E	36:44:00N
Col. Caesarea / Antiochia	31:11:00E	38:18:00N
Col. Claudia Archelais / Koloneia / Garsaura	34:02:30E	38:23:00N
Colophon	27:09:00E	38:07:00N
Colophon / Colophon ad Mare / Notium	27:12:00E	38:00:00N
Colossae	29:14:00E	37:47:00N
Comama / Col. Iulia Augusta Prima Fida	30:20:00E	37:19:00N
Conana / Iustinianopolis?	30:31:00E	37:57:30N
Coracesium	31:59:30E	36:33:00N
Corycus	34:09:00E	36:28:00N
Cotiaeum	29:59:00E	39:25:00N
Cremna / Col. Iulia Augusta Felix	30:43:00E	37:30:00N
Cyme	26:56:30E	38:46:00N
Cyzicus	27:53:00E	40:23:00N
Daskyleion	28:04:00E	40:08:00N
Derbe / Claudioderbe	33:23:00E	37:21:00N
Diocaesareia	33:55:00E	36:35:00N
Docimeium	30:45:00E	38:52:00N

(*continued*)

Continued

Site	Eastings	Northings
Dorylaeum	30:31:30E	39:48:30N
Elaea	27:03:00E	38:57:00N
Elaiussa / Sebaste	34:11:00E	36:30:00N
Ephesus	27:20:30E	37:57:00N
Erythrae	26:29:00E	38:23:00N
Etenna	31:28:00E	37:00:30N
Eucarpia	30:06:00E	38:29:30N
Eumenea / Fulvia	29:51:30E	38:19:00N
Gagai / Palaion Teichos	30:21:00E	36:17:30N
Gangra-Germanicopolis	33:36:00E	40:36:00N
Germanicopolis	32:37:00E	36:38:00N
Hadrianeia	28:38:00E	39:35:00N
Hadrianoi	28:59:30E	39:55:00N
Hadrianoupolis	31:38:00E	38:44:00N
Halicarnassus	27:26:00E	37:02:00N
Heraclea (Pontica)	31:25:00E	41:17:00N
Heraclea ad Latmum / Pleistarcheia	27:31:30E	37:30:00N
Herakleia Salbakes	28:59:00E	37:37:00N
Hierapolis	29:09:00E	37:55:00N
Iasos	27:35:00E	37:17:00N
Iconomium / Claudiconium	32:30:00E	37:52:00N
Ilium / Troia	26:16:00E	39:57:00N
Isaura (Nova) / Leontopolis	32:19:00E	37:11:00N
Kebren	26:34:00E	39:45:00N
Kidrama	29:08:00E	37:21:00N
Kyaneai	29:50:00E	36:14:30N
Lampsacus / Pityoussa	26:42:00E	40:21:00N
Lancare / Priene	27:19:00E	37:40:00N
Laodiceia (Katakekaumene) / Claudiolaodicaea	32:22:30E	38:12:00N
Laodiceia ad Lycum / Dispolis / Roas	29:07:00E	37:50:30N
Limyra	30:11:00E	36:20:00N
Lystra / Col. Iulia Felix Gemina	32:21:00E	37:35:00N
Magnesia ad Maeandrum / Leukophrys	27:31:30E	37:51:30N
Magnesia ad Sipylum	27:26:00E	38:37:00N
Mallus / Antiochia ad Pyramum	35:29:30E	36:45:00N
Metropolis	30:38:30E	39:12:30N
Metropolis	30:31:30E	38:15:00N
Midaeum	30:51:30E	39:48:00N
Miletopolis	28:21:00E	40:04:30N
Miletus	27:18:00E	37:30:00N
Mylasa	27:42:00E	37:19:00N
Myra	30:00:00E	36:14:30N
Nacoleia	30:42:30E	39:27:00N
Neapolis	31:30:00E	37:56:00N
Nicaea	29:43:00E	40:27:00N
Nicomedia	29:55:00E	40:46:00N
Nysa / Athymbra	28:08:30E	37:54:00N
Oenoanda / Termessus Mikra	29:30:30E	36:48:00N
Olbasa / Col.Iulia Augusta	30:00:00E	37:18:00N

Olympus / Hadrianopolis	30:29:00E	36:24:00N
Ouasada	31:56:30E	37:30:00N
Pappa / Tiberiopolis	31:55:00E	37:55:00N
Parium / Col. Gemella Iulia *Hadriana	27:04:00E	40:26:00N
Parlais / Col. Iulia Augusta Hadriana	30:48:00E	38:01:00N
Patara / Arsinoe	29:20:00E	36:16:00N
Pednellisos	30:55:30E	37:13:00N
Pergamum	27:10:00E	39:08:00N
Perge	30:52:30E	36:58:00N
Pessinus / Iustinianoupolis	31:34:00E	39:21:00N
Phaselis	30:33:00E	36:31:00N
Phellos	29:40:00E	36:14:00N
Philadelphia	28:30:30E	38:21:00N
Philomelium	31:56:30E	38:21:30N
Phocaea	26:45:00E	38:40:30N
Pinara	29:15:00E	36:30:00N
Pogla	30:16:00E	37:17:30N
Poimanenon	27:54:00E	40:04:00N
Pompeiopolis	34:13:00E	41:30:00N
Prusa	29:03:30E	40:11:00N
Prusias ad Hypium	31:08:00E	40:55:00N
Prusias ad Mare / Kios	29:07:30E	40:25:00N
Prymnessus	30:35:00E	38:42:30N
Sagalassus	30:32:00E	37:41:00N
Saittai	28:36:00E	38:45:00N
Sardis	28:02:00E	38:28:00N
Sebaste	29:38:00E	38:29:30N
Sebastopolis	29:10:00E	37:29:00N
Seleucia / Claudioseleucia / Seleucia Sidera	30:38:00E	37:54:00N
Seleucia ad Calycadnum / Tracheia	33:53:30E	36:23:00N
Selge	31:08:00E	37:13:30N
Side	31:24:00E	36:46:00N
Sidyma	29:13:00E	36:25:00N
Silandos	28:50:00E	38:45:00N
Sillyum	30:59:30E	36:59:30N
Sinope	35:09:00E	42:02:00N
Smyrna	27:08:00E	38:26:00N
Soloi / Pompeiopolis	34:32:00E	36:43:30N
Stektorion	30:09:00E	38:20:00N
Stratonicea	28:03:00E	37:19:00N
Stratonicea / Hadrianopolis	27:47:00E	39:10:00N
Syedra	32:11:00E	36:24:00N
Synada	30:33:00E	38:33:00N
Synaos	28:58:00E	39:05:30N
Tabae	28:51:00E	37:26:00N
Tabala	28:48:00E	38:37:00N
Tabia / Taouion	34:32:00E	39:51:00N
Tarsus / Antiocheia ad Cydnum	34:54:00E	36:35:00N
Telmessos	29:07:00E	36:42:30N
Temenothyrae-Flaviopolis	29:25:00E	38:41:00N
Teos	26:48:00E	38:10:30N
Termessus	30:28:45E	36:59:00N

(*continued*)

Continued

Site	Eastings	Northings
Thyateira	27:50:00E	38:55:00N
Tius / Teos / Tieion	32:02:00E	41:34:00N
Tlos	29:26:00E	36:33:00N
Traianoupolis	29:34:00E	38:41:30N
Tralles / Dia / Seleucia ad Maeandrum / Kaisereia	27:50:00E	37:52:00N
Tripolis ad Maeandrum / Apollonia ad Maeandrum / Antoniopolis	28:57:00E	38:03:00N
Tyana	34:36:30E	37:50:00N
Tyriaion	31:54:00E	38:17:00N
Xanthos	29:20:00E	36:22:00N
Zeleia	27:36:00E	40:12:30N

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10

Towns and Territories in Roman Baetica

Simon Keay and Graeme Earl

INTRODUCTION

In the Mediterranean provinces of the Roman empire, towns consisted of juridically defined political and administrative units comprising a built-up urban core (*oppidum*) and surrounding rural territory (*territorium* or *ager*). These units played a key role in the assessment of provincial communities for tax liability in the imperial period.[1] Any attempt to understand their economic impact within a region or province, therefore, must hinge upon a consideration of both the character and extent of both the built-up area and its surrounding territory.

This key relationship between urban and rural communities has been explored in a number of important archaeological studies in recent years.[2] More often, however, built-up townscapes are analysed in isolation from their rural contexts, or vice versa, whether from archaeological or historical perspectives. A major obstacle to a more 'joined-up' understanding of towns and their surrounding landscapes is that the boundaries of *territoria* are not readily reconstructed. If we have no idea about their extent, it becomes very difficult to gauge the economic or demographic importance of towns as integrated urban and rural units within broader provincial landscapes.

This chapter attempts to develop a new method for looking at urban territories. It focuses on one of the most densely urbanized

[1] See Corbier 1991.

[2] Such as Leveau 1984, 2002; Carreté *et al.* 1995; Barker *et al.* 1995, to name but a few. See also the useful review of implicit historical and archaeological issues in Leveau 1994.

regions of the western Roman empire, Baetica, and advocates the integrated analysis of epigraphic and archaeological evidence within a specific geographical context as the best way forward. In particular, it explores two issues. It begins by using a range of geographical and archaeological criteria to test the robustness of the boundaries of a range of neighbouring towns recently proposed from an analysis of epigraphic data. It also attempts to gauge how far it is possible to think in terms of the size of the populations within these boundaries. The chapter then goes on to consider the relationship between boundaries as an administrative construct and a lived reality on the ground, suggesting that boundaries are best considered in terms of structured imprecision or 'fluid' boundaries. It concludes with an attempt at ranking territories in the study area on the basis of various archaeological and geographical variables, with a view to discussing the potential contribution that this kind of approach might make for bridging the gap between analyses of urban and rural landscapes.

THE PROJECT BACKGROUND

The study presented in this chapter needs to be understood in its broader research context. It arises from a project that has been studying changing social, economic, and geographical relationships between some 195 towns and nucleated settlements in central and western Baetica between *c.* 500 BC and AD 200.[3] The project has the following five research questions:

[3] The 'Urban Connectivity in Iron Age and Roman Southern Spain' project was funded by the Arts and Humanities Research Council of the UK and is in the process of final writing-up. The collaboration and support of the Delegación Provincial de Cultura (Sevilla) of the Dirección General de Bienes Culturales of the Consejería de Cultura of the Junta de Andalucía, the Instituto Andaluz de Patrimonio Histórico, the Departamento de Prehistoria Arqueología and the Departamento de Historia Antigua de la Universidad de Sevilla, and the Department of Archaeology of the University of Southampton are gratefully acknowledged. Versions of this chapter have been given as papers at the conference 'Aufkommen, Entwicklung und Transformation des epigraphic habit in den hispanischen Provinzen. Kolloquium', Münich, organized by the Kommission für Alte Geschichte und Epigraphik des Deutschen Archäologischen Instituts in Munich, and to seminars at the universities of Oxford and Cambridge. The authors would like to thank Professor Alan Bowman for his invitation to publish this contribution in the present volume.

1. How significant were geographical considerations in the location of towns in southern Spain between the fifth century BC and the second century AD?
2. How significant were inter-urban relationships over the same period?
3. How were they manifested?
4. What was the impact of Rome on these relationships?
5. What kind of methodologies can be developed for characterizing connections between towns?

These are being answered through the application of new methodologies that allow urban attributes and different classes of archaeological material to be modelled within landscape contexts by computer-based analyses. These are firmly situated within an interpretative framework that focuses upon inter-urban connectivity. Those approaches that are most relevant to this chapter concern the creation of interlinked spatial and other databases, modelling of alternative territorial indicators and archaeologically based urban hierarchies.

The Study Area (Figs 10.1 and 10.2)

The project research area focused upon the middle and lower Guadalquivir Valley and its tributaries, from the region of Almodóvar del Río (Córdoba) in the east down to the Marismas (which corresponded to the Lacus Ligustinus in antiquity) in the west, before flowing out into the Atlantic immediately to the north of Sanlúcar de Barrameda (Cádiz). In terms of modern administrative boundaries it is encompassed within the modern province of Sevilla, together with the western edge of the Provincia de Córdoba, the northern fringe of the Provincia de Cádiz and the eastern edge of the Provincia de Huelva.

This area encompassed the foothills of the Sierra Morena in the north, where land rises to *c.* 400 m above sea level, the broad flood plain of the Guadalquivir westwards from the point where it intersects with the Genil, the very fertile soils of the Campiña lying to its south, and down to the Sierra de Grazalema; to the south of Seville the lower Guadalquivir Valley opens out to encompass the flatter lands of the Marismas and anticipates the Atlantic coast. One of the key characteristics of this region is its topography, which consists of very extensive flat areas interspersed with low-lying hills and plateaux

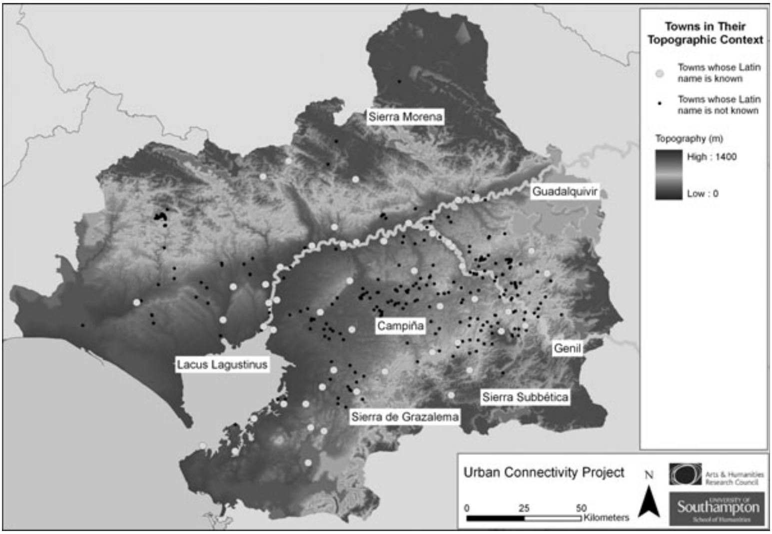

Fig. 10.1. The towns of the Urban Connectivity Project in the topographic context of Roman Baetica.

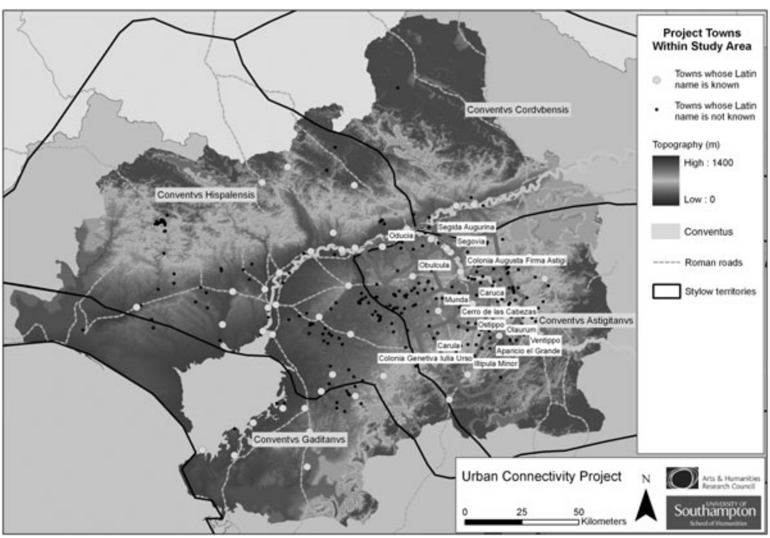

Fig. 10.2. The towns of the Urban Connectivity Project lying within the study area of the western *Conventus Astigitanus*.

that facilitate visibility over considerable distances—in some cases to well over 60 km.

Some 195 towns are distributed throughout the study area. They are densest in the rolling hills and plains of the Campiña lying to the south of the Guadalquivir, an area that corresponds in general terms to the *Conventus Astigitanus*.[4] Identification of these with communities named by Greek and Roman authors, such as Strabo, Caesar, or Pliny, or with names recorded on epigraphic and numismatic sources is fraught with difficulty.[5] Although some reconciliation is possible, some towns, such as Soricaria[6] and the *rei publicae tispitanae*,[7] have yet to be associated with specific sites, while the ancient names of many archaeological sites are lost to us (Fig. 10.2). The more sparsely urbanized regions within the study area correspond to areas encompassed within the *Conventus Hispalensis* and *Cordubensis* (between the foothills of the Sierra Morena and the southern terrace of the Guadalquivir), and the *Conventus Gaditanus* (the Sierra de Grazalema adjacent to the Marismas).

The Data

Antiquarians and scholars have been collecting historical, epigraphic, and archaeological data concerning central and western Baetica since the sixteenth century. Systematic analysis of this is difficult, however, since it has had an unequal history of accumulation. Before the 1960s, for example, there had been only sporadic investigations of archaeological sites across the region,[8] and it was not until the surveys by Ponsich during the 1960s and 1970s that the foundations of more systematic knowledge of Roman urban and rural sites over much of western Baetica were laid.[9] Unfortunately, however, his work largely excluded Turdetanian sites, extensive areas to the south of the River Guadalquivir fell outside his survey area, and the level of recorded detail was minimal. Notwithstanding this, his surveys formed the basis for the *Inventario* of the mid-1980s—a catalogue that comprised

[4] Discussed by Cortijo Cerezo 1993: 142ff; 2008.
[5] See discussions of individual towns by Stylow *et al.* 1998; Caballos 1996.
[6] *De Bello Hispaniense* 24, 27.
[7] See Stylow *et al.* 1998, 288.
[8] Bonsor and Clark Maxwell 1931; Hernández Diaz *et al.* 1951.
[9] Ponsich 1974; 1979; 1987; 1991.

map references, very basic information and references for each known town, and to which have been added occasional surveys of limited scope.[10] In the 1990s this was incorporated into a digitized data retrieval system called SIPHA (Sistema de Información del Patrimonio Histórico de Andalucía). This has been supplemented by periodic surveys carried out by the Consejería de Cultura of the Junta de Andalucía that take modern municipal limits as their boundaries. There have also been many rescue excavations in towns such as Hispalis, Astigi, and Carmona, as well as occasional research projects at towns such as Munigua, Celti, and Laelia, among others.[11]

For the purposes of the project, this site-based information was combined to form a large project database of some 350 Iberian and Roman sites that might loosely be classed as possibly 'urban' and that, following definition of urban criteria, were later refined to 195 towns. These data were supplemented by further information derived from visits by project members to a large number of these sites, particularly GPS-derived site coordinates, photographic records, identifications of surface material, and so on. Entries for individual sites were then augmented by a large amount of systematically collected epigraphic evidence,[12] together with a patchwork of published reports about ceramics, sculpture, coins, and other material evidence, much of which had been studied for its own intrinsic value, rather than for what it might tell us about the towns from which it derived. All these site records, together with some 150,000 individual data records, were then linked by means of a Geographical Information System (ESRI ArcGIS) to vectorized digital cartography and aerial photography at scales of 1:5,000 and 1:10,000.

All the data described above were collected and recorded so as to allow 'old' data to be re-contextualized to provide a broad empirically based data framework for urban sites in the region. This has the key advantage that the framework can be continually updated as new information for individual towns comes to light. Data integration was fundamental to the success of this approach. The framework was based extensively upon technologies aimed at minimizing the

[10] Ruiz Delgado 1985 is a good example.

[11] For Hispalis, see Ordóñez 2002, Astigi (Sáez *et al.* 2004), and Carmona (Belén and Lineros 2001), Munigua (Schattner 2003), Celti (Keay *et al.* 2001), and Laelia (Caballos *et al.* 2005).

[12] *CILA* II.1; *CILA* II.2; *CILA* II.3; *CILA* II.4; (Stylow 1995; Stylow *et al.* 1998).

generalization so often associated with such a synthetic approach; in particular, various ‘fuzzy’ database techniques were explored and the semantics underlying the data combined.[13] Thus the realities of the record—its uncertainty, variability, and inconsistency—remain, without unduly limiting its potential role in a synthetic approach.

Initial Results

Project work to date has concentrated on a range of issues, such as the suitability of inscriptions as an indicator of social and political links between towns and the relevance of network analysis as a technique for modelling connectivity between towns.[14] These will be alluded to below when relevant. For the purposes of this chapter, however, there are two further issues that need to be briefly mentioned.

THE DEVELOPMENT OF ROMAN TOWNS

The origins of many towns in western Baetica are to be sought at least as early as the Iberian period (fifth to later third centuries BC), if not before in many cases. Prominent emplacements and rich cultural sequences suggest that Carmo (Carmona) in the north-west Sevillan Campiña and Urso (Osuna) in the south-east Sevillan Campiña were key centres from an early date, akin to the Colina de los Quemados (Córdoba), Obulco (Porcuna), and Castulo (Linares) beyond the study area to the east. They were at the top end of a complex hierarchy of settlements, a large number of which were fortified. This is something of a surprise since traditional studies have assumed that the Guadalquivir was the primary economic focus of the region, dominated by settlements such as the Cerro Macareno and Setefilla.

During the later Iberian and Roman republican periods, the urban settlement pattern remains much the same, with little archaeological evidence for any major intervention by Rome, either in terms of new

[13] Niccolucci *et al.* 2001.

[14] Another includes the new means of chronological analyses. All of these are discussed in a number of recent papers (Keay, Wheatley, and Poppy 2001; Keay and Earl 2006; 2007; Earl and Keay 2007; Keay 2007; Isaksen *et al.* forthcoming); the final publication is in progress (Keay and Earl forthcoming).

urban foundations or in the appearance of new rural settlements. The limited numbers of foundations that do take place occur on the richer soils of the middle Sevillan Campiña. All of this suggests that Rome controlled the Iberian communities of the region by working through pre-existing settlement hierarchies based around the dominant Iberian centres of Carmo and Urso. However, differences in the density of 'urban' settlements (higher around Urso and lower around Carmo), as well as differences in the range of material culture present at the sites, such as the marginally greater number of first-century BC to first-century AD inscriptions at sites closer to Urso, highlight significant differences between them.

While there is a broad continuity in the occupation of Iberian urban settlement from the republican into the early imperial period, their distribution is still markedly differentiated. The larger early imperial towns still tend to cluster within the Sevillan Campiña away from the Guadalquivir and Genil. However, the *coloniae* of Hispalis and Astigi exhibit exceptionally good evidence for the 'urban attributes' that one would expect from *coloniae* that were major centres of Roman power (public architecture, well-appointed private houses, etc.). This suggests that the Guadalquivir and the Genil had gained a degree of regional ascendancy that they had lacked in earlier periods. The establishment of the *Via Augusta* at the start of the early imperial period is fundamental to our understanding of these developments. It was a new route of communication that linked the newly established *coloniae* at Astigi and Hispalis with the provincial capital at Corduba (Córdoba), and Gades (Cádiz) respectively.[15] In doing this it effectively marginalized Urso but incorporated Carmo into an alternative axis of communication dependent upon Roman power focused at Hispalis and Astigi. In addition to these changes, a number of republican settlements of Iberian origin in the western and central Sevillan Campiña were abandoned while several alternative centres with no precedent were established, some of which were newly fortified: there is as yet no obvious patterning to this. It is often assumed that towns with the most Roman 'urban' attributes were primarily those with privileged status, particularly *coloniae* and *municipia*. However, a quantitative analysis of the presence of the 'urban' attributes that one would expect to find at such towns across the region set against evidence for their legal status suggests that while many

[15] Sillières 1991.

privileged towns did indeed exhibit 'urban' characteristics, others were noticeable by their absence. Furthermore, there were quite a few settlements with 'urban' attributes but with no evidence for privileged status.

URBAN HIERARCHIES

The presence or absence of colonial or municipal status at individual towns at specific periods has often been used as a way of creating urban hierarchies in Baetica. A disadvantage to this kind of approach, however, is that urban status, which is an indicator of the legal constitution of a town, does not necessarily tells us about the actual character of the town as a built environment susceptible to archaeological analysis; this is particularly true of the many *municipia* known to have existed in the province. The approach adopted by this project, therefore, has been to produce a set of data-sensitive regional urban hierarchies based on attributes and variables for use in network and other inter-site analyses. Thus, rather than being based upon preconceived hierarchies defined by historical/epigraphic evidence or summary archaeological analyses, these hierarchies are fluid and synchronic. They are predicated upon the presence and absence of the different known archaeological and historical attributes used to define urban sites in the project, such as defences, public architecture, cemeteries, key classes of pottery, pottery kilns, visual prominence, and so on, as well as a consideration of the historical/epigraphic evidence, for the Iberian, Roman republican, early imperial, mid-imperial, and late imperial periods.[16] These hierarchies draw upon the quantitative presence of a range of data at each town collected for this project by collaborators, some of whom are leading scholars in their respective fields.[17] While they are thus limited by being

[16] Keay and Earl 2006.

[17] Antonio Caballos Rufino (Departamento de Historia Antigua, Universidad de Sevilla), José Beltrán Fortes (Departamento de Prehistoria i Arqueología, Universidad de Sevilla), Francesca Chaves Tristán (Departamento de Prehistoria i Arqueología, Universidad de Sevilla), Enrique Melchor (Departamento de Historia Antigua, Universidad de Córdoba), Myriam Gordón (Departamento de Prehistoria i Arqueología, Universidad de Sevilla), and Urbano López (Departamento de Prehistoria i Arqueología, Universidad de Sevilla).

dependent upon data currently available, they can be updated as new material comes to light.

URBAN TERRITORIES IN ROMAN BAETICA

Evidence for urban boundaries in Baetica is very limited.[18] Surviving legal evidence makes it clear that the territorial limits of towns were recorded on official documents for tax purposes and that they were carefully inspected every year by municipal magistrates.[19] In the case of *coloniae* at least they were recorded on maps, such as the large cadastral map discovered at Arausio (Orange) in Gallia Narbonensis or the fragment of a bronze surveying-map from Lacimurga in Baetica/Lusitania.[20] However, the main challenge that would confront attempts at defining the extent of *territoria* by tracing boundaries between Roman provincial towns is the intangibility of the boundaries themselves. The writings of the *agrimensores* make it clear that the boundary markers (*termini*) often took the form of wooden or stone markers or natural features that could be easily obliterated if they were not regularly maintained.[21] While one might assume that there would have been little doubt in official minds over the direction taken by boundaries marked out in this way, the reality on the ground must have been open to considerable ambiguity. This is best illustrated by the following description by Hyginus of how boundaries were often designated:

> From the small hill called such-and-such, to such-and-such a river, and along that river to such-and-such a stream or such-and-such a road, and along that road to the lower slopes of such-and-such a mountain, a place that has the name such-and-such, and from there along the ridge of that mountain to the summit, and along the summit of the mountain

[18] Generally, see Mackie 1983; Cortijo Cerezo 1993: 213–18; Rodríguez Neila 1994: 202–6; Sáez 2002. As a consequence, scholarship has tended to focus more upon land divisions within territories, the *pagi* and *vici*, rather than the limits themselves (such as Cortijo Cerezo 1993: 227–56; Rodríguez Neila 1994: 206–17; Sáez 2002: 406ff.); see however Le Roux 1999 for a holistic study of the territory of the Augustan *colonia* of Augusta Emerita in Lusitania.

[19] Generally, see Corbier 1991: 221ff.

[20] Gallia Narbonensis: Piganiol 1962. Lacimurga: Gorges 1993.

[21] Campbell 2000: 468–71.

> along the watersheds to the place that is called such-and-such, and from there down to such-and-such a place, and from there to the cross-roads of such-and-such a place, and from there past the tomb of such-and-such to the place where the description began. (Hyginus I: trans. Campbell 2000: 79)

Such a situation would be even more complicated when one considers that boundaries were frequently disputed by neighbouring communities, motivated by a range of issues, such as ownership of different kinds of land and access to water or grazing land.[22] As a result they were often moved, with their new position being advertised by inscribed stone markers. Also, since they are hardly ever found *in situ*, they usually provide us only with a record of the fact that a boundary between two particular communities had been disputed and moved.

The earliest known example of an inscribed boundary marker comes from El Moralejo, *c.* 3 km from Ostippo (Estepa) in central Baetica. This commemorates the restoration of the termini of the *agrorum decumanorum* by the Ostipponenses in AD 49.[23] Slightly later are the examples from El Torcal (Priego de Córdoba), dating to AD 83,[24] which marks the boundary between Cisimbrium and Ipolcobulcula, and Zambra from central Baetica, dating to AD 84,[25] and the marker from Poyo de las Vacas (Villanueva de Córdoba) that commemorates the settlement of a boundary dispute between Sacili (Alcorrucén), Epora (Montoro), and Solia (Cortijo Majadaiglesia) dating to AD 117–38.[26] While they tell us little about the course taken by the boundaries themselves, these monuments have been taken by some as evidence for major phases of boundary definition under Claudius, the Flavians, and Hadrian.[27]

The only other kind of epigraphic evidence at our disposal is provided by the colonial law of the Colonia Genetivae Iulia of Urso

[22] The extensive writings of the Roman *agrimensores* on this subject are translated by Campbell (2000: 5–9, 17–49, 59–75, 91–101, 454–67).

[23] *CIL* II 1438; *CIL* II 2/5, 994. The inscription may have been set up in memory of Claudius' renovation of earlier *agri decumani* within the neighbouring territory of Urso—see Caballos 1996: nota. 75; 2006: 373.

[24] *HEp* 1, 288.

[25] *CIL* II 2/5, 302.

[26] *CIL* II 2/7, 776. There are also two additional inscriptions that commemorate boundaries between towns in Baetica and Lusitania: *HEp* 1 1989: 115; *CIL* II 1041; *CIL* II 656 in the Flavian period. The significance of these is discussed by Le Roux 1994: 41ff.

[27] Le Roux 1994.

and the municipal law of Irni, both of which would have had relevance to other towns in the region with similar status. Neither law refers to the location of the boundaries. Instead, the former refers to the inviolability of the boundaries according to the law and sanctions against those that infringed it.[28] The latter occasionally mentions the boundaries of the municipality and the fact that each year the *duumvir* and *decuriones* decided whether or not to visit the territories of the municipality and other sources of revenue. However, it tells us nothing about the location of the boundaries.[29]

Given this paucity of direct epigraphic evidence for boundaries, it is hardly surprising that recent studies of such Baetican towns as Astigi, Celti, Carmo, Urso, Italica, and Corduba have invoked largely notional 'edges' for the boundaries of their territories on the basis of major geographical features such as rivers.[30] All of this makes it difficult to comment upon the extent and limits of urban territories in Roman Baetica apart from the very obvious point that the greater the density of urban settlement in a given region, the more likely the towns are to have had smaller territories.

A Combined Geographical, Archaeological, and Epigraphical Approach

From a computational perspective, Cartesian systems of locational analysis, such as the derivations of Thiessen polygons, have in the past sometimes been seen as the best tool for defining boundaries between towns. Such polygonal summaries take the form of notional geometric territories that encompass the area closest to each town relative to all other towns, and have been used as a way of modelling pre-Roman and Roman urban territories.[31] One major drawback of

[28] *CIL* II 2/5, 1022, chs LXXIIX, CIIII: see also Crawford 1996: 421–33.

[29] Ch. 76: González 1986: 193; for urban territories and their revenue see Corbier 1991.

[30] For Astigi, see Durán Recio and Padilla Monge 1990, Carmo (Amores *et al.* 2001), Urso (Vargas Jiménez and Romo Salas 2002), Italica (Corzo 1983), and Corduba (Knapp 1983: 36–9; Cortijo Cerezo 1993: 216–18) See also a detailed consideration of the territory of Urso from the perspective of *Lex Colonia Iulia Genetiva* together with an analysis of available archaeological evidence for rural settlement in Caballos 2006: 362ff.

[31] Such as Curchin 1995: Fig. 1; López Palomo 1999: Fig. 288; Burillo 1998: Fig. 85; Ruiz Rodríguez *et al.* 1991: Figs 3 and 4, etc.

this approach is that it represents a simplistic and rationalist approach to the definition of territory that is probably more relevant to modern economic geographers than to the rather different perceptions of landscapes and their inhabitants by ancient communities.[32] Another is that the territories proposed in this way ignore major geomorphological features that may have played an important role in structuring the landscape and, perhaps, the choice of urban location. Approaches of this kind, therefore, have limited analytical value when applied to ancient landscapes. However, given the dispersed nature of much of the data considered in this study, it is imperative that some notional territory is defined in the case of each site. Without some form of territorial model those data separated from and otherwise unconnected to urban centres cannot be considered in the light of their associations to wider networks. In many cases such data may in fact be pivotal to understanding such networks, in addition to their archaeological significance in isolation. We believe that any analysis of urban territories needs to consider both the geographical characteristics and contextualized archaeological variables of proposed territories, since they were the end product of economic, social, and political negotiation between neighbouring communities.

As a result, it was decided to use territorial divisions proposed in a recent study by Stylow[33] as a notional framework and to examine their robustness through comparison with a range of geographical considerations and archaeological variables (Fig. 10.3). The area chosen for this analysis was the western sector of the *Conventus Astigitanus*, since this was the only part he had studied that fell within the research area of the Urban Connectivity Project. The value of his approach is that he drew heavily upon the one source of evidence that one could expect to be sensitive to the social and cultural idiosyncrasies of different urban communities, namely Latin stone inscriptions, rather than by simply drawing lines on the basis of intuition or geographical models.

[32] Such as that of Pliny the Elder (*NH* III, 7–17): for alternative readings of the significance of Pliny's descriptions, see Beltrán Lloris 2007 and Carey 2003.

[33] Stylow *et al.* 1998. Note also an attempt by Cortijo Cerezo (1993: 223–5) to use the localized distribution of inscriptions mentioning different voting tribes as a way of defining the limits of the territory of Ostippo (Estepa), which concludes by emphasizing the importance of taking natural boundaries into account.

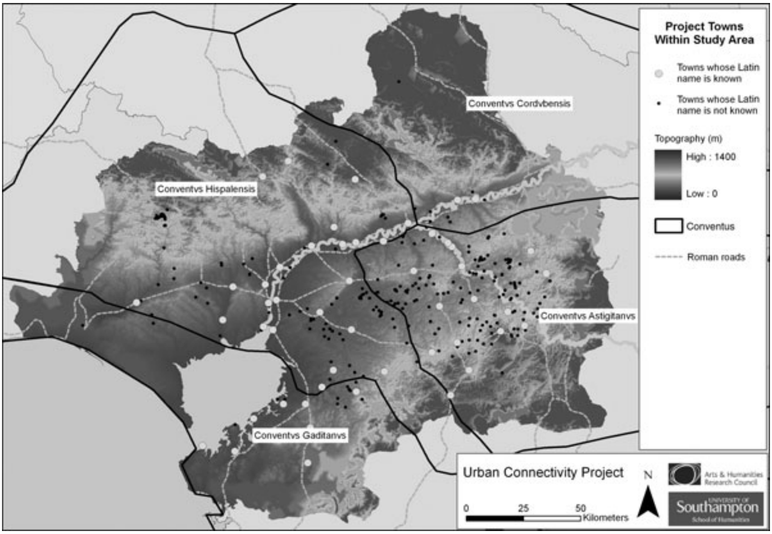

Fig. 10.3. Urban territories in the western sector of the *Conventus Astigitanus* according to Stylow *et al.* 1998.

GEOGRAPHICAL PERSPECTIVES

Location, Topography, and Territories (Fig. 10.4)

The area chosen for analysis is the south-eastern Sevillan Campiña, which is defined by the mountains of the Sierra Subbetica to the south and the rivers Guadalquivir to the north, and the middle and lower Genil to the east. The landscape is relatively flat in general, although it differs from areas further west by the rolling hills and plateaux dissected by small seasonal streams. The soils are rich and well adapted to a range of crops, being well watered by seasonal streams running northwards from the Sierra Subbetica down towards the Guadalquivir and eastwards towards the Genil. The hills offer regular vantage points that promote short- to medium-distance visibility, while enabling the distant Sierra Subbetica to the south and the Sierra Morena to be seen on clear days. It is noticeable, however, that the Guadalquivir and Genil have cut down deeply into the landscape and are visible only from the immediate river terraces.

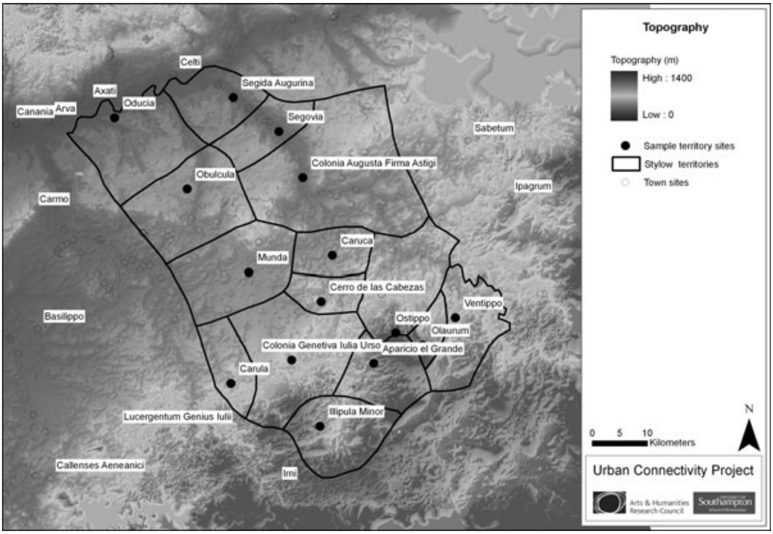

Fig. 10.4. The topography of the western *Conventus Astigitanus.*

Roman urban settlement in this region was quite dense. The Augustan *colonia* and *conventus* capital of Astigi (Écija) was the principal centre in the region, located on flat land close to a ford on the Genil, while the Caesarian *colonia* of Urso was located on the southern side of a very prominent plateau close to the foothills of the Sierra Subbetica, whose abrupt northern face dominates the surrounding Campiña and affords extensive visibility towards the Guadalquivir and the Sierra Morena in the north. Other known towns in the region include Ilipula Minor (Cortijo de Repla), Ostippo (Estepa), Olaurum (Lora de Estepa) in the foothills of the Sierra Subbetica, as well as towns such as Ventippo (La Atalaya Chica, Casariche), Carula (Cerro del Agua), Carruca (Cortijo de les Cosmes), Munda (Consuegra), and Obulcula (Castillo de Moncloa) on flatter lands in the central Campiña, and centres on the terraces of the Guadalquivir and Genil at Oducia (Mesa de Lora), Segovia (Isla del Castillo), and Segida Augurina (La Saetilla). In addition to all of these, there are a number of other sites whose characteristics suggest that they were non-rural agglomerations (such as El Guijo) or towns whose Latin name is not known to us, such as Cerro de las Balas or Aparicio el Grande. The region was also very heavily peppered with rural settlements of different sizes and varieties.

In the course of re-studying inscriptions for the updated re-publication of the *Corpus Inscriptionum Latinarum*, Stylow assigned all inscriptions to urban centres, or adjacent areas.[34] He then defined the urban territories on the basis of regionally specific epigraphic differences, such as formulae, letter-form, and epigraphic support, tempered by a thorough understanding of local geography.[35] The resultant map highlights a range of territories that are dependent upon principal towns but which also encompass other non-rural settlements. The territories are of different size, with those with thinner soils in the foothills of the Sierra Subbetica, such as Ilipula Minor and Olaurum, being smaller than those with more fertile soils in the lower-lying Campiña such as Astigi, Urso, Munda, and Oducia being considerably larger.

Since most of the inscriptions that Stylow analysed were of early imperial date, the territories that he defines fall with this horizon. However, the rarity of boundary markers from this part of Baetica[36] makes it impossible to confirm his proposed boundaries or define any boundary changes that might have arisen as a result of inter-community disputes. While the Roman *agrimensores* give the impression that boundary disputes were common in the Roman empire, the absence of epigraphic evidence for them could be taken to suggest that they were actually comparatively rare in Baetica.[37] The reasoning here would be that since most Baetican towns had been established in the pre-Roman iron age, their territories would have become well established by the early imperial period and not subject to boundary disputes as frequently as other parts of the Roman empire.

Urban Location and Communications

The position of the rivers and the alignment taken by known roads makes it clear that the urban territories in the region were focused

[34] Stylow 1995.

[35] These are then argued in the *praefatio*, each chapter dedicated to a specific town in *CIL* II 2/5.

[36] Apart from the example dating to AD 49 from just outside Ostippo: see above, p. 286.

[37] A suggestion made to one of us by Werner Eck. Indeed, Caballos 2006: 365 argues that the limits of the Colonia Genetiva Iulia were more or less the same as those of the pre-existing town of Urso.

upon three interconnected communications nodes (Fig. 10.5). The most important was the Augustan *colonia* of Astigi, which lay at a key junction between that part of the lower Guadalquivir Valley dominated by Hispalis (Seville) in the west and that dominated by the Colonia Patricia (Córdoba) to the east on the one hand, and on the other between the River Guadalquivir to the north and the Campiña and Sierra Subbetica to the south. It also lay astride the east–west *Via Augusta* that connected it with Obulcula and Carmo to the west, and the lesser road that ran from the vicinity of Celti (Peñaflor) in the north, southwards to Segida Augurina, Segovia, Astigi, Carruca, and Ostippo. Astigi was also the starting point for another road that ran south-west to Carula, Urso, and Ilipula Minor. Ostippo was the principal node of communications in the south-east, being connected to the road that ran north to Carruca, Astigi, and ultimately Celti, as well as to another westwards to Urso and Carula, another south-west to Ilipula Minor and Irni (Los Baldios) beyond and yet another south-eastwards towards Olaurum and beyond. Urso was the communications node in the south-west, lying astride the Ilipula to Astigi road and that linking Ostippo and areas further east.

It is noticeable that several towns lay outside this interconnected network. Oducia in the north was one such outlier, lying on a lesser route along the south terrace of the Guadalquivir, while Aparicio el Grande,[38] which is sited between Urso and Carruca in the centre of the area, was another, as was Ventippo in the south-east. It should also be pointed out that there were few direct known connections between Munda, Obulcula, and Oducia.

Cost Distance

Stylow's territories seem to fit quite closely with calculated maps of effort or cost associated with terrestrial movement. Such cost-distance analyses, although complex both to construct with any validity and indeed to analyse, do at this stage seem to respect principal urban centres (Fig. 10.6). The only exceptions would seem to have been Ilipula Minor in the south, which is situated in the foothills of the Sierra Subbetica and relatively inaccessible, and Ostippo in the south-east. It is also noticeable that there are contiguous areas of low cost

[38] Or Los Argamasones: its Latin name is unknown.

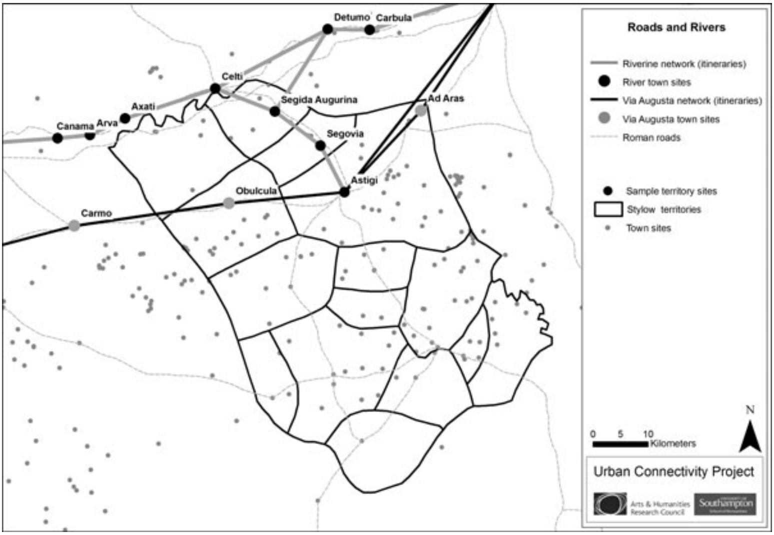

Fig. 10.5. Roads and rivers in the western *Conventus Astigitanus*.

bands focused upon Segida Augurina, Segovia, Astigi, Carruca, and the Cerro de las Cabezas (Osuna), suggesting that communications between these and their suggested territories would have been relatively easy. It would have been less so between Oducia, Obulcula, Munda, and Carula, and difficult between Ilipula Minor, Urso, Ostippo, and Olaurum. What such summaries do not currently consider is the extent to which a correlation between cost and urban centres may be spurious, in fact representative of related factors. As a consequence, further work will consider such costs in greater detail, informed by a growing corpus of similar studies in archaeological computing.

Exploitation of Agricultural Resources

There is no doubt that water would have been one of the most precious resources in the region—being vital in determining the viability of towns and, arguably, the integrity of the territories proposed by Stylow. Water was crucial to the populations of all the towns, but particularly so to *coloniae* like Astigi and Urso, whose populations were arguably higher and which would have had public

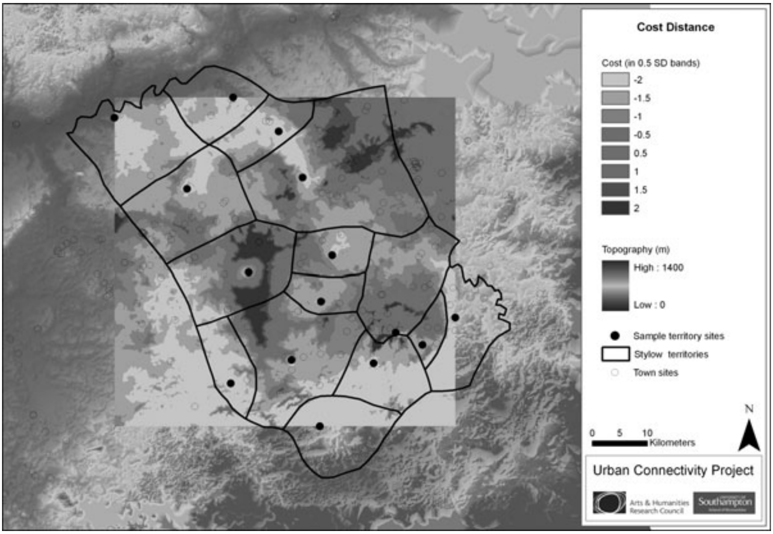

Fig. 10.6. Cost-distance analyses of urban territories in the western *Conventus Astigitanus.*

baths and other water-hungry monuments. Similarly, water was key to agricultural production in the region.

The mean distance of towns within the territories from such water sources as rivers and seasonal streams was the first simple measure chosen to characterize the availability of water (Fig. 10.7). In general this suggests that throughout the study area, closeness to water sources was an important issue. The territory of Aparicio el Grande, close to the Sierra Subbetica, is best located in this regard, while at all the others towns were less well located. This will have been a particularly important issue in those territories where slope effort was high (Fig. 10.6), such as Ilipula Minor.

The absence of any reliable soil fertility data makes it difficult to assess the agricultural potential of the land encompassed by the territories proposed by Stylow. For the purposes of this chapter, therefore, it was assessed indirectly by the degree of water run-off, or watershed, on the understanding that that the greater the watershed the greater the agricultural potential (Fig. 10.8). This would point towards the territory of Urso being the most propitious, followed by those of Munda, Astigi, and Oducia. It is particularly

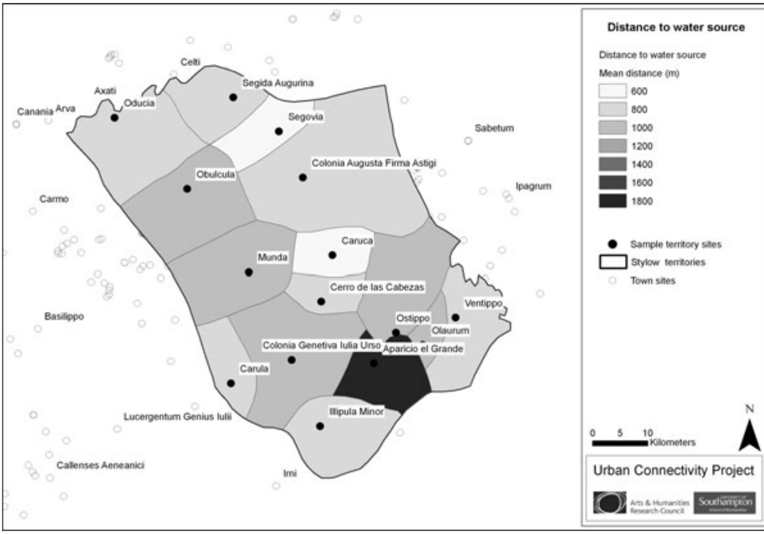

Fig. 10.7. Distance to water sources in the urban territories in the western *Conventus Astigitanus.*

noticeable that the territories of Carruca, Olaurum, and Carula had particularly low run-off and, therefore, less fertile soils.

In some ways, these conclusions are borne out by the density of known rural settlements in the region (Fig. 10.9; Fig. 10.10), that developed in the course of the first two centuries AD.[39] Analysis of the distribution of all known sites[40] expressed in terms of percentages of the overall total suggests that they were greatest in the territories of Urso, Ostippo, Munda, Oducia, and Aparicio el Grande. Settlement numbers in the territory of Astigi, however, were comparatively lower, pointing, in *prima facie* terms at least, to a different kind of agricultural regime existing in the hinterland of the Augustan *colonia*.

[39] Although part of this area was surveyed by Ponsich (1974; 1979; 1991), the more recent study by Durán and Padilla 1990 provides a fuller treatment of the chronological evidence for the area around Astigi.

[40] In other words those currently in the SIPHA database. It is important to note that the rural settlement data were derived from a number of different surveys carried out in different parts of the study area at different times since the 1960s onwards: thus while one cannot argue that the total numbers are directly comparable, they may be representative.

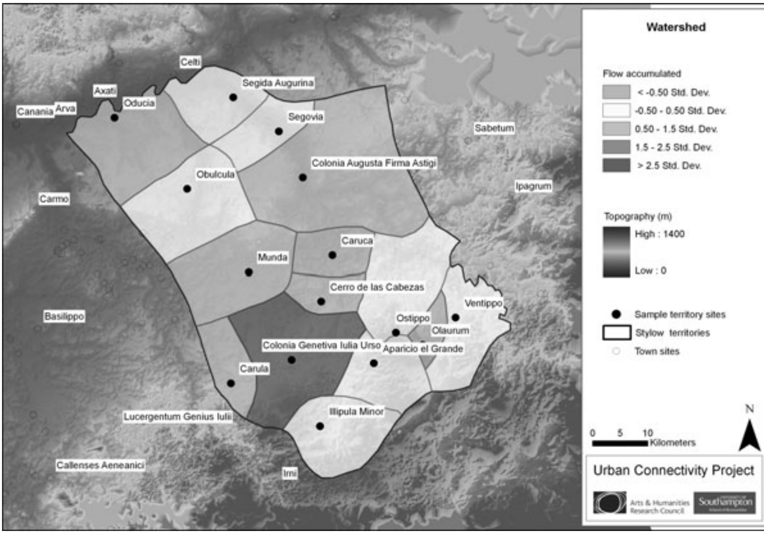

Fig. 10.8. Watersheds in the urban territories in the western *Conventus Astigitanus.*

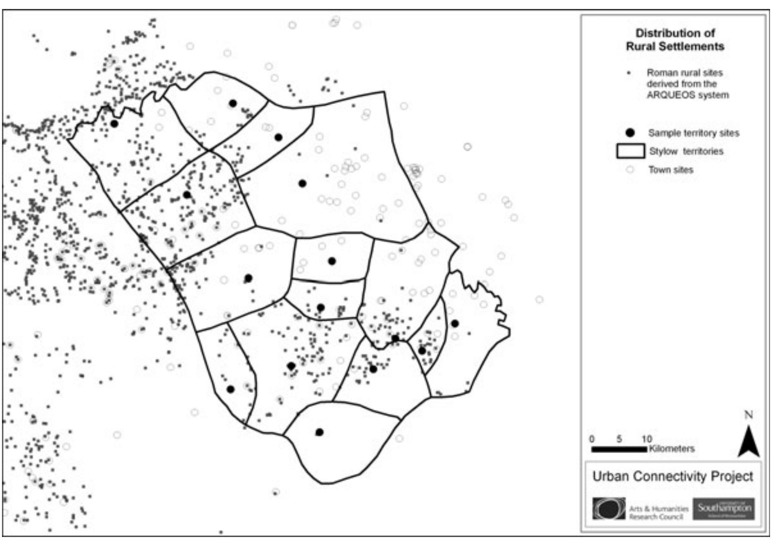

Fig. 10.9. Known rural settlements within the urban territories of the western *Conventus Astigitanus.*

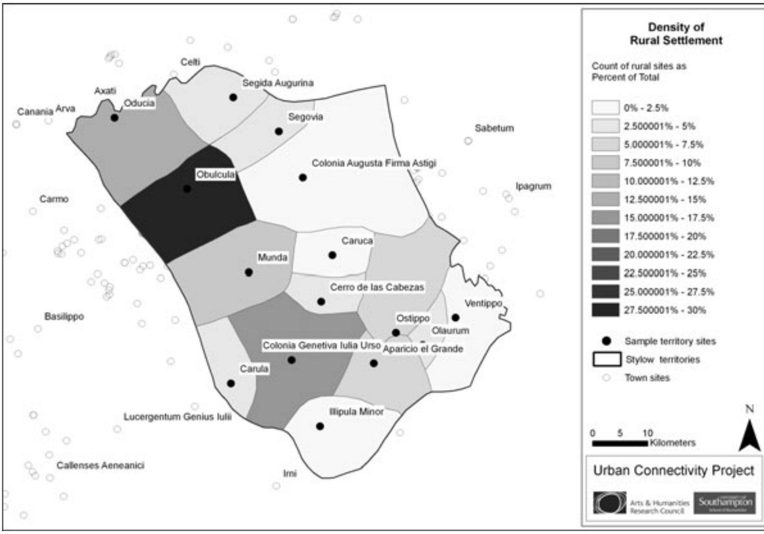

Fig. 10.10. Density of rural settlement within the urban territories in the western *Conventus Astigitanus.*

ARCHAEOLOGICAL VARIABLES

Settlement Hierarchies

Following the methodology developed by the project for the definition of settlement hierarchies (pp. 284–5), Astigi emerges as the most important in the region, both as an Augustan *colonia* and in having a high number of urban attributes[41] (Fig. 10.11), as well as having another six settlements with urban attributes within its territory. The other *colonia* in the region, Urso, appears to have fewer urban attributes detectable, although mention of a range of public buildings in the surviving chapters of the *Lex Iulia Genetivae*[42] makes it clear that this is to be explained by the absence of research and poor surviving evidence.[43] Elsewhere in the study area and immediately beyond, it is noticeable that there is a fairly even spread of evidence for urban attributes at each of the principal towns within Stylow's

[41] Sáez *et al.* 2004.
[42] *CIL* II 2/5, 1022.
[43] Campos 1989.

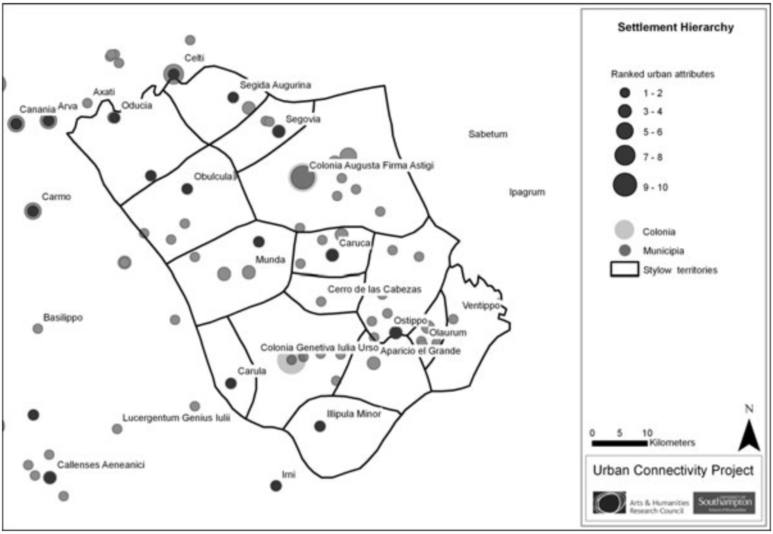

Fig. 10.11. Settlement hierarchy in the western *Conventus Astigitanus.*

suggested territories; indeed in some territories, such as those of Obulcula, Segovia, Carruca, Munda, and Ostippo, there are several sites that have urban attributes even though they are not the prime urban centre or have any legal status (see pp. 301–3 below). In those cases where urban status is absent, such as Munda and Olaurum, the absence of urban attributes is presumably to be explained by the absence of research.

It is harder to talk in terms of settlement density. The territory of Astigi emerges as having the greatest urban density in the region (Fig. 10.12), followed by Obulcula, and then Ostippo, the Colonia Genetivae Iulia Urso, and Munda. However, the figures here may be skewed by the inclusion of major Iberian settlements within the territories of Astigi[44] and Obulcula,[45] something that will be remedied in the final project publication by undertaking analyses similar to those conducted here on a phase-by-phase basis. Urban settlements are much less dense in the remaining territories.

[44] Such as the Cerro de las Balas.
[45] Such as the Cerro de San Pedro VII.

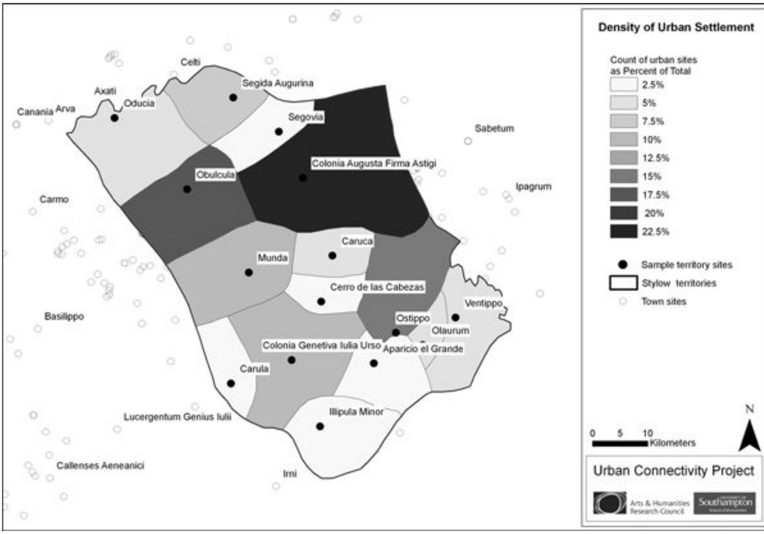

Fig. 10.12. Density of urban settlements within the western *Conventus Astigitanus.*

The Epigraphic Habit

Latin inscriptions are more readily susceptible to statistical analysis than other kinds of archaeological material,[46] owing to a long tradition of careful documentation that goes back to the sixteenth century, buttressed by the subsequent systematization of texts, particularly with the publication of the *Corpus Inscriptionum Latinarum* in the later nineteenth century, and the *CILA* and the *CIL* II 2/5 at the end of the twentieth century.

Since they are also the markers *par excellence* of the political and social activity centred at Roman towns,[47] their spatial distribution across the study area complements the earlier analysis of urban attributes. In Fig. 10.13 the total numbers of inscriptions from each territory have been subdivided into eleven different categories with a

[46] There are of course conflicting arguments about the degree to which surviving inscriptions are representative of original epigraphic populations at any one time, as well as about the range of biases that could affect interpretations of the significance of this kind of analysis: Keay 2007.

[47] For discussion see Woolf 1996.

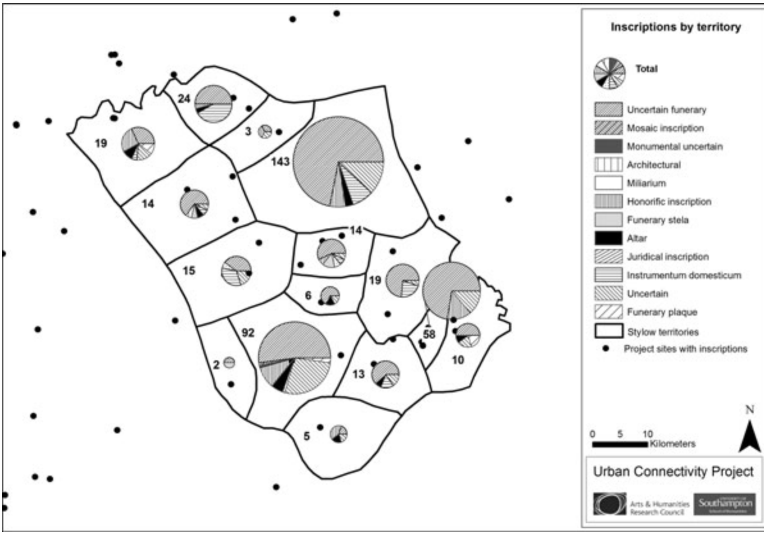

Fig. 10.13. Statistical breakdown of Latin inscriptions by territory.

view to discovering where the epigraphic habit was most intense, and whether there were any marked differences from one territory to the next. It suggests that epigraphic usage was the most intense within the territories of the *colonia* of Astigi and, to a lesser extent, Urso. Otherwise it is fairly even within the other territories across the study area. The principal differences lie in the proportion of funerary to other kinds of inscription. Although these are generically the most common class of Latin inscription in the Roman west, it is noticeable that here Astigi, Olaurum, Ostippo, and Obulcula appear to have substantially more than other settlements in other territories. The same impression can be gained by looking at the inscriptions from the individual towns within the territories (Fig. 10.14). It is also noticeable that honorific inscriptions, the evidence *par excellence* for urban-based political and social behaviour, are not just restricted to the two *coloniae* of Astigi and Urso but are quite widely represented at other towns across the area, such as Ilipula Minor, Carruca, Segovia, and Oducia, attesting the relatively deep percolation of this urban-based social, political, and religious practice across the region.

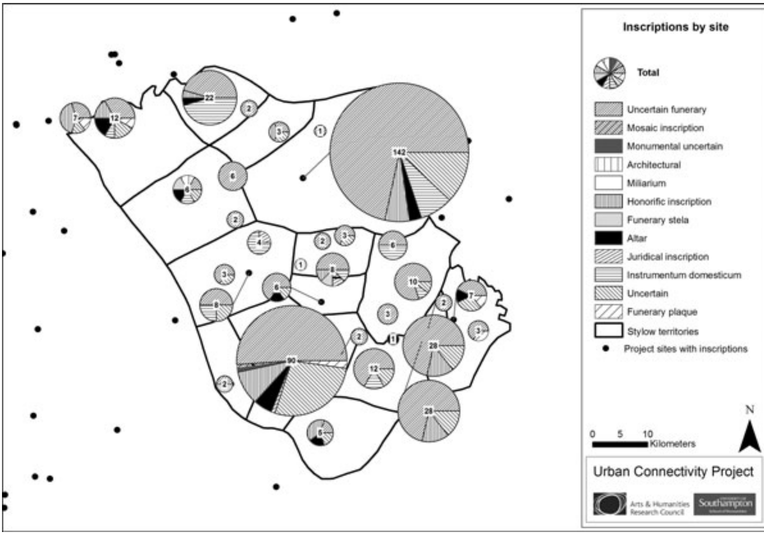

Fig. 10.14. Statistical breakdown of Latin inscriptions by town.

Case Study: Munda

In the previous pages, the limits of urban territories distinguished by Stylow in the western *Conventus Astigitanus* were compared with a range of geographical characteristics, and the variability of archaeological data within them was assessed. In general the territories seem to fit reasonably well with such variable distributions. The territories of Munda, Urso, Obulcula, and Astigi fit particularly well in terms of calculated travelling effort ('cost') and of inter-urban and inter-rural visibility; Astigi, Urso, and Ostippo work well as major regional communication hubs; the epigraphic evidence points to understandable differentiation between towns and their territories, such as Astigi, Ostippo, and so on. If the territorial limits do have some kind of underlying logic, it is interesting to note that some, such as those of Obulcula, Munda, Carruca, Ostippo, and Ventippo, all seem to encompass other, presumably secondary, centres, raising interesting questions about the limits of the classical model of single town territories.

While it has been useful to try to establish whether one geographical criterion was more relevant than another, it is likely that the establishment of the limits of a territory would have been the end result of

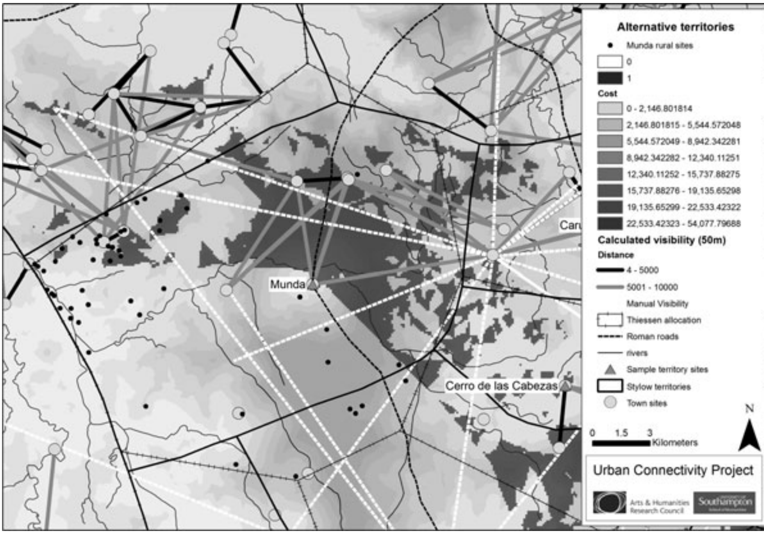

Fig. 10.15. Alternative territories: the case of Munda.

a complex range of *overlapping* geographical considerations, such as the proximity of neighbouring towns, topographical features, the availability of water resources, soil fertility, and visibility.

With this in mind, the available geographical measures used to test Stylow's territories for the single town of Munda were re-presented on a single map (Fig. 10.15).

The site of ancient Munda, the archaeological site of Alto de las Camorras and Consuegra,[48] lies in a flat plain to the north of Urso (Osuna), a short distance to the east of La Lantejuela (Sevilla). It occupies two low-lying hills, known as Consuegra (182 m) and the Alto de las Camorras (182 m), a short distance to its south-west. The maximum area of occupation on both hills was 115 hectares. The site, which is best known for the battle between Caesar and Pompey that took place in its hinterland (*De Bello Hispaniense* 27, 32, 33, 36, 41, 42), was occupied from the Late Bronze Age into the mid-imperial period. Little is known about the layout of the Iberian site although it occupied a reduced area in the highest part of Consuegra, while one of its cemeteries lay in the adjacent Alto de las Camorras. Virtually

[48] The case for the identification is argued in Stylow *et al.* 1998; see also Ferreiro López 2005.

nothing is known about the layout of the Roman-period town, which lay on the hill of Consuegra and covered some 77 hectares, while Alto de las Camorras continued as the site of one of its cemeteries. Finds from the site include surface ceramics and construction material, while some inscriptions are also known (*CIL* II 2/5, 1126–9a). Other settlements with urban characteristics within Stylow's proposed territory include Cerro de la Atalaya.

The analyses undertaken by the Urban Connectivity Project showed a close coincidence between the territorial limits proposed by Stylow, a purely geometric Thiessen polygon focused upon Munda and defined on the basis of its closest neighbouring urban centres, a clear variation in computed travelling cost, and a fall-off in the density of rural settlement. All of this suggests that some kind of geographical logic underlay the negotiation of the limits of the land upon which Munda was dependent, and in the case of rural settlement either that these same geographical imperatives drove rural settlement and/or that the rural settlements respected the same territorial extents associated with urban centres. It is, however, interesting to note that Munda itself is slightly off-centre with respect to Cerro de la Atalaya and other known urban settlements. Furthermore, although rural settlements are known throughout Munda's territory, the centroid of their distribution lies to the west of the town. By contrast, the principal arc of visibility calculated from a random sample of locations around the town lies to the north and west, with no coverage of land lying to the south. It might be tempting to use this information as a way of identifying a single boundary to Munda's territory. It is the contention of this chapter, however, that this would be misplaced, and that the 'fluidity' of the territory edge observed around Munda could be taken to represent the day-to-day reality of the boundary on the ground in opposition to a rather more precise administrative perception of where it might have ran. The complexity of Fig. 10.15 does not anticipate any future integrated computational strategy for dealing with what are clearly variable, and at once interdependent and distinct factors. Rather than combining these data procedurally, we propose that it is only from detailed comparison and analysis within the GIS software and alongside the numerical and textual data that any understanding of territoriality can develop. The figure serves to summarize one set of these data.

POPULATION SIZE

It is notoriously difficult to estimate the size of populations within the Roman empire, whether in an urban context or in the surrounding countryside. There have been many valiant attempts at gauging these from the literary, epigraphic, and archaeological evidence, often in conjunction with comparators from pre-modern non-industrialized societies.[49] These have tended to revise downwards earlier population estimates. However, they have often foundered on a variety of grounds, such as the unsuitability of ancient data for fine-grained statistical analysis and the over-simplistic interpretation of available archaeological evidence. Indeed, it is the view of the authors of this chapter that meaningful modelling of the size of ancient populations will remain elusive until there is a better understanding of relationships between human behaviour and the patterning of material culture. Only then will it be possible to start equating numbers of individuals with the very heterogeneous and incomplete data sets available to archaeologists.

Despite the richness of the archaeological record from the study area, available data do not readily lend themselves to the fine-grained analysis that might inform us about the relative size of populations at individual towns and at towns within urban boundaries.[50] No attempt was made to model rural populations, because although the evidence for the distribution of rural sites here is better than in many parts of southern Spain, virtually nothing is known about their extent or character, and detailed consideration of them lay beyond the scope of this project.

The method adopted by the authors of this chapter was necessarily crude in order to match the quality of the data available. The areas of all towns and that of their calculated territories were multiplied by the approximate minima (137) and maxima (216) per hectare for pre-industrial populations provided by Hassan (1981). However, the crudeness of the project data should be emphasized. The *Colonia Augusta Firma Astigi* is the only town sufficiently well known to enable its early imperial boundaries, and thus area, to be identified

[49] See Hassan 1981 and papers in Bintliff and Sbonias 1999, among others.

[50] The towns of southern Spain have only rarely been the subject of population estimates. Carreras 1996, for example, uses Baetican town areas and surveys in his broader analysis of population density in the Iberian Peninsula. A weakness of his study is that his evidence for the former is derived from other published data, which were themselves sometimes old and inaccurate.

with some confidence. However, the figure given here excludes any possible suburban population. This is at present impossible to calculate, although archaeological discoveries outside the walls suggest that it is bound to have existed. Figures for the extent of the other towns in this study have been estimated based on analyses of field data for the 'edge' of sites,[51] but cannot be readily ascribed to a single period with any confidence. The limitations of the method used to calculate the extent of territories will have become clear throughout this chapter.

The first measure of population size focused upon the principal urban centres for each of the fifteen territories in the study area. Unsurprisingly, perhaps, the two *coloniae* of Astigi and Urso would appear to have had the largest populations, with minima of 10,097 and 15,823 and maxima of 15,919 and 24,948 respectively (Table 10.1). It is almost certain, however, that the figures for Urso are an overestimate, given the almost complete absence of archaeological evidence for the settlement. More unexpected were the minimum and maximum figures for population at Ostippo, 14,275 and 22,507 respectively. Here again, the figures are not really credible given that we know virtually nothing about the archaeological record at the site. The other urban centres in the project area ranged from a group of towns with middle values, from Ilipula (7,151 to 11,275), Munda (5,891 to 9,288), and Obulcula (4,439 to 6,698), to towns with lower values, such as Oducia (685 to 1,080): the figures for Carruca and Carula are so low as to be of very little value.

The second measure of population size, the aggregate size of population at all urban settlements within each of the territories, is largely an indication of the degree to which the populations chose to live in a nucleated environment, rather than a measure of the total population in each territory, since rural populations have had to be excluded. These figures echo those for the individual towns at the upper end of the scale, namely at Ostippo (32,255 to 50,854), Astigi (30,097 to 47,452), and Urso (31,340 to 49,411). The middle is dominated by Munda (18,705 to 29,491) and Obulcula (18,474 to 29,126), while the territories of Carula (9,478 to 14,944), Segida Augurina (8,565 to 13,720), and Carruca (5,491 to 8,658) emerge as more significant than when viewed as individual centres of population.

[51] As represented by significant drops in the density of surface materials within an appropriate topographic context.

Table 10.1 Key statistics for the ranking of town attributes in the western *Conventus Astigitanus*

Capital	Area of capital (ha)	Average site area for all towns in territory (m^2)	Area of territory (ha)	Urban attributes of capital	Total of urban attributes for all sites in territory	Total number of inscriptions	Benefactions	Average river proximity (m)	Number of towns visible from main town in territory	Number of towns visible from main town in other territories	Number of rural sites	Density of rural sites (per hectare)
Aparicio el Grande	7.3	39,080	17,104	4	4	13	0	2444	0	0	31	0.00012
Caruca	20.4	76,956	11,701	1	10	58	0	511	3	12	1	0.00017
Carula	28.3	230,614	11,462	1	1	92	0	456	1	1	16	0.00017
Cerro de las Cabezas	5.0	4,000	8,605	1	1	2	0	554	0	0	19	0.00023
Colonia Augusta Firma Astigi	73.7	143,612	60,511	9	25	10	0	586	1	1	13	0.00003
Colonia Genetiva Iulia Urso	115.5	207,960	36,509	2	6	143	1	1157	2	0	79	0.00005
Illipula Minor	52.2	522,297	21,061	2	2	6	1	600	0	1	2	0.00009
Munda	43.0	169,385	28,621	1	9	5	0	1252	2	1	49	0.00007
Obulcula	32.4	66,656	29,510	2	6	14	1	693	0	0	145	0.00007
Oducia	5.0	29,153	28,888	2	3	19	1	1143	0	0	78	0.00007
Olaurum	9.6	58,504	5,250	1	7	3	0	609	2	3	20	0.00038
Ostippo	104.2	196,195	25,730	3	11	14	1	843	0	0	37	0.00008
Segida Augurina	17.0	211,734	15,866	1	4	24	0	718	1	3	15	0.00013
Segovia	18.4	107,275	12,673	3	6	15	0	255	1	1	14	0.00016
Ventippo	10.9	109,312	19,580	1	1	19	0	275	1	2	7	0.00010

TERRITORIAL HIERARCHIES

There has been a long tradition of studying the economy of Baetican towns and the development of rural settlement.[52] Some studies have focused on the development of towns as built environments,[53] with consideration being given to production and demography,[54] among other issues. Others have focused on the rural domain, primarily drawing upon the ambitious survey of settlement in the lower Guadalquivir by Ponsich,[55] but also using more recent surveys and analyses of olive oil production through the medium of Dressel 20 *amphorae*.[56] There have also been attempts to integrate both sources of evidence[57] and to look at the economy of Baetica in terms of towns within their rural contexts. However, there has never been an attempt to establish hierarchies of territories by mapping the archaeological evidence for the character of towns against that of the territories in which they lay, not least because the boundaries of territories are so difficult to define. Nevertheless, the integrated nature of town and country in the Roman empire suggests that this is an appropriate approach.

As a first step in this direction, the fifteen territories discussed above were ranked on the basis of a range of summary statistics. Those chosen were those most susceptible to intelligible measurement and encompassed the following categories: the area of towns and territories; their respective population estimates; the urban attributes of towns and territories; the numbers of inscriptions from territories; the average proximity of towns from rivers within each territory; the number of towns in each territory visible from the principal town in that territory; the number of towns in other territories visible from the main town of each territory; the number of rural sites within each territory and their density per hectare (Table 10.1).[58] Each of the fifteen territories was then assigned a rank number from one to fifteen for each of these categories, after which the total overall rank score for each territory was calculated, with the highest

[52] Starting with Thouvenot 1940: 231ff; see also Chic 1994.
[53] Such as León and Rodríguez Oliva 1992; Keay 1998.
[54] See, e.g. Chic 1999; Haley 1991.
[55] Ponsich 1974, 1979, 1987, 1991.
[56] Remesal Rodríguez 1998.
[57] Chic García 2001.
[58] The analyses related to visibility are not included in this article but form part of the definitive publication of this project (Keay and Earl forthcoming).

rank going to that territory with the lowest rank score (Table 10.2). The ranked totals were standardized in order to allow the above calculations, but we are aware that the variables may include elements of correlated variation, and also that ranking introduces biases into the analysis, notably as a function of the type of data summarized and in turn of the number of identical values. As a consequence, work in progress has begun to incorporate more nuanced statistical analyses both in order to qualify the values within variable types, and to provide more robust comparators between variables and ranks, including principal components analyses and cluster analyses. It must be stressed that these rankings cannot be properly understood without reference to primary data about each territory: indeed they are perhaps best understood as a coarse method for focusing critical approaches on the archaeological record and local context of each site. Differential survival of the evidence is another key issue here, the detailed consideration of which lies beyond the scope of this chapter.

At a superficial level, however, these rankings enable the comparative 'importance' of each territory in the region to be calculated on the basis of different kinds of geographical and archaeological criteria, and to understand which contribute to this. The standardized rank totals in Table 10.2 suggest that the territories can be broken down into three notional groups. The first group, with the lowest standardized rank totals (71, 86, and 91), and thus the highest rankings, comprises the *coloniae* of Urso and Astigi and the Flavian *municipium* of Ostippo. While the first two are perhaps to be expected in view of the colonial status of their principal towns, Ostippo is more surprising. All three *tend* to have low overall group totals, and thus high rankings, in criteria related to the towns themselves (area, populations, attributes, inscriptions), but high scores, and thus lower rankings, in criteria related to the broader territories (river proximity and rural settlements). This could be taken to suggest that these territories were more urbanized than those in the second and third groups. What also sets these territories apart from all the others is that their principal towns seem to have been key communications hubs for this part of Baetica.[59] The second group with the middle standardized rank totals (116, 109, 117, 108, 111, 110, and 118) consists of the territories of Carruca, Segovia, Carula, Obulcula,

[59] This issue is treated more fully in Keay and Earl 2007.

Table 10.2 Ranking of towns in the Western Conventus Astigitanus by attributes

Rank no.	Capital	Area of capital rank	Average site area for all towns in territory (m^2) rank	Area of territory rank	Urban attributes per capital rank	Total of urban attributes for all sites in territory rank	Inscriptions Rank	Benefactions Rank	Average river proximity (m) rank	Number of towns visible from main town in territory rank	Number of towns visible from main town in other territories rank	Number of rural sites rank	Density of rural sites (per hectares) rank	Standardised rank total
1	Colonia Genetiva Iulia Urso	1	4	2	5	6	1	1	13	2	10	2	14	452
2	Ostippo	2	5	6	3	2	8	1	11	10	11	5	10	552
3	Colonia Augusta Firma Astigi	3	7	1	1	1	11	6	6	5	5	12	15	569
4	Caruca	8	10	12	9	3	3	6	4	1	1	15	4	613
5	Segovia	9	9	11	3	6	7	6	1	5	5	11	5	616
6	Carula	7	2	13	9	13	2	6	3	5	5	9	3	643
7	Obulcula	6	11	3	5	6	9	1	9	10	12	1	13	645
8	Illipula Minor	4	1	7	5	12	12	1	7	10	5	14	9	658
9	Munda	5	6	5	9	4	13	6	14	2	5	4	11	671
10	Segida Augurina	10	3	10	9	9	4	6	10	5	2	10	6	686
11	Olaurum	12	12	15	9	5	14	6	8	2	2	7	1	732
12	Ventippo	11	8	8	9	13	5	6	2	5	4	13	8	743
13	Oducia	14	14	4	5	11	6	1	12	10	14	3	12	784
14	Aparicio el Grande	13	13	9	2	9	10	6	15	10	13	6	7	865
15	Cerro de las Cabezas	15	15	14	9	13	15	6	5	10	15	8	2	993

Ilipula Minor, Munda, and Segida Augurina. Within this group, urban area is one of the criteria that achieves lower scores, and may thus be significant, while urban attributes and rural settlement score rather higher and are, thus, perhaps of less relative importance. The third, least 'important', group with the lowest standardized rank totals (131, 133, 144, 154, and 176) comprises the territories of Olaurum, Ventippo, Oducia, Aparicio el Grande, and Cerro de las Cabezas. Here the lower-scoring and thus higher-ranking criteria are numbers and densities of rural settlements, as well as urban attributes. Since the actual number of benefaction inscriptions is small, the low score value here may not be significant. On the other hand, urban areas, and thus urban populations, are high-scoring, thus suggesting that low urban populations were a characteristic of these territories. One final general comment is that whatever credence one has in these rankings, if any, the presence of urban attributes and inscriptions throughout all the territories in the region attests the depth of penetration of *urbanitas* in the western sector of the *Conventus Astigitanus*.

CONCLUSIONS

The characterization of urban territories, whether epigraphically, topographically, culturally, or through some other means, is inevitably complex but deserves to be explored more widely. The contention of this chapter is that they are susceptible to definition by drawing upon a careful contextualized analysis of key epigraphic criteria, and that territories so derived can be usefully analysed by a range of archaeological and geographical factors. From this it becomes apparent that territoriality is a function of many components, each of which has implications for the connectivity of central and surrounding locations. The ancient landscape can be seen as multifaceted, with relationships between places ebbing and flowing not merely in time (which is a highly significant benefit of such analyses), but also in terms of cost of travel, tangible network factors such as rivers, similarity of urban material culture assemblages, chronology, and spatial patterning, topography including slope and landscape character, and so on. In the light of this, it is suggested that the territories of Roman towns should perhaps be thought of at two conceptual levels. At one level there are territories as understood by Roman administrators, whose boundaries formally defined the 'edge' of land dependent upon town-based communities that formed the basis of tax assessment by the Roman state, and which could be expressed in simplified cartographic form in municipal archives. At another, these same boundaries also existed as notions differentially experienced by people on a day-to-day basis. As such, they were much more 'fluid' than legalistic understandings of territories would suggest, and are better understood in terms of structured imprecision than a line drawn across the landscape. Notwithstanding this, the analysis undertaken in the last section of the chapter suggests that, however imprecise, these territories can act as a useful unit of analysis. The creation of relatively crude hierarchies that combine archaeological, geographical, and epigraphic data acts as a useful palliative to the strictly town-based analyses of provincial landscapes and their populations.

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11

Ptolemaic and Roman Egypt

Population and Settlement

Alan Bowman

I. THE DEMOGRAPHIC SCENARIO

Any advance in understanding patterns of population and settlement in Egypt from the third century BC to the mid-fourth century AD[1] will be seriously flawed if it is based on macro-economic calculations that are regarded as secure. Despite the fact that A. H. M. Jones regarded Josephus' population figure of 7.5 million, excluding Alexandria, as the only reliable population statistic for a sizeable region in classical antiquity,[2] scholarly debate remains vigorous and there is still no consensus on the size of Egypt's population in classical antiquity (Table 11.1). Scheidel has well summarized the issues, and, allowing for the geopolitical idiosyncrasies of Egypt, which are well recognized, the debate sits squarely in the larger demographic landscape of Italy and the rest of the Roman empire, which is at present dominated by arguments for and consequences of high and low counts.[3] It is, of course, possible to construct scenarios in which various demographic features can be quantified, proceeding from high, low, or median counts,[4] but

[1] I here explicitly exceed the stated chronological parameters of the Roman Economy Project (OXREP), but the importance and the quality of the evidence for the third century BC, now presented in Clarysse and Thompson 2006, justifies this.

[2] Jones 1948: 10, echoed by Finley 1985: 31.

[3] Scheidel 2001a; cf. Morley 2001; Scheidel 2007: 85, who suggests an *actual* fluctuation of the population of Egypt between 4 and 7 million. The effects of the Antonine Plague will certainly provide an example of fluctuation; see below.

[4] E.g. Tacoma 2006; Alston and Alston 1997. See also the contributions of Lo Cascio and Bagnall to Bowman and Wilson 2009.

Table 11.1. Some estimates of the population of Egypt in the Ptolemaic and Roman periods.

References to Estimates	Date	Population	Density/ km^2
Clarysse & Thompson 2006: II 100–2	*c.* 250 BC	1.5 million	75 (?)
Clarysse 2003	224/3 BC	2.8 million	
Butzer 1976: 84	Early Ptolemaic	2.4 million	
Butzer 1976: 83	150 BC	4.9 million	240/135[a]
Diodorus 1.31.8	59 BC	3 or 7 million[b]	
Josephus *BJ* 2.385	AD 75	7.5 million excluding Alexandria	
Krüger 1990: 38	Roman period	6.3–6.8 million	287–309
Rathbone 1990, Bagnall & Frier 1994: 54	Roman period	3–5 million	
Lo Cascio 1999	Roman period	*c.* 8 million	
McEvedy & Jones 1978: 226–9	II AD	*c.* 5 million	
Scheidel *et al.* 2007: 48	*c.* AD 150	5–6 million	

[a] The higher density is the estimate for the Valley and the Fayum, the lower for the Delta. For comparison, Butzer's estimate for 1250 BC is 2.9 million (1976: 83).
[b] The uncertainty concerning the figure in this passage arises from a textual difficulty, on which see the summary by Rathbone (1990: 104 n.2), who opts for accepting the lower number.

these are inevitably speculative and do not offer a secure basis for reaching conclusions on the broader questions. As Scheidel has shown, almost all the hypotheses involve assumptions or consequences that have some degree of implausibility or poorness-of-fit.[5] This is partly, but not only, because an accurate understanding of the major demographic features necessarily involves other quantifiable elements that are themselves equally or more uncertain: amount of land under habitation and cultivation; crop yields and carrying capacity of the land; density of habitation; intrinsic growth rate of the population; rate of urbanization; to name but a few.

There has been a considerable amount of work in recent years on the demography of Egypt, producing varying and irreconcilable figures that resist any generally accepted consensus. The main thrust of the present chapter is to consider how and where we might take advantage of data on settlement and population (even where

[5] Scheidel 1999, 2001a, and 2001b.

ambiguous or fragile) as a basis for further understanding of economic development, given the acknowledged uncertainties in the macro-demographic picture. It will be evident in the end that we shall not at present be able to replace the widely varying modern estimates illustrated in Table 11.1 by anything like a definitive solution. I proceed, rather, along the lines suggested by M. H. Hansen in advocating the 'shotgun method' and relying heavily on the approach initiated by Rathbone in assembling what reasonably precise and reliable figures we do have.[6] In fact, what follows traverses much of the ground covered by Rathbone, without repeating all the detail, adding material assembled by Bagnall and Davoli, and other pieces of more recent evidence.[7] This offers some basis for considering what patterns emerge from these figures and what tendencies they suggest for the macro-demographic picture. I then conclude with some *comparanda* from other regions of the eastern Mediterranean. I hope that it will emerge from this that, even if it has not yet been achieved, some progress is possible in understanding the structure of the population, density of habitation related to amount of land under cultivation, numbers of settlements, urbanization rates, and growth and decline of population over time. As a preliminary, I note the conclusions reached by the authors of the most recent and thorough study of the demography of Egypt. Features of the population structure about which we can know something are: household structure; the female life table; patterns of first marriage; fertility control; and the balance of fertility and mortality. Features about which we cannot at present know anything reliable are: infant mortality; male life expectancy; and the sex ratio.[8] In view of the tenacity of the notion that Egypt was in some way 'atypical' in the Graeco-Roman world, it is also worth emphasizing the view of Bagnall and Frier that the population structure of Roman Egypt fits very well into pre-modern Mediterranean patterns as they are observed in other periods and places. If we believe this, as I think we must, there is every justification for thinking that our conclusions will have a wider relevance.

[6] Hansen 2006; Rathbone 1990. I am aware that there are several relatively recent studies, including my own (Bowman 2000), that present quantified data and figures, but many of these are subject to degrees of uncertainty outlined above; the conservative approach adopted here dictates scepticism in accepting their historical validity, as opposed to their illustrative value. See also Alston 2002; Tacoma 2006.

[7] Principally Bagnall 1993; Davoli 1998; 2005.

[8] Bagnall and Frier 1994: 170.

It is certain that by ancient standards the population of Roman (if not late Ptolemaic) Egypt was large and that there was a very large number of settlements.[9] As a preliminary, it is worth considering the evidence for the area of land on which these settlements lay (see Fig. 11.1). This is, once again, a matter on which there is no consensus, and there is a tendency to express a preference for this or that figure without rigorous argument or justification. Further, a clear distinction is not always made between land under cultivation and area under habitation. Calculations from modern estimates of surface area are undermined by changes in the course of the river that have affected the area of the floodplain. At the top of the scale are the total area estimates of 35,000 and 34,000 km^2, probably better taken as usually referring to total inhabited surface area.[10] Most estimates for the cultivated area in Hellenistic and Roman times lie in the range of 20,000 to 27,000 km^2. This order of magnitude is ultimately based on two independent calculations by Meeks and Schlott-Schwab, which were influentially elaborated by Karl Butzer, the hypothetical breakdown of whose figures for land and population are reproduced in Table 11.2.

This compares closely with the figure of 27,659 km^2 for the census of 1882[11] and with Bagnall and Frier's estimate for the 'inhabited area' (which I take to mean settlement plus cultivated land) of about 28,000 km^2.[12] It is the basis for the more detailed set of figures for individual nomes (i.e. districts) in the Valley calculated by Bagnall, which is further

[9] At least that much may be deduced from Diodorus' statement (1.31.7) that there were more than 30,000 κῶμαι and πόλεις, even if the figure itself is of no value at all (cf. Rathbone 1990: 107). Inferences about the number of villages in particular areas (below, p. 333) might suggest that the figure of 3,000 is likely to be a reasonable minimum; that would, on the face of it, better suit a *low* total population estimate but is perhaps considerably too low. Bagnall 2009 emphasizes the importance of *numbers* of settlements, rightly, in my view (see below, pp. 332–3).

[10] So Baines and Malek 1980, basing the estimate of 34,000 km^2 as the total surface area of the Valley and Delta on figures from 1949/50. McEvedy and Jones 1978: 226–9 estimated the *cultivated* area at 35,000 km^2. Scheidel 2007: 48 gives a figure of 30,000 km^2 without explanation or justification.

[11] Meeks 1972; Schlott-Schwab 1981: esp. 160–9. Butzer 1976: 80–6, cf. Rathbone 1990: n. 14 for Barois's early twentieth-century figure of 24,105. Scheidel prefers a figure closer to 20,000. Butzer's figure for the Fayum is considered too small by Clarysse and Thompson 2006: II 90, arguing for about 1,600 km^2 (which Rathbone 2007 considers too large), but this does not greatly affect the total for the whole of Egypt. The census figure for 1882 is quoted by Butzer 1976: 92.

[12] Bagnall and Frier 1994: 56 n. 15. Others have preferred the lower end of the range, *c*. 20,000 km^2.

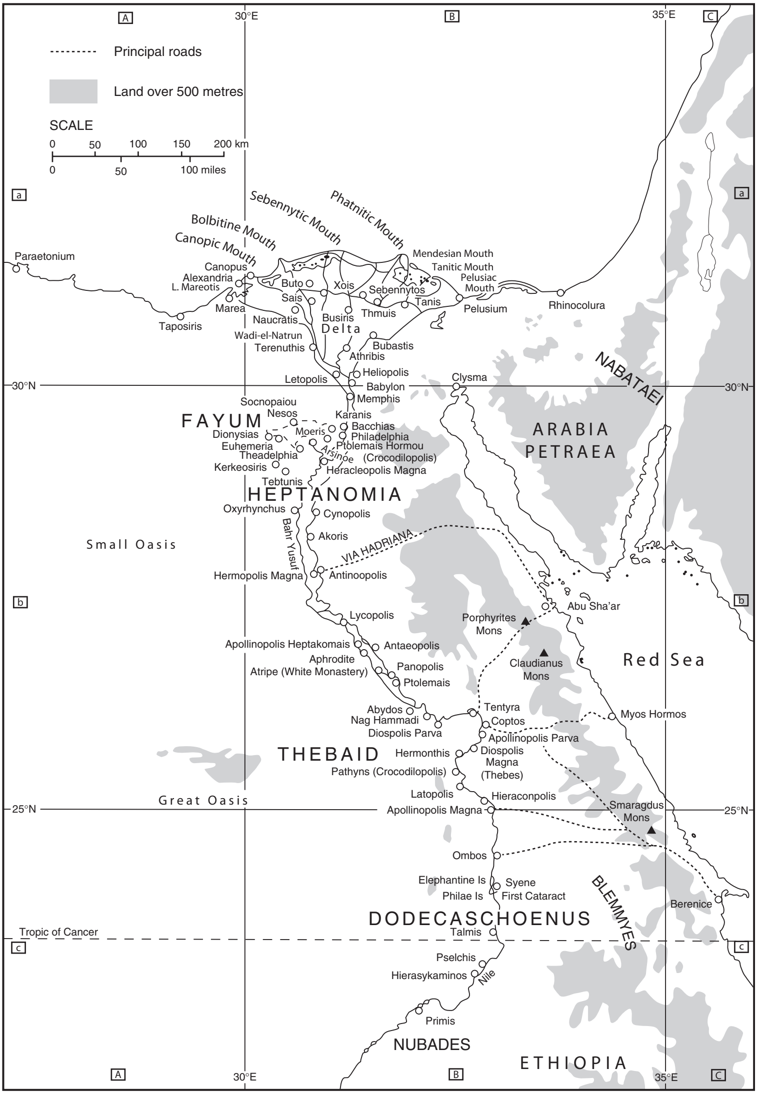

Fig. 11.1. Map of Egypt

Source: After Rowlandson 1996, Map 1.

Table 11.2. Population density by region.

Region	1250 BC			150 BC		
	Area (km^2)	Density/ km^2	Population	Area (km^2)	Density/ km^2	Population
Valley	9,000	180	1.62m	10,000	240	2.4m
Fayum	400	180	0.072m	1,300	240	0.312m
Delta	13,000	90	1.17m	16,000	135	2.16m
Desert			0.025m			0.050m
Total			2.9m			4.9m

Adapted from Butzer 1976: 83, Table 4

broken down in Table 11.3 (and cf. Fig. 11.2).[13] The areas about which we have a significant amount of more detailed information are the Hermopolite, Oxyrhynchite, Herakleopolite, and Arsinoite, and they are further discussed below.[14] The total of Bagnall's estimates presumably represents something more than 25 per cent of the total inhabited surface area, and the individual nomes exhibit wide variation in size. It is of course possible to extrapolate from them to speculative estimates for areas about which we have little or no detailed information (e.g. if the Oxyrhynchite has *c.* 120 villages, the Hermopolite will have had *c.* 180), but from the point of view of economic analysis this has only limited illustrative value and begs a question about possible differences in regional settlement patterns, especially as between the Delta, Valley, and Fayum, but perhaps also in the Valley itself.[15] The results of estimates calculated within the range of 'known' population sizes and averages produce maxima and minima with such wide parameters that they are of little use in terms of economic quantification.[16]

[13] Bagnall 1993: App. 3; cf. Bagnall 1992: 138. These figures are presented and analysed with minor modifications by Tacoma 2006: 54–5, who produces a model with significant margins of error or speculation, as do Alston and Alston 1997.

[14] After the end of the third century the Antinoite Nome was created out of the Hermopolite Nome, but this administrative change may here be ignored (cf. n. 43 below).

[15] Compare Butzer's hypothetical settlement patterns for 22 nomes of the Valley in the Dynastic period (1976: 74–5, Table 3), reconstructing hierarchies of size based on a classification of Cities, Large Centres, Small Centres, and Large Villages. For numbers of villages see below, pp. 335–6.

[16] Tacoma 2006: 54–5: e.g. Oxyrhynchus 20,000–42,000, Ombos 5,000–10,000, a 'rounded average' of 14,000–22,000; cf. n. 73 below. These are hardly more promising than the range of 4 to 8 million for the population as a whole. The calculations rest on the principle that the population of the capital will be directly related to the capacity of the

Table 11.3. Estimates of land use based on the assumption of 90 per cent habitation/cultivation.

Nome	surface area	cultivated/inhabited area at 90% total		grainland area at 80% cultivated/inhabited		garden land/vineyard at 10% cultivated/inhabited		other uses at 10% cultivated/inhabited	
	(km²)	(aroura)	(km²)	(aroura)	(hectare)	(aroura)	(hectare)	(aroura)	(hectare)
Ombite	72	23,522	64.8	18,818	5,184	2,352	648	2,352	648
Apollonopolite	137	44,757	123.3	35,806	9,863	4,476	1,233	4,476	1,233
Latopolite	225	73,507	202.5	58,806	16,199	7,351	2,025	7,351	2,025
Diospolite	284	92,782	255.6	74,226	28,448	9,278	2,556	9,278	2,556
Koptite	331	108,137	297.9	86,510	23,832	10,814	2,979	10,814	2,979
Tentyrite	300	98,010	270.0	78,408	21,600	9,801	2,700	9,801	2,700
Diospolite Parva	306	99,970	275.4	79,976	22,032	9,997	2,754	9,997	2,754
Thinite	613	200,267	551.7	160,214	44,136	20,027	5,517	20,027	5,517
Panopolite	575	187,852	517.5	150,282	41,400	18,785	5,175	18,785	5,175
Antaiopolite	531	173,477	477.9	138,782	38,232	17,348	4,779	17,348	4,779
Hypselite	125	40,837	112.5	32,670	9,000	4,084	1,125	4,084	1,125
Apollonopolite Parva	206	67,300	185.4	53,840	14,832	6,730	1,854	6,730	1,854
Lykopolite	250	81,675	225.0	65,340	18,000	8,168	2,250	8,168	2,250
Koussite	272	88,862	244.8	71,090	19,583	8,886	2,448	8,886	2,448
Hermopolite	1,140	372,438	1,026.0	297,950	82,080	37,244	10,260	37,244	10,260
Kynopolite	110	35,937	99.0	28,750	7,920	3,594	990	3,594	990
Oxyrhynchite	780	254,826	702.0	203,861	56,160	25,483	7,020	25,483	7,020
Herakleopolite	643	210,068	578.7	168,054	48,706	21,007	5,787	21,007	5,787
Arsinoite	1,500	363,000	1,350.0	290,400	80,000	36,300	10,000	36,300	10,000
Nilopolite	133	43,511	119.7	34,809	9,575	4,351	1,199	4,351	1,199
Aphroditopolite	200	65,340	180.0	52,272	14,400	6,534	1,800	6,534	1,800
Memphite	281	91,802	252.9	73,442	20,232	9,180	2,529	9,180	2,529

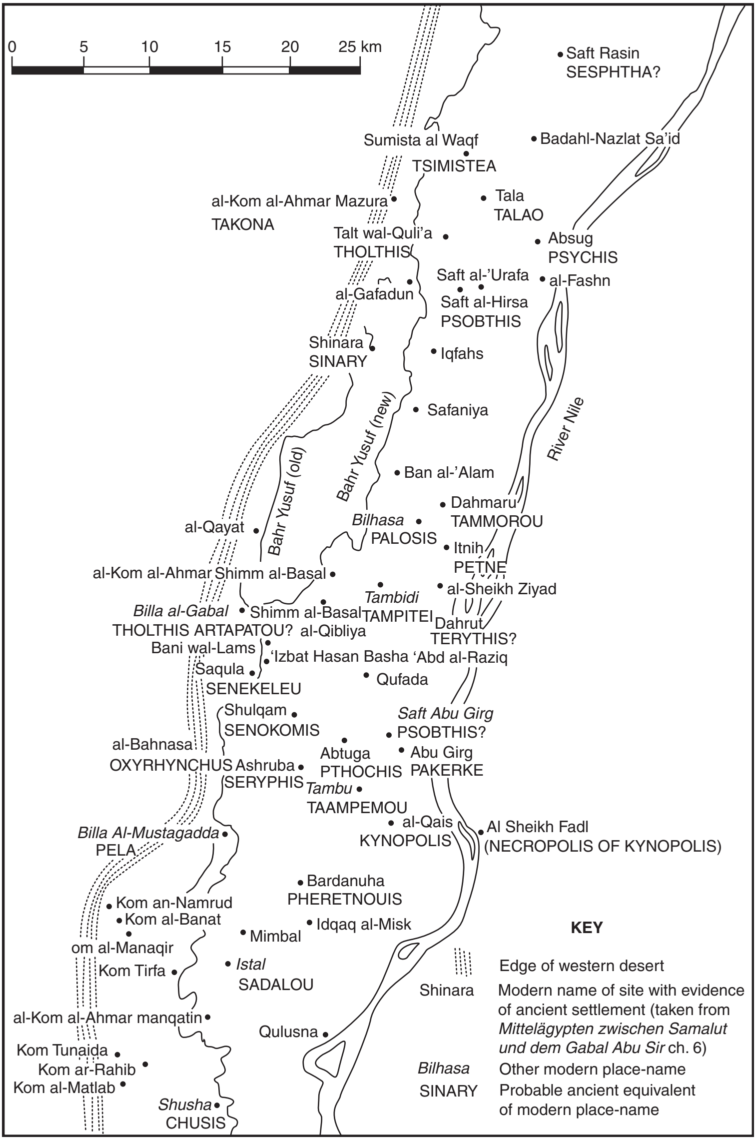

Fig. 11.2. Map of the Oxyrhynchite Nome

Source: Rowlandson 1996, Map 2.

To summarize this brief and inevitably inconclusive discussion, we are not now able to calculate total areas in antiquity with any great precision. The best figures available for total surface area suggest around 34,000 km^2, and for the inhabited plus cultivated area a maximum of 27,000+ km^2 (based on the sources cited in nn. 12–13 above and comparison with the 1882 census figure). The latter will have to be brought into play at some later point in calculations connected with the agricultural economy, but for the present it can be placed on the back burner.

Before considering the evidence in some detail, something needs to be said about key structural features of the patterns of population and settlements, in particular population growth (and decrease), population density, rates of urbanization, and demographic structure. Rates of growth and decline are clearly crucial. For Egypt we need to distinguish the effects of immigration (impossible to quantify precisely) from those of intrinsic growth and decline. Although immigration must have had a huge impact in the first century or more of Ptolemaic rule, we are probably justified in thinking, even if only intuitively, that its impact was not nearly so significant after *c.* 150 BC. The recent proposal for a low population of *c.* 1.5 million in the mid-third century BC does not, in any case, seem plausible even if we recognize that the higher figure implied by Butzer is hypothetical.[17] Evidently, we need to be constrained by what seem to be plausible intrinsic growth rates in a pre-modern Mediterranean pattern.

territory to support it, thus assuming a standard rate of productivity. He concludes that most towns were 'rather small' but this impressionistic statement lacks any contextualization or yardstick. For a critique of Tacoma's methodology see Bagnall 2007. See further below and the chapters by Wilson and Marzano (Chapters 7 and 8) in this volume.

[17] For the low estimate see Clarysse and Thompson 2006: II 100–2, challenged by Rathbone 2007, noting the likely under-reporting of taxable adults and the over-estimate of the inhabited area of the Fayum. One might add that Clarysse and Thompson's overall figure for Egypt is obtained by upward adjustment of the low figure for population density in the Fayum, derived from the census documents (60/km^2) to 75/km^2 and applying it to the rest of Egypt. If this surprisingly low figure for the Fayum *c.* 250 BC is correct, one could offer speculative reasons as to why that might not be representative of Egypt as a whole (e.g. immigrants were not impoverished refugees but ambitious speculators who were offered larger allocations of land than was the case for indigenous Egyptians elsewhere and this could be worked more efficiently owing to improvements in irrigation technology). Butzer's graph (1976, 85: Fig. 13) shows an estimate of about 2.5 million *c.* 500 BC, a decline from the New Kingdom level, and his speculative figures for the Ptolemaic period (Table 11.2 above) suggest a doubling of the population between *c.* 300 and 150 BC.

Bagnall and Frier have noted the possibility of a long-term growth rate of 0.3 per cent while believing that 0.1 per cent is more likely.[18] Elsewhere a rate of 0.08 per cent is described as 'modest'.[19] It is obvious that the only possible type of conclusion is not that we must apply some particular rate within the possible parameters, but that we can accept a specific rate if it represents a plausible change from one figure to another over the given time period. The actual rate of growth will be determined by factors such as the carrying capacity of the land, birth rates and infant mortality rates, disease, and so on.[20] A firm conclusion is not possible when we know neither figure. Bagnall and Frier note that with an intrinsic growth rate of 0.2 per cent per annum, the population will double in *c.* 350 years; a steady population increase from (say) 2.5 million in 250 BC to 8 million in AD 150 represents an intrinsic growth rate of 0.3 per cent. As a very crude illustration with no claim to historical exactitude, partly based on Butzer's speculative estimates (see n. 19), one might take a population of around 2.5 million at the start of the Ptolemaic period, augmented by rapid immigration perhaps well in excess of 0.5 million, increasing to about 4 million by 150 BC at a consistent average annual growth rate of 0.3 per cent. Continued consistent growth of 0.25 per cent would take it from around 4 million to around 7 million by AD 70. This can, of course, only be assessed for goodness-of-fit with model populations and with other demographic factors, not as a precise historical reality (and many would still regard it as too high), but we should note the claim or the assumption that Egyptian population levels were broadly stable over the period.[21] Some benefit may be gained from comparison with Egyptian population levels in the nineteenth century, even though the accuracy of those figures too is open to serious question. Adjusted modern estimates for the period from 1805 to 1905 show the indigenous population more than doubling in size over that period.[22]

Speculative though it may be, there is perhaps some value in further considering the impact of immigration. Although there is

[18] Bagnall and Frier 1994: 100.
[19] Butzer 1976: 86.
[20] Scheidel 2001b.
[21] Bagnall and Frier 1994: 173–8 (but cf. n. 3 above).
[22] See Scheidel 1999, with graph at 323, representing an annual growth rate of about 0.8 per cent (figures in contemporary sources show a quadruple increase). Increase from the 1805 modern estimate of 4.8 million to 8 million in 1882 represents a growth rate of about 0.5 per cent per annum.

general agreement that the scale of immigration from the Greek world into Egypt after the Ptolemaic takeover was large, there is no basis for estimating exactly how large. The foundations of Alexandria and Ptolemais may be assumed to have new and large populations that were almost entirely immigrant and might have together approached 400,000 by the later Ptolemaic period: Alexandria perhaps well in excess of 300,000 in the mid-first century BC, and Ptolemais was a city not smaller than Memphis. To this should be added the new Greek settlers in the Fayum (a very high percentage of its population), and elsewhere.[23] The incidence of mass and very rapid immigration, which represented an increase of the population from (say) 3 million to 3.5 or 3.75 million over a period of a few decades, would be impossible to document precisely in the ancient world and it seems doubtful that modern parallels would be very helpful.[24] We do not know much in detail about the origins of the Greek immigrants,[25] but it is perhaps worth bearing in mind the possibility that the potential intrinsic growth rate of the Greek immigrant population could have been higher than that of the indigenous population (although that distinction was blurred in the course of time by patterns of intermarriage). Reasons for that might be imagined: some genetic predisposition; cultural patterns; higher standards of health and nutrition; larger allotments of land and greater wealth; and so on.

It hardly needs to be added that the patterns of growth and decline in antiquity were not steady or continuous or, indeed, uniform over the Mediterranean region. There seems no reason to doubt a trend of

[23] Alexandria, Diodorus 17.52.6, more than 300,000 ἐλεύθεροι, to which the slave population would have to be added; Memphis, Strabo 17.1.2, cf. Thompson 1988: 32–6. Fayum, see Clarysse and Thompson 2006: II 140–1, and elsewhere (Heinen 1997; Kramer 1997). Rathbone's estimate (1990: 112–13) of a 'total Greek population of around 400,000' apparently takes no account of Alexandria and Ptolemais, which would have more or less doubled that figure.

[24] There might, however, be some comparison to be made with post-1945 Australia, which was aiming to encourage migration in order to increase the population by 1 per cent per annum and thereby achieve an annual growth rate of 2 per cent (presumably a combination of natural growth and immigration, which must also have been the case in Ptolemaic Egypt), partly by offering cheap fares to migrants; see http://www.immi.gov.au/media/publications/statistics/federation/timeline1.pdf.

[25] See Clarysse and Thompson 2006: II 140–2; Bagnall 1984 = 2007: VI, 1997; and cf. Fraser 2007, identifying members of the garrison at Hermopolis with origins in Cyrene, Crete, Thessaly, and southern Asia Minor, but, surprisingly, probably none from Macedonia.

natural population growth up to *c.* AD 150, and there is very good reason to see a sharp decline as a result of the Antonine Plague of the 160s. Precise figures are, to say the least, debatable. Attempts to quantify it (ranging between 40 per cent and 20 per cent) have been based on the evidence of tax documents from the Fayum village of Karanis and, more recently, the carbonized papyri from Thmuis in the Mendesian Nome (Delta).[26] There was undoubtedly a demographic recovery, but there is no agreement on scale or chronology. One estimate posits a fairly well-sustained recovery of 20 per cent or more, suggesting approximately a sixty-year climb to pre-plague levels. Another postulates a recovery period of at least a century.[27] The late third and early fourth centuries have traditionally been seen as a period of depopulation and decline, but it is important not to extrapolate from a few bits of anecdotal evidence, robust though they may be, to broad longer-term trends. The clear evidence for decline in some Fayum villages (see below) may be local and sporadic and may also conceal internal migration, or movement to towns and larger settlements (which some have also identified or hypothesized for the second century AD).[28]

Modern estimates of population density also vary widely, with little consensus as to what is or is not sensible.[29] An estimate of 8 million people living on 27,000 km^2 of inhabitated/cultivated land yields an overall average of almost 300/km^2, higher than Butzer's maxima for the second century BC (above), perhaps higher than most people would envisage for the Mediterranean in antiquity, and impossibly

[26] Boak 1955; Rathbone 1990: 114–19, 134–7; cf. Bagnall 2000.

[27] Rathbone 1990; Bagnall and Frier 1994: 173. The debate is clearly focused in Bagnall 2000; Van Minnen 2001; Scheidel 2002; Bagnall 2002a, in which the discussion turns on analysis of taxation, costs, prices, wages, etc. This lies beyond the purview of the present chapter, which deals with what 'raw' evidence exists for population and settlement, and is reserved for further discussion in a later volume. It is relevant that a main point made by Bagnall 2002a is that the proxy data claimed by Scheidel 2002 as fitting his model are 'capable of explaining any evidence at all' (p. 115). For the view that there are no proxy data that are useful for estimating the impact of the plague see Greenberg 2003.

[28] Bagnall 1979/82 = 2003: VI analyses the evidence for shrinkage in some Fayum villages in the fourth century. See further below. For movement to the *metropoleis* especially in the second century AD, see Bagnall and Frier 1994: 169.

[29] Cf. Rathbone 2007. For widely varying estimates of regional population densities in dynastic Egypt, see Butzer 1976: 80.

high for some.[30] In the present context, there might be more to be gained by concentrating on the smaller picture and setting aside the possible meanings of such global averages. Most people cluster in nucleated settlements, larger or smaller, and the density in towns would certainly be expected to be greater than in villages. This reduces the matter to (a) the carrying capacity of a certain amount of land with a certain number of settlements on it (or, to put it another way, the size of the *territorium* that a settlement can draw on through an infrastructure of transport networks, markets, etc.), and (b) the physical organization of living space in the settlements and the number of people it will accommodate. Modern estimates very often appear to depend on notions of what *seems* too high or too low without analysis of the particular carrying capacity and conditions. In the Egyptian context, an extreme illustration of this will be the village of Soknopaiou Nesos, in which a population was supported without the village having any land in its own territory; the key factor here was land attached to neighbouring villages, and this curious phenomenon might have been a major reason for the decline and eventual disappearance of Soknopaiou Nesos in the early third century AD.[31] In short, there seems no reason to assume a 'Mediterranean standard' by which a particular density per km^2 in a specific region should be regarded as excessively high or low within reasonable parameters. This seems all the more obvious when one looks at a recent estimate for the Roman provinces, in which Egypt is more densely populated than any other province by several orders of magnitude.[32] Self-evidently, a significant part of the explanation for such differences is topographical—the floodplain of the Nile Delta and Valley compared (say) with the mountains of Greece. We shall have to consider what conclusions to draw about the impact of this on the economy of the regions in question: more scattered (and smaller?) settlements in mountainous regions, greater distances and difficulties of communication, among other factors, will have a profound effect.

From the point of view of the economic historian, levels of urbanization are perhaps equally significant. They have not been ignored in

[30] The average density for a total *surface* area of 34,000 km^2 is about 235. Cf. Rathbone 1990: 108–9.

[31] See Hobson 1984.

[32] Scheidel *et al.* 2007: 48: all other provinces are below 50 per km^2; Egypt is in the range 167–200 per km^2, vastly greater than the densities suggested by Clarysse and Thompson for the Ptolemaic Fayum (see n. 17 above).

the Egyptian context and they receive some closer attention elsewhere in this volume. It is now generally recognized that Egypt was, by the standards of the classical Mediterranean, highly urbanized. At the crudest level, one can estimate 40 nome capitals at an average population of say 10,000 (an average, by the way, in which one can have no great confidence), plus Alexandria and a couple of other large cities (Memphis, Ptolemais) accounting for more than 0.5 million: total 1+ million, calculated as a percentage of the (estimated) total population. By this method, the 'urbanization' rate has been set as high as 37 per cent.[33] This may seem, in the context of modern discussion of ancient levels of urbanization, completely implausible for the pre-industrial Mediterranean economy, predominantly rural–agricultural, because there has been a tendency to polarize the productive agrarian economy and the consumer cities. So if the cities are simply or predominantly consumers of the greater proportion of the major product (agricultural), then the higher the rate of 'urbanization', the more implausible it will be—in other words an agrarian society needs a high ratio of rural 'producers' to support its urban 'consumers'. However, I do not believe that this simplistic dichotomy can validly be applied to the Roman Mediterranean economy and certainly not to Egypt. We need to consider further (a) the criteria for classifying centres as 'urban', and (b) the economic role of urban centres and their inhabitants across the whole spectrum of production and consumption; in other words to articulate the relationship between urban and rural settlements in a more nuanced way, taking account of the two-way flow of goods, services, and control (both personal and institutional) of the economic processes.[34]

As for demographic structure, I make no attempt at this point to go beyond the conclusions of Bagnall and Frier, about which a few remarks were offered above.

With these uncertainties all duly acknowledged, we proceed on the principle that the demographic picture of population type and

[33] Bagnall and Frier 1994: 53–6. Their high percentage of urbanization is a consequence, of course, of a low population estimate. A total of 1.5 million 'urban' inhabitants in a high count population of 7.5 million = 20 per cent. Sharp 1998: 44 calculates an urbanization level of 20 per cent in a population of 6 million.

[34] Note Bagnall 1992 and 2007, emphasizing that the landowning population of Hermopolis in the mid-fourth century can account for only a small percentage of the total population—thus most of the inhabitants must have been engaged in something other than agriculture.

structure can comfortably be accommodated in the pre-industrial Mediterranean pattern, a position that now seems to (or should) command a consensus.[35]

II. REGIONS, VILLAGES, TOWNS, HOUSEHOLDS

Introduction

> What we need are detailed historical maps of Greek and Roman Egypt which show the location and size of settlement centres in the various main historical periods in relation to the main topographical features and the main elements of the irrigation system.[36]

What we need and what we have are unfortunately far from matched. Working with what we have forces to us to contemplate a picture that is patchy and uneven, compounded by uncertainties inherent in the interpretation of older archaeological reports (and the fact that much good evidence for the Hellenistic and Roman periods unfortunately remains unpublished or incompletely published).[37] The account that follows is far from comprehensive, even so, and attempts to delineate population and settlement patterns by analysing some evidence for areas and units of population. I believe that there is room for improving and refining our estimates of size and distribution of villages, but that lies beyond the scope of the present exercise.

The available data do not represent all areas or periods equally or adequately. Our best documentary evidence comes from the Fayum and from the nomes of Middle Egypt (Herakleopolite, Oxyrhynchite, Hermopolite, and Panopolite), with the Delta almost a complete

[35] Cf. Clarysse and Thompson 2006: II 256.

[36] Rathbone 1994: n. 7.

[37] Not least because the archaeological efforts on Graeco-Roman sites in the late nineteenth and early twentieth centuries were largely directed towards finding and publishing papyri, and archaeological remains were not fully recorded or (as at Tebtunis and Antinoopolis) archived and left incompletely published. The somewhat later University of Michigan excavations at Karanis were an exception in that the records of the site are meticulous, but are still largely unpublished. The best published collection of data for size and population of villages and *metropoleis* remains that by Rathbone 1990, although the author described it as a working paper. It would be pointless to recalculate these, so the following sections proceed from that basis (with additions or modifications where appropriate) and then consider what further analysis might be useful. For Fayum villages see also Davoli 1998 and 2005.

blank (the main exception being the carbonized papyri of Thmuis in the Mendesian Nome). The archaeological evidence for the Delta has, however, been recently augmented by survey activity,[38] and Alexandria has received considerable attention. Older archaeological evidence for the Fayum villages has been supplemented by survey and excavation in the past two decades, but our knowledge of this aspect of Middle Egypt remains (with the exception of the metropolis of Hermopolis) very poor. Recent activity in the eastern desert and the Red Sea ports also provides some evidence of both types. A database that assembles the evidence for town and village sites in Egypt, with physical features (including site dimensions) and population, building on and incorporating earlier compilations, will enable us to make some comparisons, even if not as nuanced as we would like, with nucleated settlements in other provinces.[39] For limited parts of the dataset we can even derive figures that offer the possibility of rank-size analysis, although there remain serious questions about exactly what this can tell us (see below). It hardly needs stressing that the data for individual sites are incomplete (making accurate dating hazardous at best) and liable to be partial, but we feel able broadly to rely on evidence based on pottery types, for example. Further detailed analysis will follow, but at present it is worth stressing that, although there are plenty of sites of no more than a few hectares, many of the known town and village sites are extremely large by comparison with those in some other provinces (though not all, particularly in the near eastern area). Possible explanations for this may well have economic implications, and an extended surface area does not necessarily imply high population levels—one could envisage large, low-density areas of habitation and there may again be significant regional variations.

These observations themselves might seem to invite us to confront again the recurring questions of criteria, definition, and terminology. However, I do not feel that this is a particularly useful deployment of space here and have avoided the temptation to propose hard-and-fast

[38] See http://www.ees.ac.uk/deltasurvey/ds-home.html and http://www.dur.ac.uk/penelope.wilson/Delta/Survey.html

[39] Material for the Egyptian section was compiled by Alexandra Sofroniew and supplemented by Amin Benaissa; data for other provinces have been assembled by Annalisa Marzano and J. W. Hanson (see Chapters 8 and 9, this volume). For Egypt, the database will include full bibliographical references but exclude documentary citations of the sort assembled in Calderini (1935–). When complete and revised, it will be available at http://oxrep.classics.ox.ac.uk.

classifications. The documents themselves employ terminology that is for the most part clear and unambiguous as far as larger settlements are concerned (*polis*, *metropolis*, *kome*, and so on). It is notable that many of the *komai* I discuss are of a size and organizational complexity that makes them comparable to 'small towns' elsewhere.[40] If there is a problem, it relates rather to the size and status of smaller settlements such as *epoikia* (generally envisaged as something like 'hamlets') and it is in this size-range that we are most likely to have lost quantifiable data.[41] It is easiest to state that in general (ignoring the larger conurbations for the moment) the districts (nomes) are treated as consisting of a capital town (the metropolis) and a number of dependent villages; I include the Fayum in this, even though some have considered its villages to be larger and more complex than elsewhere. The data from the Oxyrhynchite and Hermopolite Nomes (see below) suggest that there were comparably large villages there too, but perhaps not so many.

Villages

One immediately striking fact is that in the areas of the Delta and Middle Egypt for which we do have evidence, archaeological or documentary, the number of settlements is large. The archaeological surveys of the Delta reveal many, relatively closely packed with Roman remains, but this kind of research is relatively new and impressions are still provisional. As noted above, there are four nomes for which we have good evidence for the number of villages and for the surface area of the nome, from north to south the Arsinoite (Fayum) (1,300 km^2), Herakleopolite (643+ km^2), Oxyrhynchite (780 km^2), and Hermopolite (1,140 km^2).[42] For the latter three, the evidence has been collected in gazetteers that offer a useful point of departure for quantified analysis.[43] To these we may add a more recent survey of the Mendesian Nome that is particularly welcome since data for the Delta are so scarce.[44] It is difficult to

[40] Cf. Mango 2011.

[41] See Marzano, Chapter 8 in this volume, pp. 211, 218.

[42] Tacoma 2006: 54 takes the Hermopolite figure as valid for the fourth century but smaller than in the third century because of the detachment of the Koussite Nome; I have not adopted this position.

[43] Herakleopolite, Falivene 1998 (an update is being prepared by Dr Amin Benaissa); Oxyrhynchite, Pruneti 1981; Hermopolite, Drew-Bear 1979.

[44] Blouin forthcoming.

derive any robust estimates for the number of villages from these toponymic data and a full contextualization of this evidence would require detailed analysis of toponyms from the preceding and following periods, which we have not been able to undertake,[45] but it does seem likely that despite a very few conspicuous cases of 'disappearance' such as Soknopaiou Nesos after the 230s, most of the occupied sites remained occupied throughout the period under consideration here (from *c.* 100 BC into the first half of the fourth century).[46] As for absolute numbers of villages, the best guesstimates are for the Arsinoite around 150 and for the Oxyrhynchite around 120. If the latter figure (1 village per 6.5 km^2) were proportionally scaled according to the relative size of the nomes, we might estimate around 100 villages in the Herakleopolite and 180 in the Hermopolite.[47] The Mendesian produces, for the Roman period, a comparable number of around 120 village toponyms.[48]

This picture is capable of further nuance, however. The very significant, mainly Greek, immigration in the early Ptolemaic period involving enlargement of existing sites and foundation of new ones has been noted (above, p. 327). Both these phenomena are difficult to quantify and their impact was not equally distributed throughout the country. Even on sites that were to all intents and purposes new foundations, such as Alexandria, there are traces of pre-existing settlement but there were clearly many new Greek foundations in the Fayum and some in Upper Egypt too.[49] What we can now observe beyond any dispute from the census data of the third-century BC

[45] For the later period cf. Banaji 2002: 241–50; there must be more to be discovered from Coptic and Arabic toponyms.

[46] Soknopaiou Nesos, Davoli 1998; 2005; Clarysse 2005. Other Fayum villages that experienced drastic shrinkage or abandonment in the fourth century are Karanis, Theadelphia, Euhemeria, Dionysias, and Philoteris.

[47] I avoid extrapolating from the Oxyrhynchite estimate (cf. Rathbone 1990) to the Arsinoite because settlement conditions were different in the Fayum (for the estimate of *c.* 150 villages and hamlets in the third century BC see Clarysse and Thompson 2006: II 110–11). These guesses are broadly consistent with the toponymic data for the Herakleopolite. The much larger number assembled by Drew-Bear for the Hermopolite is partly attributable to the sources she uses, which include Coptic toponyms.

[48] Blouin forthcoming, who also offers the opportunity to make a very rough estimate of the area of the nome. This is certainly smaller than the nomes discussed above and supports the traditional view that the Delta was more densely settled than the Valley.

[49] For Rhakotis see McKenzie 2003; for Greek-type urban foundations in Upper Egypt, Kramer 1997; and Heinen 1997.

Fayum, reassembled and re-edited in meticulous detail, is that the villages themselves began on a small scale in the third century BC and they must have expanded greatly in size over the next 300 years. This will be a result of the combination of intrinsic population growth and immigration, and it is unfortunate that we do not have precise figures for any of the individual villages at both termini of this time span, but it is probable that some villages whose population was a few hundred to around 1,000 in the third century BC may have expanded to 3,000 or more by the end of the first century AD.[50] The figures compiled from the census records of the third century BC show few with more than 1,000, and an average (for what that is worth) of about 600.[51] The graph of size distribution shows a small handful of large villages and a clustering at the lower end of the range.[52] By the end of the second century BC, Kerkeosiris (not one of the villages represented in the census data) may have had a population of around 1,200 and a territory of almost 1,300 ha.[53] By the mid-Roman period (*c.* AD 70–160), reasonably plausible estimates converge to give us a clear impression at least of orders of magnitude of some of the major villages: Karanis 3,600, Philadelphia 3,500, Theadelphia 2,300.[54]

A significant degree of recovery from the effects of the Antonine Plague was probably eventually achieved within 50 to 100 years and should not necessarily be linked with the apparent 'disappearance' of

[50] See Clarysse and Thompson 2006: II 104–9 for adult populations of Arsinoe (Krokodilopolis) and various villages, with averages applied; considered too low by Rathbone 2007. In a paper presented at the OXREP conference in 2007, Rathbone suggested a population density of 100/km^2, and in the second century AD at least four villages had populations over 3,000, while on a low estimate Arsinoe had 20,000. Compare the generally larger but much more speculative estimates of Müller 2006: 97 and App. 1 (and note the criticisms by Derda 2006).

[51] Clarysse and Thompson 2006: II 106.

[52] Ibid.: 108; compare the villages of the Oxyrhynchite and Hermopolite in the later Roman period (above, pp. 333–4). For villages in the Mendesian Nome (Delta), see Rathbone 1990: 134–7: the village of Psenathre had 319 taxpayers in AD 131/2 (*P. Thmuis* 77.12), implying a total population in excess of 1,000.

[53] For Kerkeosiris, see Crawford [Thompson] 1971.

[54] Rathbone 1990. For Philadelphia, see further below. For Karanis in the Roman period, the estimate of Van Minnen 1994: 234–6 is implausibly much larger, in the range 15,000–20,000. This is based on an extrapolation from the available archaeological evidence of the number of houses, multiplied by the likely number of occupants per house. Van Minnen compares this explicitly to Pompeii and is compelled to see it as exceptionally large even in the context of the larger Fayum villages of the Roman period.

some villages from the papyrological record.[55] However, the figures for taxpayers and revenues in the early fourth century clearly show 'catastrophic decline' in population numbers and in tax yield in some villages (principally Karanis and Theadelphia) and this has been linked to severe neglect of the irrigation system.[56] Even here, caution is in order. Such archaeological evidence as exists does not fit the picture of total decline, and the patterns of change and population movement may have differed even in different parts of the Fayum (see Table 11.4).[57] Since irrigation in the Fayum was artificial, it need not have been equally neglected everywhere.[58] There is no reason to assume that this was a widespread phenomenon in Middle and Upper Egypt, and the evidence for the villages of Jeme and Aphrodito in the later Byzantine and early Islamic period suggests healthy population levels that either did not decline significantly or, if they did, eventually recovered.[59] The tax revenues drawn from Egypt may have been somewhat reduced in the later period, but it hardly needs emphasizing that a smaller population and a reduced tax yield do not necessarily betoken 'economic decline'.[60]

Even where there is no reliable evidence for absolute figures, we may venture a little further in analysing relative sizes of villages and relationships between them, relying especially on previous work by Rathbone, to which some more recent evidence can be added. In the Oxyrhynchite Nome, calculated as a surface area of some 780 km^2, there were perhaps around 120 villages, of which somewhat over 80 are postulated as large enough to have some form of their 'their own administration'.[61] Rowlandson's map (Fig. 11.2) includes the names, ancient and modern, of about fifty settlements outside the metropolis.

[55] See above, n. 27. Most conspicuously Soknopaiou Nesos, which vanishes completely; Tebtunis declines drastically. See Clarysse 2005 and cf. Keenan 2003.

[56] Van Minnen 1995; Bagnall 1979/82, 1985, and 1992 = Bagnall 2003: VI, XVII, and XII.

[57] Detailed review of the evidence in Keenan 2003. For Karanis see Pollard 1998.

[58] The best recent archaeological evidence comes from Philoteris, which certainly did decline; see Römer 2004.

[59] Wickham 2005: 411 gives summary descriptions, characterizing them as medium-sized (estimates for Aphrodito *c.* 2,000, Jeme 1,000–2,000, following Wilfong 2002). Zuckerman 2004: 233 proposes a much larger population (7,000) for sixth-century Aphrodito (on ? 76.2 ha).

[60] As demonstrated by Whittow 2001: 150–1 with reference to late medieval England. On taxation levels see Rathbone 1989.

[61] Evidence for this is being compiled by Dr Amin Benaissa (Oxford).

Table 11.4. Some sample estimates of areas and populations of selected Fayum villages.

Village	Population[a]					Site area[b]	Land	Date	Source[c]
	IIIa	IIa	I/IIp	II/IIIp	IVp				
Karanis			3,600	2,300	340	80 ha	3,383 ha	170s	D 74 Bagnall 2003
Bacchias						34 ha			D 117
Euhemeria						65 ha			Bb
Hiera Nesos							1,117 ha	167p	R
Kerkeosiris			1,200				1,297 ha	118a	R
Philadelphia			3,300			50 ha	2,750+ ha[d]	167p	R, Hanson (2007)
Soknopaiou Nesos			1,100	760>	420>0	22 ha			R, Davoli (2005), Messeri Savorelli (1989)
Theadelphia			2,300	80		25 ha	*c.*1874 ha	mid-II	R, D, Sharp (1999), Bagnall (2003)
Narmouthis			(6,500)[e]			60 ha			R, D 223
Tebtunis			4/5,000			57 ha			D 179, Rowlandson (1999)
Magdola (kom)						200 ha			D 213
Dionysias			1,150			40 ha			R, D 301
Philoteris			1,100			10.7 ha			Römer (2004)
Kom Madi						12 ha			D 253
Mednet Quta						4.5 ha			D 355

[a] Dates are approximate. 'I/IIp' should be taken as indicating pre-Antonine Plague levels and 'II/IIIp' post-Antonine Plague levels.
[b] It hardly needs stressing that these figures depend on excavation or survey data, cannot be chronologically precise and may only partially represent the site size, which will, in any case, have grown or shrunk over time. In most cases the site sizes given are broadly attributable to the Roman period (but assuming rather than demonstrating growth from Ptolemaic to Roman periods begs a crucial question, of course).
[c] Ba = Bagnall 1985; Bb = Bagnall 1993: 110ff.; R = Rathbone 1990; D = Davoli 1998.
[d] The minimum figure is based on the well-known evidence from the Zenon archive that in the third century BC, Apollonius, the finance minister of Ptolemy II Philadelphus, was granted a 10,000-*aroura* estate near Philadelphia.
[e] This figure is derived from a papyrus now lost and therefore cannot be checked. See Rathbone 1990: 132.

Rathbone's analysis of the relevant documents suggests that villages were somewhat more densely clustered in the north and west toparchies but spread fairly evenly around the nome in terms of size of territories. As for relative sizes, the most useful document, because most nearly complete, is *P.Oxy*. X 1285 (third century), which contains two lists of tax payments in cash, of which the first is the more extensive. The figures in the text are probably in need of some revision, and it is not explicit as to whether the taxes are assessed on persons or land. But assuming, as Rathbone argues, that the payments are not partial and are a reliable guide to the relative fiscal size of the villages, we can produce a composite list of payments that will represent the distribution of villages by size.[62] The metropolis is of course, not represented at all in these data. This evidence can then be compared with that derived from *P.Col*. IX 247 from the fourth-century Hermopolite Nome.[63] In this volume, Marzano (Chapter 8) discusses the possible insights and constraints involved in applying rank-size analysis to data of this sort, and this need not be repeated here.[64] In the case of both the datasets, the log–log graphs representing the distribution show a similar convex shape. This '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 rule would predict'.[65] It is also relevant that a sharp drop in the distribution line reflects a bias towards smaller units and missing data. Here we can say that in the third and fourth centuries AD the pattern of

[62] The use of this text for illustrative purposes is very much a short-cut and should be read with Rathbone's more detailed analysis (1990), which also includes two other Oxyrhynchus texts (XIV 1659 and XXIV 2422) yielding comparable orders of magnitude; cf. Rowlandson 1996: 286–90 (Table 1). My calculations are based on an amalgamation of the two lists, supplementing missing figures in the one from the other and omitting most of the figures that are complete in neither. Rathbone noted that we have no single piece of evidence that might enable us to move from relative to absolute size in terms of the population of these villages and this is still the case. *P.Oxy*. XLVI 3307 (early IV AD) has a *κατ' ἄνδρα* assessment for a few villages that looks promising but it is unfortunately not clear that the figures are the *total* annual assessments for each village.

[63] The statistics from both texts have been entered in a database that will be available on the OXREP website, along with the graphs derived from them. I am indebted to Justin Dombrowski of Columbia University for assistance with this.

[64] She notes the discussion of rank size by Tacoma 2006: 50–5 but this treats only the *metropoleis*.

[65] Marzano, Chapter 8, p. 211.

distribution suggests a very small number of large villages and a very large number of smaller settlements, which fits the belief, for which there is some evidence in the documents, that the largest villages may have had complex facilities serving smaller units in their region. It is also worth emphasizing the similarity of the pattern of distribution in geographical and administrative divisions (nomes), which are likely to have been similar in character, the more so because the Oxyrhynchite text comes from the third century (almost certainly before *c.* AD 270, judging by the pre-'inflation' size of the payments) and the Hermopolite from the mid-320s. For what this is worth, then, it suggests no major change in the patterns of rural settlement, or significant reduction in the number or proportion of smaller village sites, in the course of a period often characterized as one of demographic and economic crisis.

Since we have what can be regarded as a reliable figure for the amount of grainland in the Oxyrhynchite Nome in the first half of the fourth century (202,534 *arourae* = 55,696 ha),[66] we can take one further speculative step that might at least have some illustrative value. If the list in *P.Oxy.* X 1285 includes two-thirds of the Oxyrhynchite villages, and grainland was proportionally distributed, the total grainland attached to these 80 villages should be approximately 135,022 *arourae* (37,131 ha), and it is a simple matter to calculate a proportional distribution between the villages according to relative size. We can then calculate a more detailed subdivision on the assumption that grainland constituted about 80 per cent of all of the productive land in the nome and suppose that the 10 per cent (maximum) was occupied by garden and orchard land and 10 per cent put to other uses (including pasturage).[67] This may be no more than a sighting shot, but the result is consistent with the actual figure we have for the early fourth century, and this hypothetical distribution is, I believe, more significant in indicating orders of magnitude of village territory in the Oxyrhynchite (with no implication as to distribution of ownership between villagers and metropolitans, which will of course have changed over time) than simply calculating a meaningless *average* of *c.* 120 village

[66] Bagnall and Worp 1980.

[67] See http://oxrep.classics.ox.ac.uk and cf. Bagnall 2002b. The figures can be regarded only as approximations at this stage. Further analysis of land use and crops will be undertaken in a future volume, which will concentrate on agricultural production and consumption.

territories over *c.* 202,000 *arouras*. The hypothetical picture that emerges can be summarized as follows. The Oxyrhynchite Nome is an area of *c.* 780 km^2, of which *c.* 696 km^2 is productive, 80 per cent of it is grainland and 10 per cent orchard/vineyard, 10 per cent other uses. Settlement consists of a metropolis of perhaps 30,000 people (see below) and around 120 villages, for about two-thirds of which we can graph the size distribution.[68] There seems no reason why this pattern should not in general be applicable to the Nile Valley, although caution is needed in making comparisons with the Delta too, where the configuration of settlement may have been somewhat different.[69] But it also affords some basis for comparison with the data for Fayum villages (above, Table 11.4), which may help us to form some idea not only of relative but also of absolute sizes of populations in these villages. Such a calculation will have to take into account the carrying capacity of the land and also the levels of taxation and surpluses, which cannot be attempted in detail here. Thus we could imagine that the actual population increased by the orders of magnitude discussed above, and also that the demand for surplus production also increased after the Roman annexation. It should be noted, however, that if the distribution suggested in Table 11.3 is of the right order of magnitude, there is no reason to think, as has sometimes been suggested, that the bigger Fayum villages tended to be significantly larger than those of the nomes in the valley (below, p. 344).

The *Metropoleis*

The foregoing analysis needs to be set in the context of urbanization in Ptolemaic and Roman Egypt, without the prejudices created by the

[68] It should be noted that the results are not consistent with other evidence, which has been taken to indicate relative sizes of a smaller number of villages, namely *P.Oxy.* XLIX 3462 (I BC) and *P.Mich.* inv. 412r (*ZPE* 24 (1977), 133–7, late III AD), but it is not clear that this comparison is valid; the Michigan text refers to distribution of labour according to the σχοινισμός of the adjacent village, which might just mean the length of dike for which it was responsible.

[69] See above, n. 48. For Thmuis in the Mendesian Nome (Delta) see Rathbone 1990: 114–19, discussing unusual conditions in the context of the Antonine Plague. For Upper Egypt cf. also Naboo with 7,271 ar. of taxable grainland (*P.Giss.* III 60, AD 118–19; Rathbone 1990: 124–5).

notions of consumer cities as parasitic on the agrarian sector.[70] This should enable us to be more precise about the relationship of patterns of rural settlement to urban nuclei in the Fayum and Middle Egypt, in particular. As noted above, the levels of urbanization need to be related both to the comparative economic functions of the urban centre and the villages, and to the economic activities of the urban and the village populations.

The urban centres in Egypt comprised three (by Hellenistic and Roman standards) very large cities, Alexandria, Memphis, and Ptolemais, between 30 and 40 nome-capitals (or *metropoleis*), as well as the other 'Greek cities' Naukratis and (from AD 130) Antinoopolis. Modern estimates of population size vary widely and for most places we lack any sort of direct and reliable information on which to base such estimates.[71] The guesstimate of 0.5 million for Alexandria is now more or less standard. Ptolemaic Memphis might have had a population of *c.* 150,000, and according to Strabo, in the early Roman period Ptolemais in Upper Egypt was no smaller. Conservatively totalled, these might account for at least 0.75 million in (let us say) the first century AD.[72] Any further estimates for the total metropolite population as a whole will inevitably depend to a greater or lesser extent on guesswork and averaging. It is easy to extrapolate a total of a further 0.75 million for the *metropoleis*, yielding a total urban population of 1.5 million, which amounts to 20 per cent of an estimated total population of *c.* 7.5 million (see Table 11.5).

Although the evidence is clearly sporadic and nowhere near complete, the number of estimates that exceed 100 ha (some by a considerable margin) is striking. The *metropoleis* of Oxyrhynchus and Hermopolis probably, and Arsinoe certainly, were at the higher end of the range (and also will have served atypically large territories), but they are at least those for which we have some information and which we can relate in some way to rural settlement. As far as the actual population sizes are concerned, it does not seem possible to achieve

[70] See Alston and Alston 1997; Bowman 2000; Alston 2002; Bagnall 1993; Bagnall and Frier 1994; Tacoma 2006.

[71] E.g. Bowman 2000; Alston 2002. Tacoma 2006: 50–5 offers four estimates that he considers to have some basis in evidence and proceeds to extrapolate figures for other nome-capitals scaled according to the calculations of nome-size. See above, n. 16.

[72] The population of Roman Memphis may have remained undiminished during the first two centuries AD; see Thompson 1988: 266–7. Clarysse 1995 suggests 50,000 for Thebes but this looks like no more than a guess.

Table 11.5. Size and population data for urban centres.

City/Metropolis	Region	Area (ha)	Demographic data (Roman period)	Remarks
Alexandria	Delta	972	300,000 *eleutheroi* in 59 B.C. (Diod.17.52.6).	See McKenzie 2007: 179. Estimate parameters 825/1,000 ha
Athribis	Delta	190		Bagnall 1993, estimate based on plan and description by Jomard (*DE*)
Bubastis	Delta	140 (?)		Site now 70 ha, formerly double that size (Tietze 2003)
Naukratis	Delta	32–55 ha?		Parameters are those of Bagnall 1993 and Möller 2000
Heroonpolis	Delta	40		
Tanis	Delta	177		Bagnall 1993 and Yoyotte 1988. Peak in Ptolemaic period?
Thmuis	Delta	80/90	3,560 houses (*οἰκίαι*)	Rathbone 1990: 120
Memphis	Delta	675/485	50,000/200,000 range in Ptolemaic period, probably lower end.	Jeffreys 1986 and Thompson 1988. Area estimates for dwelling space—urban spread may be much larger
Antinoopolis	Middle Egypt	200		Bowman 2000, estimate from *Carta di Ant.* 1998
Aphroditopolis	Thebaid	100/150		Bagnall 1993; Bowman 2000
Herakleopolis Magna	Middle Egypt	150		Bagnall 1993; Padro 1999
Hermopolis Magna	Middle Egypt	150/160	7,000 households	Van Minnen 2002; see n. 81 below
Hibis	Great Oasis	120		Wagner 1987
Oxyrhynchus	Middle Egypt	160/180	Theatre capacity *c.* 13,000; 4,000 adult males receive grain-dole	Grenfell 1896/7; Rathbone[a]; Bailey 2007; *P.Oxy.* XL
Syene	Thebaid	122.5 (Ptolemaic), 150 (Roman)		Jaritz 1986
Arsinoe	Fayum	288	*c.* 6,480 *katoikoi*	Davoli 1998; Ruffini 2006

[a] Estimate of 180 ha in an unpublished colloquium paper.
Drawn from the database compiled by Alexandra Sofroniew; cf. Bowman 2000: 178. The increase postulated from Syene might be as much due to military considerations as to demographic growth.

precision and certainty. The most seductive data we have relate to numbers and sizes of houses and buildings, and to sizes of particular sectors of the population. Thus: the number of houses at Apollonopolis Heptacomias (1,273) and at Thmuis (3,560 houses) can be multiplied by an average (estimated) of 6 inhabitants per house; Hermopolis is often cited as having a total of *c.* 7,000 houses, but this must be households not houses.[73] The capacity of the theatre at Oxyrhynchus has recently been re-estimated at around 13,000.[74] The number of adult males comprising the gymnasial class (and corn-dole recipients) at Oxyrhynchus *c.* AD 270 was *c.* 4,000, the number of adult male *katoikoi* comprising the metropolitan elite of Arsinoe was nominally 6,480 or 6,485.[75] These are at least attested in our documentation (even if interpretation is still open to some variation) and therefore more robust than, for example, estimates of the sizes of town councils. Extrapolation from these figures for the gymnasial elite suggests a total gymnasial family population at Oxyrhynchus of *c.* 13,000 and at Arsinoe of *c.* 20,000. These will then have to be absolute minima for (say) the early Roman period. What we do not know for certain is what proportion of the total population of the metropolis the gymnasial families comprised. If it were a bit less than 50 per cent, that would suggest a population for Oxyrhynchus of around 30,000 and for Arsinoe around 45,000; Hermopolis and Herakleopolis will be of a similar order of magnitude, the former perhaps larger than Oxyrhynchus, the latter probably smaller. These are no more than guesstimates that are within the commonly used parameters.[76] There seems little point in tinkering with them or in substituting new estimates that cannot be verified or shown to be more soundly based, but the relationship between these estimates and the physical areas of the sites is at least broadly plausible.

It is equally difficult to arrive at many firm conclusions as regards changes in population levels over time, since there is an almost

[73] Details and references given by Rathbone 1990: 120; cf. Bagnall 1993: 53; 2009. The document on which the Hermopolite figure is based is *SPP* V 101, an extraordinary tax assessment κατ̓ οἰκίαν, which must be by household, not house. For house occupancy figures see below, p. 346.

[74] Bailey 2007.

[75] See Ruffini 2006: esp. 79.

[76] These orders of magnitude tend to a general fit with Van Minnen's (2002b) characterization of the metropolite gymnasial class as broader than a 'super-elite'. Tacoma's figures and calculations (2006: 39–50) are admirably transparent and this allows us to identify the areas of fragility, and to observe the very wide parameters in the calculations (e.g. 20,000–42,000 for Oxyrhynchus).

complete lack of evidence for the *metropoleis* in the Ptolemaic period. The main exception is Krokodilopolis (Arsinoe), where we can observe a postulated increase over the period between the mid-third century BC and the first–second centuries AD. Here the starting point must now be the estimates of Clarysse and Thompson, which suggest a total population of roughly 4,000 for Krokodilopolis, around 150 villages with an average adult civilian population of 328 and a total of about 50,000 civilian adults in the whole nome.[77] These numbers could safely be multiplied by a figure between 2.0 and 3.0 to account for the whole population, and we still need to allow for the continuing effects of Greek migration, which was certainly very significant in the Fayum. Moving from this low estimate to a population in the region of 45,000 for Arsinoe suggests a high rate of population growth, which would include migration, over 350 years.[78] We lack precise matching figures for the villages but we can see orders of magnitude in comparing the Ptolemaic averages with the estimated sizes of the large Fayum villages in the 2,000–4,000 range by the early Roman period.[79] It hardly needs emphasizing that the rates of growth in the metropolis and the villages do not at all need to be the same and among the possibilities that we need to allow for at all periods is the phenomenon of population drift into or away from the urban centres.

Although there is clear evidence for shrinkage in some of the Fayum villages towards the end of our period, we lack sufficient archaeological evidence to be able to assess possible growth and decrease in physical size of settlements over time, and we should bear in mind that such growth might be extensive or intensive; the latter might manifest as vertical expansion and would be harder to identify in the archaeological record. Several of the villages surveyed cover a large surface area, but there are so far virtually no instances where excavation has yielded clear indicators of comparative sizes in the Ptolemaic and earlier Roman periods. Karanis is the only possible exception and even here precision about chronology is difficult. Intensive growth, which might manifest as vertical expansion, would be difficult to trace archaeologically. By the same token, shrinkage of population might present as an increase in the number

[77] Clarysse and Thompson 2006: 110. They find the estimate of 28,000 for the early Roman period (Alston 2002: 331–2) 'surprisingly high'.

[78] See above, p. 327.

[79] See above, p. 335.

of empty or disused domestic dwellings, for which there is some evidence in documents (e.g. at Oxyrhynchus, where a third-century text shows a high proportion of unoccupied domestic premises) but much less sign in the archaeology.[80] At Karanis, interpretation of the archaeological evidence is complex but it has been taken to show that the earliest settlement is in the Ptolemaic period, expanding to the north of the site, followed by rebuilding in the early Roman period, expansion from *c.* AD 50 to 150, recession following the Antonine Plague, then rebuilding followed by a flourishing period in the second half of the third century and a sharp break towards the end of that century.[81] This provides a very neat match (except for the virtually undocumented fifth century) with what has been deduced from the papyri—so neat in fact that one wonders how much the reconstruction actually owes to the deductions made from the evidence of the documents. By way of comparison with the *metropoleis*, the estimate of around 7,000 'houses' at Hermopolis has also been juxtaposed with the archaeological evidence but that figure (if valid) will refer to 'households', not houses. Application of the multiplier of 5.3 for an average household postulated by Bagnall and Frier (below) yields a population figure of around 37,000 for the later Roman period.[82] There is no archaeological evidence against which to assess the guesstimates of 25,000–30,000 for Oxyrhynchus in the Roman and Byzantine periods, and the figures themselves are derived from sources many of which are far from robust.[83] There is thus every reason to emphasize the fragility of the evidence for supposed urban 'crisis' or 'decline' in the later third century. Special measures, including levies to finance extensive urban repairs, are sometimes interpreted as evidence for crisis but they could just as well be signs of civic pride, which has increasingly been noticed in social and cultural spheres at this period. Evidence for difficulties or inefficiency in civic administration, especially in funding public activities or amenities, likewise, need not indicate overall shortage of resources or wealth (though it may indicate difficulty in accessing private wealth for public purposes).[84]

[80] *P.Osl.* III 111 (AD 235), cf. also *P.Panop.Bork.* for a similar phenomenon at late third-century Panopolis.

[81] See Husselman 1979 and cf. Pollard 1998.

[82] Rathbone 1990: 120. For *SPP* V 101, see above, n. 73.

[83] Fikhman 1971; Krüger 1990.

[84] Bowman 2008.

Houses and Households

Evidence for structure and sizes of families, households, and houses is also evidently relevant both for towns and villages since it contributes something to our knowledge of settlement patterns and some quantification is possible. As with rates of growth and urbanization, it is noticeable that there is significant variation, with figures and methods of calculation often left unjustified or unexplained. We have some significant and robust documentary evidence for numbers of adult male taxpayers or other defined groups such as the adult males of the gymnasial class or the *katoikoi* at Oxyrhynchus and Arsinoe. The multipliers used to derive total population from a number of adult males between the ages of 14 and 60 have varied between about 2.9 and 3.5, with the idea that the higher multiplier is more likely to be applicable for rural population. Attempts have also been made to derive sizes of families and households from tax lists, census records, and similar documents. Once again, there is no real consensus, as may be illustrated by three sets of statistics.

Fayum villages, third century BC:[85]
    Egyptian household avge 4.0
    Greek household avge 5.0
    House occupancy avge 4.5[86]

Fayum village (Philadelphia), late first century AD:[87]
    Household avge 7.34
    House occupancy avge at least 11.27

Roman period, census returns:[88]
    Houshold avge (urban) 5.3, (rural) 4.8
    Household avge (multiple) 4.3, (extended) 5.0

The discrepancy between the first and third sets of figures on the one hand and the second set on the other is very striking and clearly needs some further discussion. Clarysse and Thompson present their

[85] Clarysse and Thompson 2006 II: 285.
[86] Cf. Alston and Alston 1997; and Alston 1997, occupancy rates of 6.3 (Ptolemaic) and 7.61/7.78 (Roman).
[87] Philadelphia, from Hobson 1985.
[88] Bagnall and Frier 1994: 58.

conclusions from the Ptolemaic census data very clearly and compare them with the estimates derived from the Roman census returns by Bagnall and Frier. The figures are all, as Clarysse and Thompson remark, in a close and plausible range, although they comment that the Hellenic emphasis in the Ptolemaic data is due to the predominance of material from the Arsinoite and Oxyrhynchite Nomes and should not necessarily be taken as representative of the population in the country at large. If we consider the possibility of an increase in family or household size from the order of 4.2–4.5 in the early Ptolemaic period to 5.0–5.4 in the mid-Roman period, we can see a (roughly) 20 per cent increase in family and/or household size, which helps us to account for the rates of population growth that we calculate. If we accept the very substantial rates of increase in both *metropoleis* and villages over this time span, it seems obvious that we have to account for them by either a growth in unit size (family or household) or an increase in the number of units, or a combination of the two. Comparison of the first and third sets would suggest a limited growth in household size over time, the corollary of which is that in the Roman period compared to the third century BC, if the population doubled, there were not merely larger households but also more of them, which could itself signify either an increase in the number of families or a change in the pattern of household composition, with a relatively stable number of families forming more households,[89] combined with the effects of immigration.

The second set of estimated figures, derived from Philadelphia in the later decades of the first century, does not, however, sit well with the others, showing a 50 per cent increase in average family size by comparison with figures from the third century BC (although the latter do not include data from Philadelphia), and house occupancy 2.5 times as dense in the later period.[90] The trend in growth is clear even if the rate or magnitude is less clear. Such archaeological evidence as is available for houses, plots, and *insulae*, mainly from Karanis and Philadelphia, does not help us to solve the problems, as is emphasized by the variation in modern estimates, based on plot

[89] I.e. a shift from nuclear to complex; see Bagnall and Frier 1994: 57–66. For a summary of family structure, see Bagnall 1993: 199–202.

[90] The texts are analysed by Hobson 1985; cf. Alston 1997. They certainly stand in need of some revision in the light of more recently published documentation of Philadelphia, but this is not likely to change the orders of magnitude significantly.

size and floor space, with guesses at an average or typical number of storeys.[91] At present I see no way of resolving these discrepancies.

III. CONCLUSIONS

It is difficult to avoid a degree of pessimism about our ability to build a reliable macro-demographic picture of Egypt over a period of around 600 years, and almost every major constituent of such a picture involves either a poor fit with other evidence or a difficult corollary. Nevertheless, from the point of view of economic development, the foregoing analysis has suggested that the quantifiable data that are available do lead us to a greater understanding of patterns of settlement and population in specific areas of Egypt at specific times. This understanding, if the methodology is sound, will provide a platform for further analysis of the 'performance' of the economy in both agrarian and urban contexts, which should not be too sharply distinguished along the lines of 'production' and 'consumption'.[92] We have expressed an intention to look closely at indicators of economic growth, integration, and decline, and the demographic data for Egypt do, I believe, suggest some reasonably robust conclusions.

- Very significant growth in population is clear from the early Ptolemaic period until the mid-second century AD, followed by decline (caused to a large extent by the Antonine Plague) and recovery, probably by the mid-third century.
- While remaining cautious about the conclusions to be drawn from rank-size correlations,[93] I suggest that the evidence for numbers, size, and distribution of villages in four areas, along with the widespread existence of fairly complex administrative

[91] E.g. Hobson 1985; Van Minnen 1994; Alston 1997, with averages per house respectively: 11.27 or 10.00; 4 or 5; 7.7. Compare the estimate of Foss for Syria (below). Calculations for urban centres would be different, see, e.g. Rathbone 1990: 141, n. 40; for a seven-storey house at Oxyrhynchus, see *P.Oxy*. XXXIV 2719. The problem of deriving population estimates from the archaeology of domestic buildings, where occupancy levels and number of storeys are unknown, is not confined to Egypt.

[92] For a service and commercial sector in the village population, cf. Sharp 1999: 165.

[93] The evidence of cities in Spain and Roman Asia Minor is further analysed in this volume by Marzano (Chapter 8), who uses the data to derive rank-size correlations.

facilities, provides a basis for estimating the degree of economic integration in the Fayum and the nomes of Middle Egypt.

- It is more difficult to be sure about decline in the later part of our period. Despite evidence for severe local decline in some parts of the Fayum in the late third and early fourth centuries,[94] we have no reason to extrapolate that (or not) to the rest of Egypt on the basis of the available evidence. We should therefore suspend judgement and make no assumption of overall population decline in the first half of the fourth century. Comparisons with other areas of the Mediterranean world in the classical period and later antiquity cannot prove anything about Egypt, but they can offer some reassurance that we are not making an exceptional case or indulging in special pleading.

Further comparisons are possible and I here offer three drawn from recent archaeological studies in the eastern part of the Roman and Byzantine empire that seem to me illuminating, partly because they offer both similarities and contrasts to the Egyptian data and partly because they suggest ways in which the Egyptian data might be further analysed and exploited.

1. The villages of northern Syria were studied by Tate, who substantially modified the earlier *communis opinio* based on the work of Tchalenko and identified a period of growth from *c.* AD 110 to 250, followed by a period of stagnation (not necessarily decline), then growth again from *c.* AD 330.[95] Some of the villages that form the core of his study are, like many of those in Egypt, substantial settlements with significant public buildings and facilities. The demographic implications were summarized by Foss, who noted that the government must have had a significant role in the expansion to *c.* AD 250:[96]

> Any figures depend on knowing how many people lived in each house. Tate frequently makes the assumption, often duly qualified, that each room was the dwelling of a nuclear family. If so, the addition or division of rooms indicates a growing population, rather than a rising standard of living in which a family might have more

[94] For a population movement at Tebtunis, see Keenan 2003.
[95] Tate 1992; cf. Tate 1997. For a very large village at a somewhat later period, see the analysis of Androna by Mango 2011 and cf. Baird 2004.
[96] Foss 1995: esp. 221–2.

rooms at its disposal . . . If it is correct [sc. Tate's assumption], one might imagine that each room was occupied by 4 or more people. Since there are some 700 villages with an average of perhaps a hundred rooms each, the total would be astonishingly high, of the order of 300,000 people in the district.

Possible comparisons with numbers of Egyptian villages and size of both houses and households[97] are obvious enough. One might add that, in both cases, one might have both population growth and rising standards of living if the increase in the capacity of the land to support population growth were sufficient.

2. Blanton's study of Rough Cilicia shows that the early Roman period saw substantial growth in every city and hinterland of the area surveyed, including the major settlements of Selinus, Cestus, and Antiochia, the last two of which were new foundations.[98] The estimate for the early Roman population of *c*. 18,000 implies an increase of over 16,000 within 300 years; some of this will be accounted for by the new foundations (as we have seen in Ptolemaic Egypt), but apart from them it is unclear whether the growth is steady or episodic. Population growth continues at a slower rate into the later Roman period, with an increase over the early Roman population estimated at *c*. 6,500. If correct, this is very important, not least because, as Blanton notes, the archaeological and inscriptional evidence for new public buildings falls in the early Roman period: *ergo* lack of evidence for new public building (recognized as quite widespread in the empire from the early third century onwards) does not necessarily imply a decreasing population. Finally, Blanton asks what were the reasons for continued growth. The first phase he attributes to governmental initiative and imperial strategy, the second (later Roman) to the growth of commercial activities. It will again be worth considering whether there is some wider pattern in a withdrawal of the government from direct initiative and participation in the activities that underpin demographic and/or economic growth.
3. Rupp's study of the region around Paphos in Cyprus is worth citing if only because the period of growth he identifies begins

[97] On this, see Hobson 1985. For a cautionary example, see n. 54 above.
[98] Blanton 2000: 60–1.

> with the reign of Ptolemy II Philadelphus when the island was part of the Ptolemaic empire.[99] In analysing the relationship between the metropolis, the 'suburban sprawl', and the agricultural hinterland with outlying settlements he emphasizes the need for a nuanced picture that does not simply present a consuming city and a hinterland with a purely agricultural function. The model of the settlement hierarchy that he outlines suggests physical dimensions significantly smaller than those of Egypt in the Roman period.[100]

The approach taken in this volume and elsewhere in the OXREP is underpinned by the belief that the cumulative evidence of a significant number of case studies will give us the evidence, direct or proxy, for making more reliable quantitative estimates of key features of the Roman imperial economy. It would clearly be rash to proceed to any firm macro-demographic conclusions about high or low counts for the total population of the empire on the basis of the evidence discussed in this chapter. It is, however, impossible to avoid noticing that the numbers of people, rates of growth and dimensions of sites quite often appear 'surprisingly large' to those who are analysing or discussing them.

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[99] Rupp 1997.

[100] Ibid. : 248. Large village: 9.5–15.5 ha. Medium village: 5.2–8.5 ha. Small village: 1.3–5.0 ha.

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