Collecting cities: some problems and prospects.

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Why survey cities?

Urbanised societies have been characteristic of most of the Mediterranean region for the past two and a half millennia, longer to the east, with small numbers of urban centres in the Aegean from 2000 BC, and in the Levant from the later fourth millennium BC. There is healthy debate about the characteristics and roles of such centres, by no means uniform, but for most periods since their initial development or introduction in each local region, densely occupied communities with populations in at least the thousands have been the principal focal nodes within the landscape. They usually constitute the most complex and differentiated communities: socially, economically and politically. They are where significant proportions of the regional population resided, where the most far-reaching social, economic and political decisions were made, and where history was written, in the literal and figurative senses.

Archaeologically, they have long been the principal focus of research, as Classical scholarship, pursuing the antiquarian tradition, documented sites and monuments mentioned in surviving written records. Broadening the questions, and the types of investigations needed to address them, has been a slow process; this can be tracked by perusing annual summaries of regional research over the past century. Until recently, uncovering yet another Greek temple or Roman basilica seems to have needed no justification; their value for understanding the past was assumed to be obvious.

A major departure in the orientation of Mediterranean fieldwork emerged from the 1970s, with the wide proliferation and rapid methodological development of intensive regional field survey. This moved away from the high-profile remains, addressed more explicit questions, and with its almost invariably diachronic data, encouraged explicitly broad and comparative perspectives. The focus for such surveys, throughout the Mediterranean, has overwhelmingly been the rural landscape. In many cases, this was a reaction against the urban, monumental, and largely descriptive concentration of previous fieldwork. But it was also pragmatic, with small, relatively inexpensive surveys providing fieldwork opportunities for the rapidly expanding numbers of academic archaeologists wanting to work within the Mediterranean. *[end page 70]*

One objective of regional survey has been to contextualise the larger, usually already known centres, though analysis and interpretation of the rural data has been pursued largely independently of studies of the centres. Three characteristics of research have contributed to this. First, the small size of most Mediterranean regional surveys means the dependent territories of an urban centre are often not fully investigated; these partial datasets do not encourage integrated analyses. Second, centres may shift through time, such that for some phases the primary centre may be within the study area, but for others not. Dealing with different types of picture inevitably makes comparisons difficult, whereas focusing on the rural data usually assumes the sites are broadly comparable for all periods, facilitating comparative analysis and interpretation. Third, only rarely is there any degree of comparability in the data available from the urban centre and the sites in its rural hinterland, with urban data excavated and documented to address other questions. This makes direct comparisons difficult, and discourages integrated analysis and interpretation.

By default, most regional surveys assume we can use the rural site data as a proxy for the whole system. But the farmsteads, hamlets and villages represented by most dots on the maps usually represent only a limited component of the overall regional population. They are principally agricultural production sites, tied to their functional position at the base of an economic settlement hierarchy, only peripherally engaged with the dimensions of differentiation which characterise urbanised societies. They usually show little variability, and are only a limited index of social, economic or political change in the entire system. This is not to say they are not interesting, but they usually provide a restricted insight into the complete settlement system. A particularly telling characteristic of such sites is that they usually differ little from their pre-urban counterparts. Recognising the opposite position, ancient cities will certainly not be representative of all communities, but they are absolutely central, both to the past society, and to our attempts to understand it.

If cities are so significant, why are urban surveys such a limited component of Mediterranean archaeology? Four practical and administrative characteristics certainly do not facilitate such research. First, ancient cities were often situated in favourable locations, encouraging continuity in occupation or re-occupation. If presently occupied, the potential for archaeological exploration may be extremely restricted, and only feasible through excavation (therefore also relatively expensive, and in consequence, limited). In some cases, long-term commitments to urban rescue archaeology accumulate sufficient 'excavation windows' to allow effective syntheses (e.g. Pariente and Touchais 1998; Symeonoglou 1985; Jones *et al*. 2003), though incompatibility with rural survey data remains an obstacle to integrated analysis.

Second, given the historical interest in cities and their civic monumentality, they are often designated ancient monuments and are managed by national heritage organisations, in contrast with the countryside more readily accessible for survey. This means access to both often involves different agencies and research permits. The latter *[end page 71]* can be difficult to obtain, particularly as fieldwork at the ancient monument is likely to be perceived as disruptive to site management and tourism, and any fieldwork allowed may be highly constrained.

Third, as the traditional focus of archaeological investigation, urban sites may also already be under investigation, and so be the established 'territory' of a different project. Permission to survey, even where possible, may be viewed as duplication by administrative or funding bodies, put pressure on local support resources, or cause friction between researchers.

Finally, purely pragmatically, the intensive survey of an urban site can seriously over-shadow the data collected from the rest of a region, with all of the processing, documentation and storage requirements this entails. As long as survey was viewed as inexpensive and rapid fieldwork, this was a serious discouragement. The very limited collection strategies applied to cities in many surveys suggest this was a real concern, with limited collection (e.g. Whitelaw and Davis 1991), simple grab samples (e.g. Jameson *et al.* 1994; Mee and Forbes 1996), or limited coverage of cities by extensive collection units (Forsén and Forsén 2003). The resulting small and spatially poorly differentiated samples do little more than document the presence or absence of material of particular periods at a site, and undermine effective integrated analyses of rural and urban data.

The over-riding trend of Mediterranean rural surveys in recent decades has been toward greater intensification of data collection and increasing analytical and interpretive expectations, requiring commensurately larger samples, longer study periods, significant storage commitments and inevitable publication delays; survey is no longer the quick and cheap fieldwork option it was originally envisioned to be. This shift recognises that the data collected in the 1970s-80s from sites was so limited, it is usually difficult to do more than put dots on a map where a few sherds of a given date were recovered. Limited artefact recovery severely constrained the chronological and functional interpretation of sites, and low resolution collection rarely allowed discrimination of changes in site size or function through time (Whitelaw 2000; Bintliff *et al*. 2007; Winther-Jacobsen 2010).

If limited collections and low resolution have been considered problematic for interpreting small rural sites, they have been recognised as an even more significant problem for urban survey (Walker 1985; Bintliff and Snodgrass 1988; Perkins and Walker 1990; Alcock 1991; Keay *et al*. 1991; Mattingly 1992; Martens 2005; Lolos *et al*. 2007). Urban sites can be expected to represent far more complex communities, in terms of both history and internal differentiation. They are also far more likely than small rural sites to be deeply stratified, so raising additional questions about the representativity of surface samples.

Beyond these practical and administrative considerations, there are more fundamental problems of theory and method, rarely explicitly addressed. John Bintliff and Anthony Snodgrass, in their 1988 call to arms for Mediterranean urban survey, largely assumed *[end page 72]* that the relevance of intensive urban survey was obvious (similarly Whitelaw and Davis 1991). The reasons they articulate relate explicitly to their engagement with rural survey data, and the need to incorporate the urban dimension of regional settlement into any understanding of the overall regional system. Their emphasis was primarily demographic: how large were urban and regional populations, what was the balance of nucleated versus dispersed population, and how did these characteristics vary through time. Essentially, the principal questions were defined by the interpretive needs of rural survey.

To date, Mediterranean urban surveys have not really engaged with the social, economic and political complexities which are the distinguishing characteristics of urban centres. While these complex characteristics almost invariably correlate with demography (Naroll 1956; Carneiro 1967; McNett 1973; Bettencourt *et al*. 2010), population size alone does not provide an understanding of the internal structure and behaviours of the occupants of specific urban communities. Complex models have been developed for Classical urban societies, based on surviving written testimony (e.g. Hansen 2004; 2006; Cornell and Lomas 1995; Parkins 1997), but the representativity of very limited written sources can rarely be assessed. Because they are sparse, such sources are extrapolated widely, negating the possibility of understanding individual centres, even regions, in their unique local and historical contexts. In contrast, a strength of urban archaeological survey data is its potentially comprehensive and representative character, at the scale of the individual community, and for comparisons among communities. These complementary datasets need to be brought more effectively together, so that each can inform the other.

However, Classical archaeology does not have an established tradition of such research; it is only rarely that archaeological data has been collected on a scale which allows city-wide behaviour to be addressed, and only recently that studies have attempted to do so (e.g. Papageorgiou-Venetas 1981; Hoepfner and Schwandner 1994; Cahill 2001; Hermansen 1982; Wallace-Hadrill 1994; Laurence 2007; Dobbins and Foss 2007; Kaiser 2000). In contrast, the questions asked of urban excavations are usually limited, documenting the chronological range of site occupation, describing the specific contexts and material recovered, focusing on the construction history of individual monuments, ticking off the expected public monuments, or trying to relate occupation sequences to specific historically noted events, largely supporting the accusation that archaeology merely illustrates history. Given the constraints noted earlier of limited access and major expense for urban excavation, the opportunities and necessity for urban survey seem obvious.

With so few analysed and fully published Mediterranean intensive urban surface surveys (see now Stone *et al.* 2011), it is difficult to document their potential, so it is worth briefly looking elsewhere. Intensive urban surface surveys have been most effectively established as a research strategy in Mesoamerica, following the path-breaking Teotihuacan Mapping Project (Millon 1973). This remains the most ambitious urban surface survey ever undertaken, mapping the 19 square kilometre city, and recovering *[end page 73]* 1.25 million artefacts (Cowgill 1974: 363). Individual studies have revolutionised our understanding of Mesoamerican urbanism, addressing political history, political organisation, neighbourhood organisation, ethnic identity, craft production, exchange, and cosmology (e.g. Millon 1973; 1981; Cowgill 2007; 2008), as well as illustrating the development of archaeological spatial analysis (Cowgill1974; Cowgill *et al*. 1984; Robertson 1999). But it can be no coincidence that a full publication of the project has never been achieved. While urban surveys have been undertaken fairly widely in Mesoamerica, only a handful of projects have been published in full (e.g. Blanton 1978; Healan 1989; Mastache *et al*. 2002; Hirth 2000; Finsten 1996; Feinman and Nicholas 2004). Most are documented only through preliminary studies (e.g. Balkansky 1998; Balkansky *et al.* 2004; Brumfiel 1980; 1986; Charlton *et al.* 2000; Diaz Oyarzabal 1980; Fargher *et al.* 2011; Garcia Cook 1998; Joyce et al. 2004; Ohnersorgen 2005; Pérez Rodriguez *et al.* 2011; Pollard 1977; Smith 1994; Smith *et al.* 2009; Smyth *et al*. 1995; Stark 1991; Pool 2003a; Santley *et al*. 1986).

The approach developed out of a long-standing tradition of site architectural mapping, and most urban surveys have been pursued in the context of parallel, regional surveys, providing a local context for the centre. The emphasis has been on architectural mapping (occupation terraces, compounds, civic-ceremonial and residential mounds), but with (usually judgemental) collections of surface materials. The questions addressed have primarily concerned site size and demographic change through time, complementing and integrated with the wider regional surveys. Interpretations of internal site organisation invariably rely on patterns of mounded architecture to identify civic-ceremonial foci (Blanton 1978; Hirth 2000; Pool 2008), though analysis at Teotihuacan has demonstrated that such concerns can also be nuanced through artefact data (Cowgill *et al*. 1984; Altschul 1987; Sload 1987; Robertson 1999; Garrity 2006). These studies, in combination with contact-period descriptions of community social organisation, have inspired approaches to social interpretation in terms of ward or corporate group organisation, which differ markedly from standard western centralised, hierarchical urban models (Marcus 1983; Sanders and Webster 1988; De Montmollin 1988; Smith 2007; 2008; 2010; Joyce 2009; Manzanilla 2009). Other than at Teotihuacan, analyses of artefact intra-site variations have principally served to map site size through time, and study craft production (e.g. Brumfiel 1986; Brumfiel *et al.* 1994; Santley *et al*. 1986; Santley *et al*. 1989; Hall 1997; Hirth 2006; Charlton and Nichols 1990; Charlton *et al.* 2007; Otis Charlton 1994; Nichols 1994; Nichols *et al.* 2000; Pool 2003b; 2009; Knight 2003; Fargher 2007). The two most successful fully published studies, of Monte

Alban (Blanton 1978) and Xochicalco (Hirth 2000), provide accounts of the character and development of each centre, though the bulk of the surface collections are employed merely for dating the occupations. Analyses at Teotihuacan on ceramics and lithics indicate that much more can be done to analyse intra-community differentiation, and explore in detail urban organisation and the nature of the differences among residential groups proposed on the basis of preserved *[end page 74]* architecture (e.g. Altschul 1987; Clark 1986; Clayton 2005; Cowgill1974; Cowgill *et al*. 1984; Krotser 1987; Rattray 1987; Sload 1987; Spence 1987; Sullivan 2006; Turner 1987; Robertson 1999; Manzanilla 2009).

Elsewhere, intensive urban surveys are far less frequent, and where conducted, have rarely been published beyond initial field reports (e.g. Vidale *et al*. 1976; Tosi 1984; Mariani 1989; Pracchia *et al.* 1985; Kenoyer 1985; Miller 1994; 2000; Kenoyer and Miller 2007; Whallon 1979:182-91; Portugali 1982; Postgate 1983; Buccellati and Kelly-Buccellati 1988; Ball 1990; Pollock *et al.* 1991; Pope and Pollock 1995; Wattenmaker 1993; Lebeau 1997; Stone and Zimansky 1999; Voigt 2005; Greenewalt *et al*. 1983; Matney 1998; Ur 2002; Stone and Zimansky 2003; Jablonka 2005; Masioli et al. 2006; Thomas 2007; Ur 2010; Ur *et al.* 2011; Bayman and Guadalupe Sanchez 1998; Lockard 2009; Millaire and Eastaugh 2011; Wilson and Schmidt 2005). Two fully published surveys provide useful Old World perspectives. The Uruk survey maps sequentially the long sequence of occupation at the city (Finkbeiner 1991). Given the eroded mud-brick architecture of the tell, the principal focus is on the finds, but analysis is limited to distribution maps. The over-riding conclusion to be drawn from these is that relatively small samples provide little data for interpretation, since individual ceramic types almost invariably simply reflect the overall period distributions. Much larger samples from the latest levels do allow some spatial pattern recognition (Petrie 2002). The Mashkan-shapir survey is one of the most coherently designed and executed urban surveys, having explicitly set out to test text-based models of Mesopotamian urban social structure (Stone and Zimanski 2004). Ceramics were not collected or analysed, because occupation was principally limited to the Old Babylonian period, and ceramic variation was not expected to be particularly informative. The spatial interpretation of community organisation therefore relies on traces of major architectural features (fortification wall, several low mounds, canals) and approximately 1,000 artefacts, as well as observations on sherd, copper and copper slag densities across the site. Alone, the artefacts produce very low density and dispersed distributions, in which it is usually difficult to see clear concentrations. Whether this is because activities were not well differentiated spatially, or the data is simply too sparse to document them clearly, unfortunately remains unclear.

Stepping back from individual projects, one can see an overall dependence on standing architecture to define the framework of community organisation. Ceramics are used almost exclusively to date the changing size, and hence population of the sites through time, and occasionally to investigate ceramic production. A limited range of other artefacts may be used to study craft production, and in very few examples, access to exotica. In general in the Mesoamerican examples, the large collections of ceramics are not analysed in detail. In the Mesopotamian studies, limited artefact samples constrain the recognition of intra-site patterns. The survey of Teotihuacan runs counter to both these trends, with large samples and diverse studies, including detailed statistical analyses, enabling the subtle exploration of a wide range of questions about urban *[end page 75]* character, development and organisation. These have been reported in a wide range of interim studies, but fully documented studies are awaited. Together with some of the preliminary studies from other sites, these illustrate the possibilities for intensive and systematic urban survey to transform our understanding of ancient cities.

More generally, not just considering urban surveys, an increasing number of archaeological studies are moving beyond description to engage with the nature of early urban communities and urban societies (e.g. Cowgill 2004; Marcus and Sabloff 2008; Storey 2006; Smith 2003; Smith 2010). Some of the most challenging ideas come from outside the western urban tradition, in Asia, Africa and the New World (e.g. Wheatley 1971; 1983; 2001; McIntosh 1999; 2005; Smith 2006; Smith 2007; Mastache *et al*. 2008; Eltsov 2008), particularly where archaeological interpretive approaches have been richly informed by historical and ethnohistorical models.

Compared to research in these other regions, Classical archaeology provides an extremely large and well-documented database, but is contributing relatively little to current debates. The long-term emphasis on the documentation of monuments has built-up a good understanding of the civic architectural framework of cities throughout the Classical world, but without more behaviourally relevant data, it is almost impossible to integrate this material understanding of urban life, with the well-developed text-based social and political models. Given the practical impossibility of large-scale urban excavation, necessary for any representative picture, intensive survey appears to be the most effective available strategy to integrate these approaches to understanding Classical cities.

To contribute effectively to developing archaeological urban research, Classical urban surveys need to be able to define the urban characteristics of sites, understand what differentiates these centres (socially, economically, politically, ideologically and materially) from other sites in their region, and define what makes them similar or different from urban centres in other regions and cultures. The data necessary to do this relates to internal organisation and differentiation within communities, and what this can tell us about the functions, organisation and importance of the centres within their broader region. To collect this, I suggest we will need five major changes in approach.

1. Large samples, which will permit statistically reliable intra-site spatial analyses and pattern-recognition, at a scale of resolution which is relevant to the full range of past behaviours of interest.

2. High resolution spatial control to allow us to recognise and document the content, scale and grain of variation. Much work has been done on urban layout and the structure of public facilities, providing a framework which needs to be filled-in at a grain relevant to the behaviour of individuals and groups within the city.

3. Well structured and highly controlled samples are necessary to ensure standardised and reliable data recovery, which in turn permits accurate density calculations and *[end page 76]* quantitative comparisons within and among collection units. Since the actual data being sampled are not known in full, we have no independent means to evaluate the accuracy of the sample; we have confidence in the sample, only to the degree that we have confidence in the methods used to select and recover it.

4. Carefully controlling the sample collection is essential, but we also need to evaluate the inevitable biases which affect it. This requires collection of information which will allow us to assess the impact of variations in material recognisability, vegetation cover, search time, lighting, walker ability and attention, among other factors. The more significance we attach to the data, and the more information we try to squeeze out of them, the more essential it is that we critically understand the nature of the sample recovered and what can or cannot legitimately be done with it.

5. We need to undertake statistically-based analyses, to establish and understand the reliability of any recognised patterns. The presentation of survey data only rarely goes beyond simple distribution plots.

If we want more out of Mediterranean urban survey, we have to put more in: we need more data, more control over it, and more creative and effective approaches to analysis. This is easy to assert, but more problematic to carry through: what are the implications?

Considerations and consequences.

With no fully published examples of intensive, systematic Mediterranean urban surveys to make the case for the above claims, I will draw examples from the on-going Knossos Urban Landscape Project, which I have been co-directing for the British School at Athens with colleagues from the Herakleion Ephorate of Prehistoric and Classical Antiquities, in central Crete. These explorations outline particular choices made, and some of the implications which emerge from initial analyses; in the space available, they can only illustrate the seriousness of each concern.

Our understanding of occupation at Knossos, based on over a century of intensive excavation, and the history of investigation, are well summarised elsewhere (Hood and Smyth 1981; Evely *et al.,*1994; Cadogan *et al*. 2004). Details of the Knossos Urban Landscape Project are also reported elsewhere (Whitelaw *et al*. 2007; 2010). The principal objective of the project is to survey intensively and systematically the Knossos valley, documenting the material record of its occupation from the establishment of the earliest sedentary communities on Crete, *c.* 7000 BC, down to the early twentieth century. Fieldwork, involving the survey of all available land within an area of $11 km^2$, encompassed the $1.5 km^2$ of the urban site, and the extensive surrounding cemeteries. This was accomplished during three six-week seasons, involving 15 collectors in the field each day. All collections were made on a 20m grid, resulting in the survey of *[end page 77] c*. 21,000 units. Approximately 420,000 artefacts were recovered; *c.* 404,000 of these were ceramic. Initial inventorying of all materials was completed in 2010, after three dedicated study seasons; specialist studies are expected to continue for a number of years. Only preliminary analyses have yet been undertaken, as data cleaning continues, but the project provides realistic data for an exploration of major concerns associated with intensive urban survey.

The immediate justification for intensive urban survey can be seen in Fig. 5.1, which plots the survey data for four broad (very roughly millennial) phases, against the contemporary findspots established by over a century of archaeological investigation. It will immediately be appreciated that the conjunction of near continuous research excavation, with extensive rescue investigations, makes Knossos one of the most intensively investigated sites in the ancient Mediterranean. Even so, clear spatial biases in earlier investigations, with major research excavations principally in the south, surrounding the Prehistoric palace, and rescue excavations under the modern villages and the main road, have left well over half of the urban site essentially unexplored. Add to this that many rescue excavations stop at the uppermost Roman levels (having established that archaeology is present), or merely document the presence of material of a given date, and the dots representing previous investigations dramatically over-play our real understanding of the archaeology of this complex stratified site.

What constitutes an adequate and appropriate sample?

Not surprisingly, this demands the further question: 'adequate for what?'. If our questions about a site are relatively simple, then small or very targeted samples may be very cost-effective (e.g. Keay *et al*. 2000), but the range and complexity of the questions they can be used to address are limited. If we are to understand the nature of urban societies, then we need reliable and necessarily substantial samples.

At Knossos, all collected material has been retained and processed. To date, preliminary dating has allowed all but c. 2,000 of 404,000 sherds to be assigned to four broad phases (Fig. 5.1), and progressively smaller quantities to be assigned to increasingly precise chronological intervals. This degree of even basic identification, is only feasible because of long-term, large-scale and intensive investigation at the site, and retention of substantial samples of well-dated excavated material which is available and accessible for direct comparisons (e.g. Momigliano 2007; Coldstream *et al*. 2001).

We aimed to collect large samples, adequate for quantitative analysis and documentation of statistically valid patterns. But statistical reliability depends on sample size and the variability within the sample, so adequate sample size cannot *a priori* be specified. With no comparable surveys to extrapolate from, this has been guesswork, though previous analysis had cautioned how inadequate most survey samples were for interpretive analyses (Whitelaw 2000). Balancing this, we were constrained by processing *[end page 78]* time, specialist study time and storage limitations, as well as overall costs. We guessed at a maximum feasible collection on the expectation of six years for collection and initial, bulky processing, constrained by the availability of local facilities and prospective finance, the latter dependent on disciplinary expectations. With no previous survey project in the Aegean on a comparable scale, we couldn't push too far, while still being considered credible.

The detailed level of study has just begun for the Knossos material and the precision of identifications will increase as specialist study proceeds, but the initially processed data can usefully illustrate the sample size constraints. Despite large individual collections, sample sizes rapidly reduce once the material is divided into interpretable categories. For collections on the city site: from a total of 243,225 sherds from 2,229 collection units, 55,574 are feature (rim, handle or base) or decorated pieces; 14,808 of these are Prehistoric. Within this latter group, 3,242 Late Bronze Age sherds have been identified so far, and of these, 682 fall in the most diagnostic category of Dark on Light decorated. Mapping these examples for the urban site, the increasing patchiness and declining interpretability of the distributions with decreasing sample size, is readily apparent (Fig. 5.2). The Dark on Light decorated Late Bronze Age sherds are by far the dominant type analysed and illustrated in stylistic studies for the period, and consequently are the most highly diagnostic, and comprise the bulk of the material which can presently be ascribed to phases of less than a century. Our examples span some 600 years, and many do not preserve diagnostic enough features to be assigned to a span less than 200 years. For documenting behaviour for the Late Bronze Age, we will eventually be able to draw upon other categories of sherds, but these are usually less chronologically precise, undoubtedly blurring or obscuring behavioural episodes.

Most urban surveys struggle to make sense of inadequately small samples (e.g. Whitelaw and Davis

1991:276), yet the analytical implications of sample size have received relatively little explicit attention (Whitelaw 2000; Bintliff *et al*. 2007:40-1). It is one thing to recall in the abstract that in a sample of 20 sherds, each one affects assemblage composition by 5%, another to fully recognise the ambiguity of small samples, and the constraints these put on analysis and interpretation. Fig. 5.3 includes 14,808 Prehistoric and 15,167 Roman feature and decorated sherds from the urban area, divided into the broad categories of fine, cooking and coarse wares. Aside from the decorative ~~rorschach~~ effects determined by small numbers, the sobering implication is that even with large samples and only simple distinctions, overall percentages only appear to stabilise as collections reach 40 or so sherds; at this point each sherd still represents 2.5% of the assemblage.

The difficulties for site interpretation are displayed in Fig. 5.4, for the Prehistoric and Roman phases, distinguishing collection units which achieve phase-specific sample sizes of 1-19, 20-39 and greater than 40 sherds. Looked at optimistically, there are substantial samples generally distributed across the site, which nearby collections units could be assessed in relation to, but realistically, these are few and far between. *[end page 80]* Reducing the samples to shorter, more behaviourally meaningful segments of time, will reduce all samples well below any notional 40 sherd target. Rather than throwing up our hands, at this or the above complications, we need to learn how to work with such data realistically; collecting large enough samples to yield adequate period-specific assemblages for analysis in even a majority of collection units is simply not a realistic option. The extreme alternative of relaxing any requirement for statistical confidence in the patterns detected, is unjustifiable, even if actually the standard practice. For some questions, incorporation of the lower resolution data, such as body sherds, will be appropriate, multiplying samples considerably. For others, pooling of data from adjacent collection units can be extended as far as necessary to produce more reliable samples for analysis, particularly if it can be established that the samples are broadly comparable, as assessed against the wider patterns of variation across the site. Most *[end page 82]* importantly, we need to ensure that the resolution of our questions and data correspond, and continually bear in mind the reliability of the patterns produced analytically, and therefore the reliability of the interpretations built upon them.

Is it just a matter of quantities? Linked to overall sample-size concerns are patterns of assemblage diversity: the range of different artefact classes represented in any sample. This has received attention elsewhere in archaeological assemblage analysis (e.g. Kintigh 1984; 1989; Jones *et al*. 1989; Grayson 1981; Thomas 1983, 1988; Sullivan 1998), but so far has largely escaped attention in the spatial analysis and interpretation of survey data. With larger samples, there is a greater chance that rare types within the assemblage will be represented. So diversity cannot be interpreted without defining the diversity which should be anticipated for samples of specific sizes selected from a particular population structure. The interpretive problems arise when we deal with relatively small sub-sets of the data, such as the shortest definable periods, or specialised types of finds: are the distributions real, or simply reflections of collection size. This has been approached effectively for assemblages through simulating multiple sampling from the aggregate population to define the probabilities of specific assemblage compositions (Kintigh 1984), but not yet explored for spatial distributions. We are not ready to do this for Knossos, but the seriousness of the problem for all survey data should be obvious. *[end page 83]*

Sampling spatial resolution on Mediterranean urban sites.

Collection resolution will be linked inversely to sample size, if the sampling strategy is constrained by the scale of the overall collection that can be processed. To maintain the overall collection scale, there will need to be a play-off, with increased resolution requiring a significant decrease in individual collection size.

Collection across the urban site at Knossos involved intensive pick-up of a $10m^2$ area, situated for best surface visibility, within all accessible squares on a 20m grid. This was arrived at working down from preliminary estimates of site size, sherd density variations across the area, and an estimate of the overall quantity of sherds that could be collected and processed in the initial six years of the project. Working from the other direction, we wanted the largest samples we could manage for each collection, aiming ideally at 20 or more sherds from an individual period for functional analyses. An average 20m spacing between collection units seems large, especially when Aegean rural surveys have regularly espoused 10m–15m spacing between transects. These latter need to be close enough to intersect small rural sites; preferably for two transects to do so, for corroboration. At Knossos, we wanted to pick up localised differences in depositional behaviour to monitor differentiation and patterning within the city. A 20m grid provides a spatial resolution broadly comparable to the scale of individual houses from prehistory through the Roman period, notionally the smallest behavioural units being sampled. In practice, of course, with different alignments, building collapse, the quarrying and re-use of earlier deposits, organised refuse dumping and post-depositional movement of artefacts in the ploughsoil, we are not realistically targeting individual structures, but the grain of the data recovered is on a scale commensurate with the basic building blocks of spatial behaviour and potentially depositional patterning. On the other hand, the collection units are also distant enough to be considered independent depositional samples, since models of ploughsoil sherd displacement indicate smaller-scale movements (Boismier 1997). Balancing this, we did not wish to have gaps large enough to miss significant anomalies, on the same behavioural scale.

Analytically, units needed to be fairly close, to allow comparison of adjacent units to recognise local patterns and to understand biases, the latter favouring multiple collections in the same field, therefore holding various aspects of the collection conditions relatively constant (e.g. vegetation and cultivation, and via these, visibility, deep ploughing or planting, field clearance of larger sherds and stones, etc.). Finally, even with relatively large individual collections, it would be necessary to pool data from adjacent squares to improve the sample size of less frequent classes of material. If spacing was too large, any such pooling would probably significantly exceed and therefore average out the spatial scale of past patterning.

The consideration of sample size above indicates that despite large collections, by the time we sub-divide the samples by diagnosticity and increasingly fine (and behaviourally meaningful) phases, they are inevitably small. But pragmatically, any increase in sample *[end page 84]* size would require lower spatial resolution. Our approach has been to retain the desired collection resolution, while recognising that we will have to pool adjacent units, to varying degrees, to achieve reliable samples for specific analyses. But this flexibility allows us to combine data in different ways and only when statistically necessary. For a gross category, no pooling may be required, whereas for a very specific type, quite extensive pooling may be necessary. Having collected the data at a resolution which is justifiable with respect to both the scale of the behavioural patterning anticipated, and the post-depositional smearing expected, we can engage in pooling only to the degree required. Taking larger samples at wider spacing would set higher arbitrary limits on the analytical resolution that could ever be achieved.

The strict control of collection strategies.

If understanding intra-community variability and organisation is a goal of urban research, we need data accurate enough to allow detailed comparisons of artefact densities across the site. On the other hand, given the wide range of depositional, post-depositional and recovery factors which affect the data collected, is this simply spurious accuracy? On the contrary, to untangle these interacting effects, we need accurate data, rather than adding additional casual and unassessable variation which undermines analyses through loosely controlled collection procedures.

As our collectors moved beyond the dense urban concentration of surface material, surface densities dropped to levels such that the 10m^2 collection areas increasingly frequently encountered little or no material. However, given the time required for precise layout of collection units, and locating units within a densely cultivated (and fenced) landscape, it became clear that our initial coverage rates would not allow completion of the entire study area. We were faced with two contradictory imperatives: we needed to move much faster, but also to collect larger areas. The original recovery strategy was maintained until collectors were outside the urban concentration, to allow direct comparison among all urban units (Fig. 5.5). Outside this, two transects 1m wide and 20m long were walked across each collection square, searching 40m^2, as compared with the original 10 m^2. While defining the edges of the searched area would be much more approximate than the measured collection units used initially, the very low density of material essentially meant that the fuzziness of edge definition would usually fall in the spaces between low density artefacts, not compromising density calculations.

This change of strategy allows the comparison of two different collection methods, regularly used in surveys, but rarely directly comparable. Collections immediately each side of the boundary between the two strategies, yield dramatically different assemblages: surveying approximately four times as rapidly, while searching four times the ground area, yielded only one-sixth the density of material. This highlights explicitly that recovered samples are drastically affected by collection strategies, and not determined simply by *[end page 85]* the sampling fraction and the density of available surface artefacts. There was considerable debate in the 1970s–80s on sampling strategies, and the implications of different strategies for site discovery; there has been relatively little on individual artefact recovery, and little basis on which to calibrate the results of different strategies (Mattingly 2000).

The data produced by the two recovery strategies can be used to explore the effects of different collection strategies. Table 5.1 presents a series of aggregate and average figures for the two types of collections, and illustrative data are displayed in Fig. 5.5. Other *[end page 86]* than the gross density differences, the principal recovery bias relates to sherd size, here monitored by average sherd weight. Decorated sherds tend to be smaller, from small, thin-walled, fine wares, feature sherds larger, being often thickened and surviving better, with body sherds broadly in the middle; tile tends to be considerably larger. Underlying the numerical comparisons, is the approximately six-fold lower recovery rate for transect, rather than intensive circular collections. Comparing average fragment weights, the smaller decorated sherds (Fig. 5.5B) are differentially poorly represented in transects, feature sherds (Fig. 5.5D) almost four times better. Interestingly, despite their considerably larger size, there are still weight differentials for tile fragments (Fig. 5.5E). The more attention-focusing collection strategy is particularly important for the effective recovery of small sherds. By being more constrained, it should also produce more reliable collections, less subject to individual collector differences (see below).

Does it actually matter, since the recovery biases are systematic? Indeed, transect recovery is positively biased toward larger feature (i.e. preferentially diagnostic) sherds, though the highly diagnostic decorated sherds, are biased against. However, complicating the picture, the systematic size differences between different classes of material interact in complex ways. By and large, finer vessels yield smaller sherds, so these will be systematically underrepresented in less intensive searches. At Knossos, there is a consistent long-term trend toward higher-temperature firing from the Neolithic to modern periods. Because there is also a parallel trend toward thinner-walled vessels, in general, average sherd size decreases through time (average weights: Prehistoric: 11.9g; Hellenic: 8.5g; Roman: 3.2g). We can also anticipate that material of different phases will have been subjected to different degrees of battering, whether it has been exposed for longer on the surface, outside the city, or subject to different types and degrees of post-depositional transformation, particularly inside the city. These attritional processes will interact with physical characteristics of the material (e.g. fabric strength, thickness, surface finish) in predictable, but complex and as yet unstudied ways.

We have not yet documented the sherd by sherd data which will be necessary for analysis of these interacting effects, but one can readily see that putting a size-dependent filter on recovery, will not affect all categories of material (e.g. period, vessel function) equally, leading to complex biasing of the collection, relative to the original surface assemblage. To get to grips with these biases, we need accurate samples of the material available for collection on the surface, and highly constrained, attention-focusing collection methodologies will be the most effective at providing a consistent quality of data for analysing, identifying, and subsequently correcting for such biases. *[end page 87]*

Recognising, documenting and accounting for recovery biases.

A wide variety of potential biasing factors has been suggested to affect survey recovery and comparability, and for several decades, most surveys have been recording a range of environmental and collection-specific variables (e.g. land-use, vegetation, soil visibility, light conditions, time of day, collector, etc.). On the other hand, there has been little analysis of these variables to determine which, if any, have affected collections, and if so, how. By far the most thorough study, Shennan's 1985 analysis of collections from a landscape survey in southern England, concluded that collection context variables altogether accounted for some 18% of the variability in artefact recovery, with minor differences between materials. These conclusions seem to have lulled surveyors into a false sense of reliability, particularly since Shennan qualified them by implying they might have little relevance beyond surveys in temperate, arable landscapes (1985: 44). Little published work has seriously considered recovery bias in the Mediterranean (see Cavanagh *et al*. 2005: 284-9). Limited attention has been given to surface visibility, usually simply weighting artefact counts by the inverse of observed visibility (e.g. Whitelaw 1991; 2007; Whitelaw and Davis 1991; Bintliff 2004-05; Bintliff *et al.* 2007; see also Cherry *et al*. 1991; Terenato 2000), though various authors note that the relationship may not be linear, and visibility assessments by different collectors may themselves be variable. Here, the point is merely to illustrate the significance of surface visibility on the quantity and characteristics of material recovered at Knossos.

Discussions with survey directors and participants indicate that visibility has been considered in different ways. Particular confusions arise in transect surveys, when environmental variables are usually an average assessment for the entire survey unit, whereas only specific areas are actually searched. At Knossos, we asked collectors to locate their collection circles in the area of best visibility within each 20m square, and record two assessments: the percent of the collection unit which was available to be searched (i.e. not physically obscured), and independently, the percent of soil within that searchable area which could be seen, for the detection of artefacts. Where the ground is obscured by standing live or a mat of dead vegetation, a minimum threshold may be necessary before any artefacts can be recognised, while visibility less than 100% may still allow most or all artefacts to be glimpsed. We can anticipate that the visibility 'windows' will differentially affect artefacts of different size. We have not yet collected the sherd by sherd data which will allow such analyses, but average sherd weight again provides a clear indication that sherd size is relevant to recovery.

Fig. 5.6 displays surveyed units in the largely level and intensively cultivated core of the city, with large quantities of material from the main phases, mapping visibility assessments and displaying the material recovered for the three broad occupation phases. While there are underlying differences among the distributions (e.g. occupation expands to the north through time), there are also low counts in areas of low visibility which affect all three phases and clearly interfere with the documentation of the material distributions. *[end page 88]*

These effects can be documented more clearly for individual categories of material, averaging the results for all collection units with the same visibility assessment. Table 5.2 lists average values for the counts of different categories of sherds in the mapped units, and Table 5.3, the average sherd weights, where available, for the same categories. Fig. 5.7 plots the distribution and presents frequency histograms by visibility range for all pottery and tile, while Fig. 5.8 does so for average fragment weight, giving visual representations of patterns of variation. The relationships between visibility and average counts are all linear, and highly correlated, with visibility accounting for 82-95% of *[end page 90]* the variation in sherds recovered (r^2: decorated: 87.8%; body: 94.6%; feature: 92.2%; all pot: 94.3%; tile: 82.1%). There is a suggestion that recovery is very poor below 20%, and that most sherds are recoverable when 80% visibility is reached. Not surprisingly, recovery improves more dramatically for smaller sherds than for larger tile fragments (Fig. 5.7D). The correlations between visibility and average sherd weight are less strong, but still indicative that recovered sherd size is significantly affected by visibility (r^2: decorated: 29.3%; body: 62.1%; feature: 45.6%; all pot: 56.3%; tile: 75.5%). The regression for sherds has a low slope, simply because there is far less variation in sherd size than for tile. What is very surprising is *[end page 91]* that there is such marked improvement in recovery for tile, even though the fragments are generally much larger than sherds.

Visibility clearly has a very significant effect on overall sherd recovery, but also differentially affects sherds according to size, and will create the same compound biases on assemblage composition outlined above. The biasing effects of visibility will not be confined to sherds, but these provide the only samples large enough to allow detailed analysis. The significance can be seen in the distributions of two components of elite Roman construction, stone mosaic tesserae, and fragments of marble wall veneers (Fig. 5.9). While both concentrate in the northern part of the Roman site, there are clear differences in spatial distribution. However, mapped against collection unit visibility, it appears that recovery of the small (7–16mm) tesserae and larger marble fragments (40–80mm) are both affected to some degree by visibility. The biasing effects complicate the perception and interpretation of the differences in spatial distributions.

Collector bias

Recovery biases due to surface visibility operate systematically, make intuitive sense, and we can anticipate how they can differentially affect different components of the surface assemblage, creating more complex biased patterns. Also intuitively obvious but less straightforward are inter-collector differences, based on differences in experience, interest, concentration, energy and exhaustion patterns, etc. These have often been noted as potential problems, usually anecdotally, and are only rarely analysed (Shennan 1985: 40-44). The hope is that such individual biases will average out across the survey *[end page 92]* region or site, though this itself is fallacious: effective collectors cannot recover more than is present, to counter-balance the under-collection of others; there are simply differing degrees of under-collection. This gross averaging may be considered sufficient, if the interest is the overall site assemblage, but if the focus is on local variations across the site, we need to understand these biases, to know how much significance can be attached to what degrees of difference as documented between samples.

In an ideal world, the units collected by different individuals would be spatially randomised, balancing their collection strengths and weaknesses. In fact, collector allocation is usually primarily a pragmatic decision. Individual teams of collectors work in a specific area each day, and the collectors on that team are therefore concentrated in one area. This usually also applies to sequential days, since it is more productive for the members of a team to be familiar with an area, general field layout and access routes, landscape characteristics, etc. Finally, whether on a barren hillside or among dense olive groves with limited visibility, it is helpful for locational accuracy for collectors to do adjacent units; in practice, individuals will often be assigned a transect or line of collection units, following a single compass bearing. The consequences can be seen in Fig. 5.10A and B, where north-south or east-west runs of high or low values usually represent individual collector bias.

The intent here is simply to recognise the seriousness of this source of bias, discussed but rarely assessed analytically. In Fig. 5.10A, the same core area is mapped, showing total pottery counts per unit, with those collected by two individuals distinguished. These individuals are highlighted because they worked in the same sub-area, and one (C) was very productive, the other (N) much less. A range of data for all individuals who *[end page 93]* collected more than 30 units within this study area, is presented in Table 5.4, giving a broader idea of the scale of inter-individual variation. In Fig. 5.10C, the units collected by the two individuals are plotted against all others, displaying counts (x axis) by average fragment weight (y axis) for decorated sherds, feature sherds and tile fragments. Collector C is good at recognising small fragments and consequently has high recovery rates, N recovers far less, and predominantly the larger fragments. These two extremes bracket the results from the other collectors; these aren't alternative patterns, there is a full range of variation between them. In addition to the gross quantitative contrasts, following the previous discussions, it will be obvious that size-linked inter-collector differences will bias collections in complex *[end page 94]* ways, even if systematically for each individual. Unlike visibility, such individual biases are not predictable. Their seriousness, and the specific nature of each individual's biases, can only be determined retrospectively through analysing the dataset.

All such biases~~, they~~ can be dampened to a degree by clear and tightly defined collection methods and close supervision. The survey literature is full of suggestions of potential biases, and if the relevant environmental and collection variables are recorded, they can be analysed to determine their individual and combined effects, and to at least a degree, the effects of the most important may be untangled. Regularly, it is then assumed that weighting factors can be used to correct the datasets, though in practice, this is only (and rarely) applied to visibility assessments. But the potential for such corrections should not encourage relaxed collection standards. First, you cannot 'multiply-up' with a weighting factor, something which is not there. If no examples of a category of finds are recognised, we cannot estimate how many there probably were originally. For example, of 23 collectors working in the mapped core area, four recovered 75% of the stone mosaic tesserae, six recovered none, and another eight recovered five or less. Given that these are spatially localised (Fig. 5.11E), some *[end page 95]* collectors may have had little opportunity to identify them, but for 1/4 of the collectors, accounting for 73 units, we have nothing to weight, to estimate the original distribution. Second, such weighting is a poor second best to careful recovery, since with relatively poor recovery, a heavy weighting factor would be estimated, generating a high value from the small and (because of the recognised bias) unreliable number actually recorded. While necessary, such corrections, particularly the more extreme, will be coarse and need to be treated very cautiously. The evaluation of recovery biases against data from adjacent units may help provide greater confidence, though the complexity of the analytical process can be seen to be growing immensely. What we cannot do, however, is ignore such biases, and rely on raw distribution maps, hoping it somehow 'averages out'.

I have only presented a preliminary consideration of two quite different sources of bias. While gross spatial patterns can be seen even in the raw data (Fig. 5.11), these two sources of bias are obviously significant (almost certainly two of the most significant), in this dataset. With thorough pre-collection briefing and rotation of collectors through the processing procedures to ensure their familiarity with all recovered materials, and close field supervision, I doubt that these problems are exceptional for this survey. We cannot ignore such biases; if we do, we really do not know what our raw distribution maps are actually telling us.

The more general point has been made previously by Shennan (1985:115): even if the effects of a variable or process are minor, we need to establish this, not simply assume it. If we do not record the relevant information on likely biases in the field, and carry through the appropriate analyses, we have no basis for actually assessing them, and therefore for developing a reliable understanding of our data.

Expanding Mediterranean urban archaeology?

Traditional approaches to investigating Classical cities have produced a globally-unique wealth of information. Text-based approaches to Classical cities can provide exceptional emic detail, though scattered in time and space across the Classical world. This makes it very difficult to assess whether the information is idealised, pejorative, biased, or if accurate, applicable to whom: the writer's individual perspective, the writer's class, only their community, to other communities in the same region, political or cultural group, etc. Contrasts between sources can be debated, but it is usually difficult to assess the relative relevance of different claims: are they due to different viewpoints, deliberate distortions, or do they document actual differences in behaviour by different individuals or groups of individuals at different points in time and space.

Archaeological information is also generated in a context, and equally embedded in our contemporary assumptions and perspectives, but it provides an opportunity to explore the relevance of specific models and interpretations through comparisons *[end page 96]* among different contextually understood communities. The archaeological approach to Classical cities has tended to be highly descriptive, monument focused, and typological, though in recent years there have been more systematic efforts to move beyond these traditional concerns, though not surprisingly, they tend to focus on a very small number of communities where long-term and usually early excavations have provided spatially extensive datasets. It is highly unlikely that the number of such datasets will expand significantly, as excavation costs and the intensity of data recovery only increases. These practical constraints suggest that urban survey represents an effective strategy to acquire a broad spectrum of intra-site data on a scale simply not feasible through excavation.

While we should be drawing on any and all available information and approaches, urban survey has the potential to enable us to more fully contextualise and therefore understand the information already gained from texts and the wealth of excavations at individual sites, and explore comparatively that from other communities, assessing it against relevant information from the community of interest. In addition, we can put the individual community into its local regional context, understanding more fully its role as a central place within the region, and as a point of articulation for that region with the wider world. More broadly, we can explore variation in the nature and role of cities within the Classical world in both space and time, based on detailed and comparable data. Finally, we can compare the potential wealth of information and sources available for the Classical city, with urban centres elsewhere in the world, to help recognise what may be generic to early urban centres, and what may be unique characteristics of Classical cities in their Mediterranean context.

With survey as with excavation, our questions are developing to the extent that they require new types of data. We have reached the point where we are severely constrained by the limited types of data collected, and the methods used to collect and analyse them. These methods were developed over the past few decades to collect information relevant to a limited range of questions, largely dictated by rural survey. This is not surprising, but it is time to expand Mediterranean urban survey. We need to re-think what we want to know, what data are appropriate to produce this information, how, given the practical contexts of Mediterranean fieldwork, we can obtain these data cost-effectively, and analyse and interpret them appropriately. As long as our questions are largely descriptive, some at least may be addressed effectively with only small-scale modifications to existing approaches. But if we want to use the archaeological record to address questions about urban communities and their character, role and development through time, we need to develop our approaches. This chapter has focused on several of the most basic pragmatic characteristics of the data we need and how we need to collect it, to be able to achieve such objectives. This has aimed to identify the scale of the problems we need to address.

One conclusion appears inevitable: we need more and better quality data, collected and analysed more rigorously. Inevitably, this will involve increased resource commitment. Stated baldly, this may initially seem unrealistic or unachievable. But, at the same time, *[end page 97]* it is clear there is relevant data widely available, but we have not usually collected it, or collected it in ways which allow us to interpret it effectively. The principal problem may be conceptual: the continuing assumption that urban survey should be a rapid and inexpensive alternative to excavation. But frankly, this has been out of date for a considerable time, as project budgets, study periods and publication schedules make abundantly clear. Mediterranean survey has developed into a complex investigation strategy in its own right, though it can also be used effectively in conjunction with other investigation strategies (e.g. targeted excavation, remote sensing). No single strategy is sufficient in itself, though the relative importance of each in a project will depend on the questions stressed and the practical opportunities for fieldwork. While much current attention focuses on the development of new techniques, a broad range of essential questions can only be addressed through the collection and analysis of artefactual data. The simple claim here is that there are ways we can develop traditional approaches to make them much more effective.

If we want more out of Mediterranean urban survey, we have to put more in: we need more and better quality data, to support more intensive and complex analyses. This will entail more control over data collection, and more creative and effective approaches to analysis. Can we actually do this? We can, but it will cost: increased investments in time, labour, specialist study and analyses, storage commitments, field and analytical costs and publication commitments.

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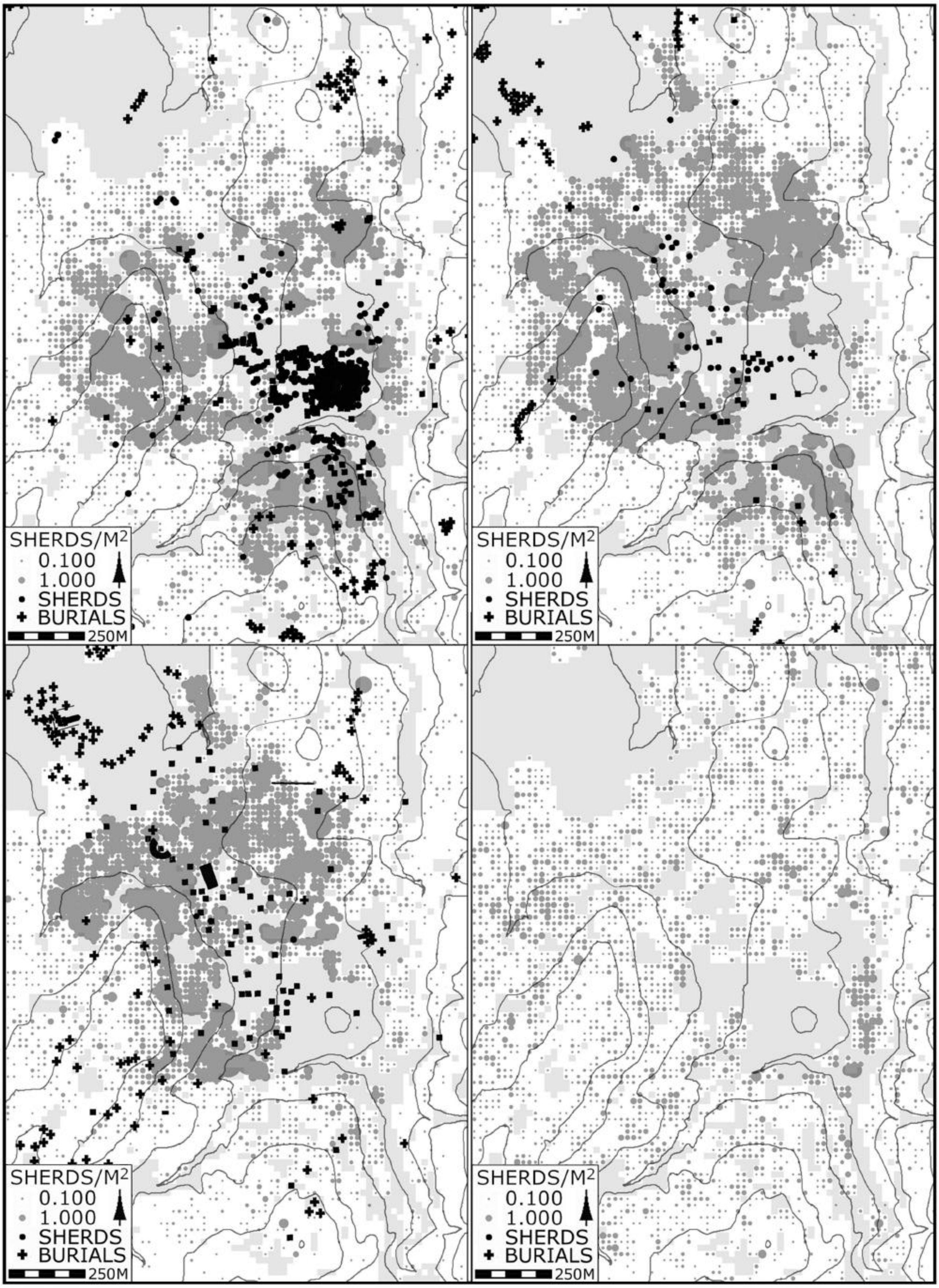

FIGURE 5.1: Knossos: excavations and surface sherd distributions: A. Prehistoric; B. Hellenic; C. Roman; D. Post-Roman. *[Page 79]*

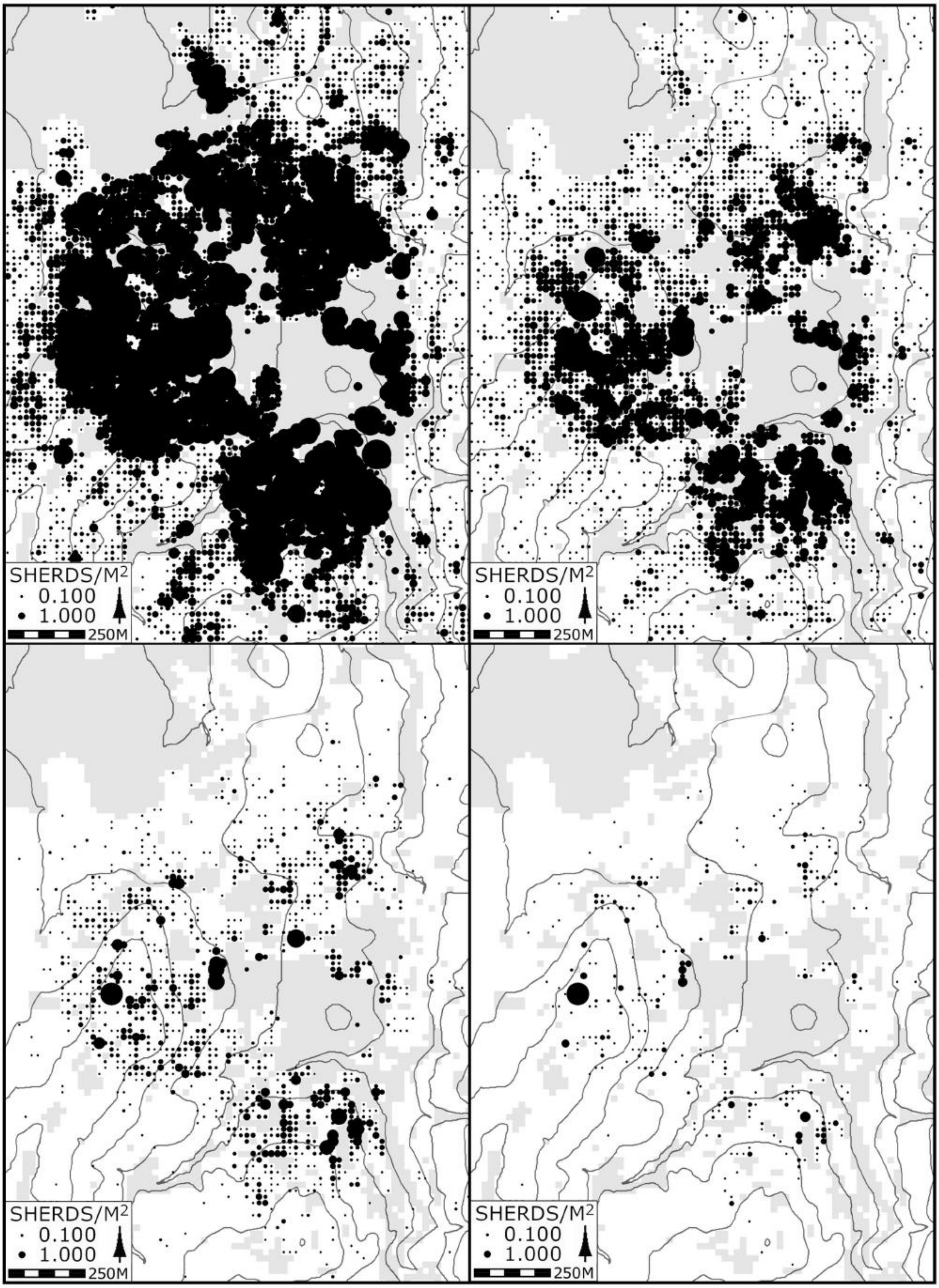

FIGURE 5.2: Surface samples, diagnosticity and sample size: A: all Prehistoric sherds; B. Prehistoric feature and decorated sherds; C. Late Bronze Age feature and decorated sherds; D. Late Bronze Age Dark on Light decorated sherds. *[Page 81]*

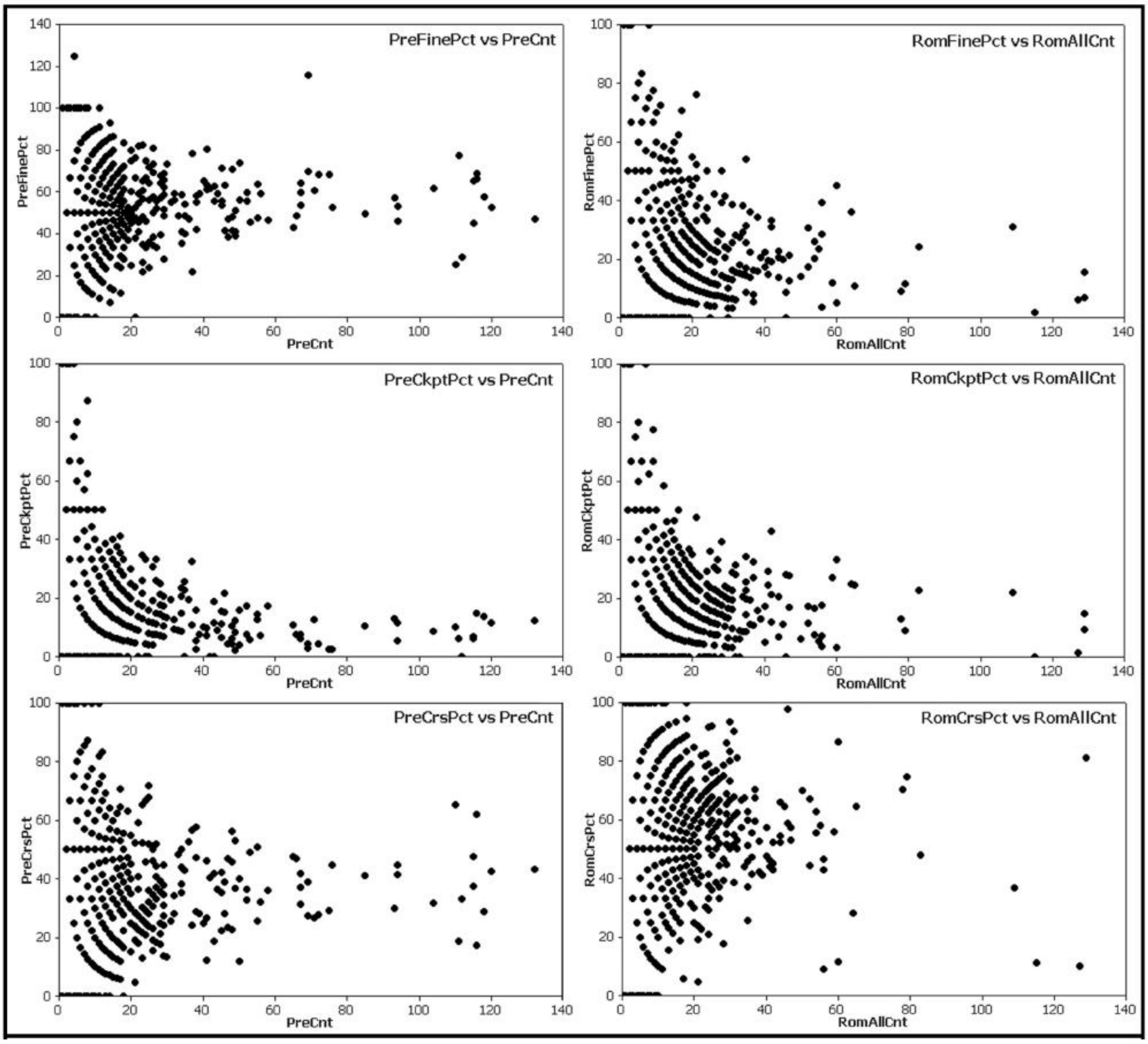

FIGURE 5.3: Collection size and assemblage composition: Left: Prehistoric; Right: Roman; Top: fine wares; Middle: cooking wares; Bottom: coarse wares. *[Page 82]*

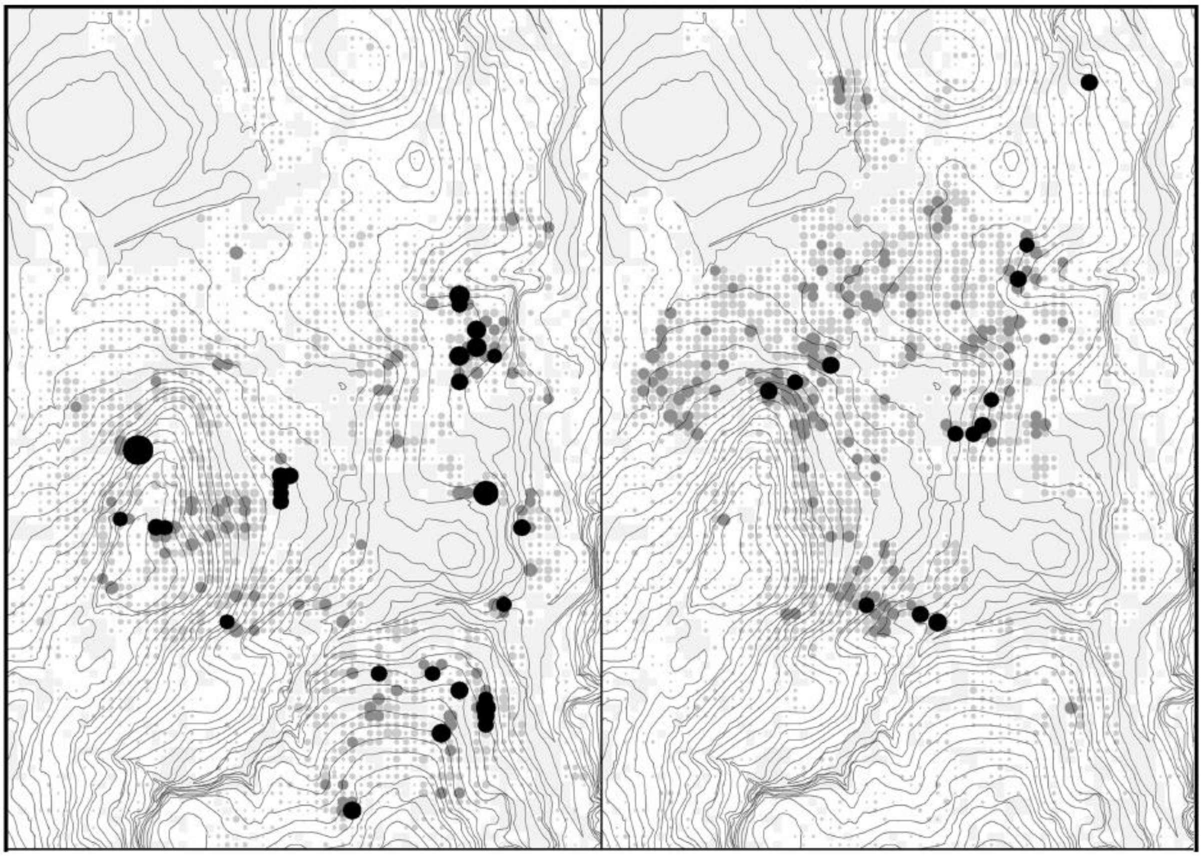

FIGURE 5.4: Sample size distributions: A. Prehistoric; B. Roman. *[Page 83]*

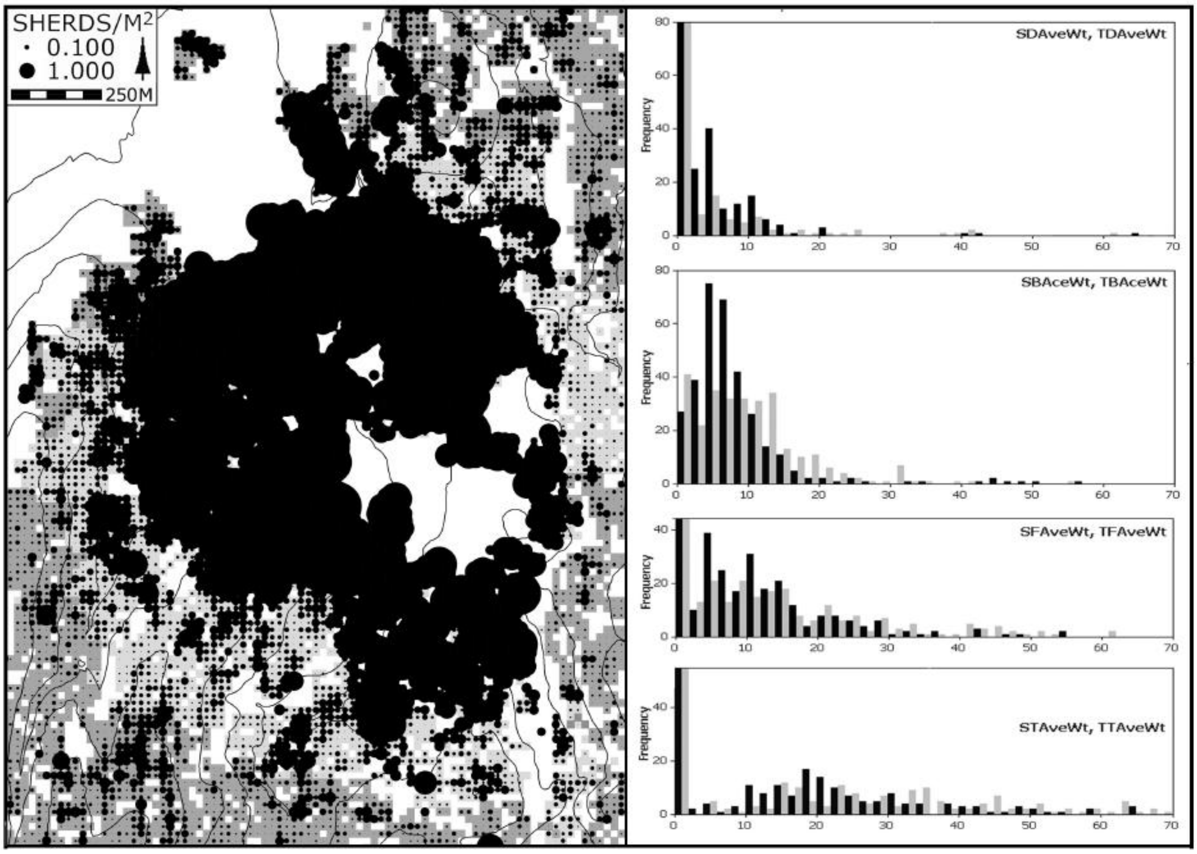

FIGURE 5.5: Collection strategies and average sherd weights: A. collection method and all sherds; B. Decorated sherds; C. Body sherds; D. Feature sherds; E. Tile fragments. *[Page 86]*

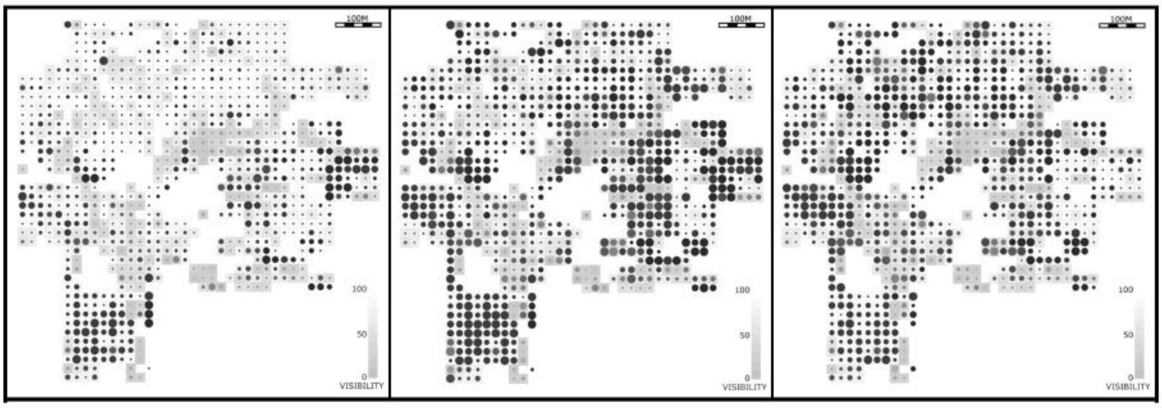

FIGURE 5.6: Core area, visibility and recovery by phase: A. Prehistoric; B. Hellenic; C. Roman. *[Page 89]*

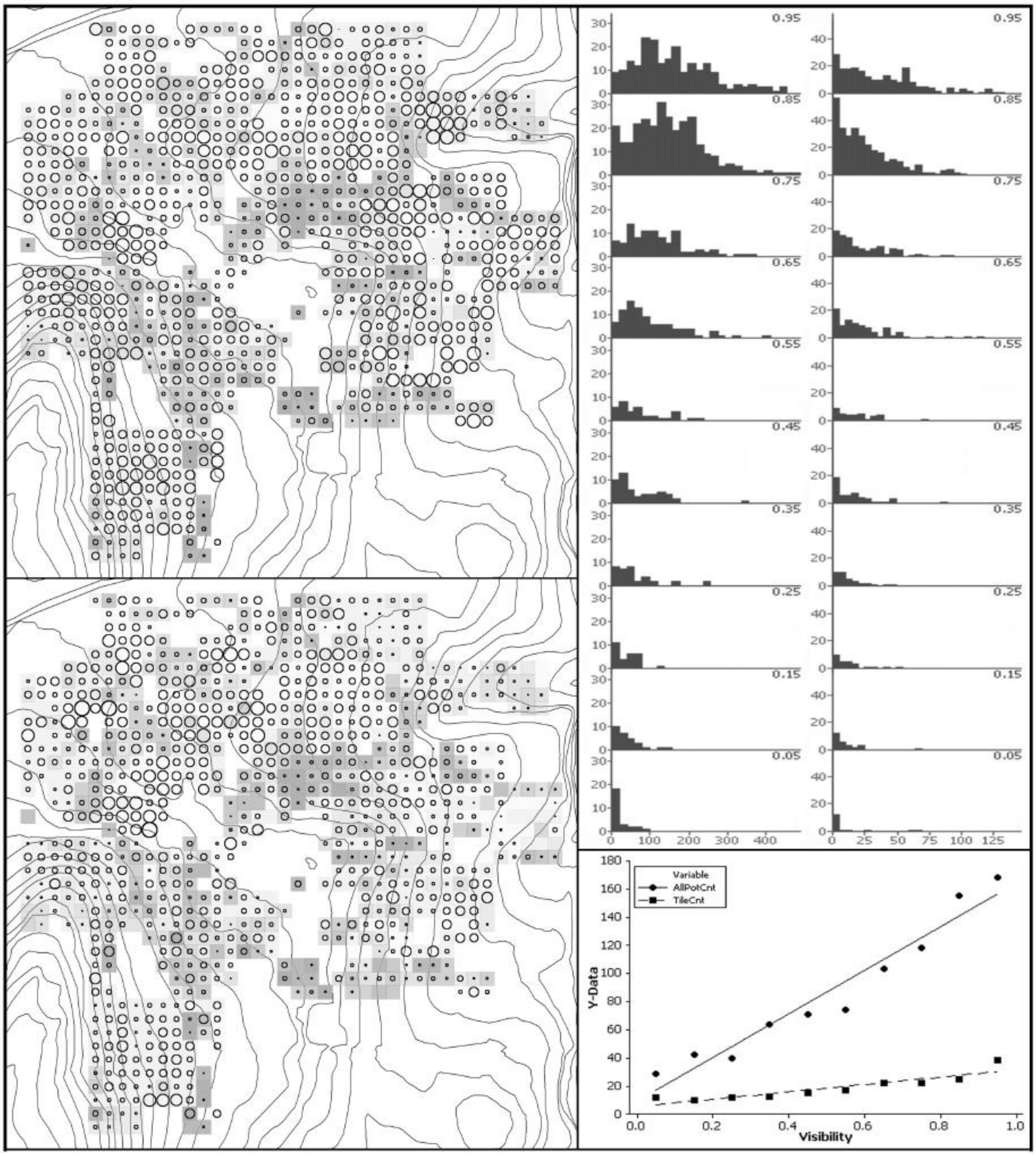

FIGURE 5.7: Core area, visibility and recovery quantities: A. all pottery; B. all tile; C. pottery and tile collection size by visibility; D. regression of collection size on visibility, pottery and tile. *[Page 90]*

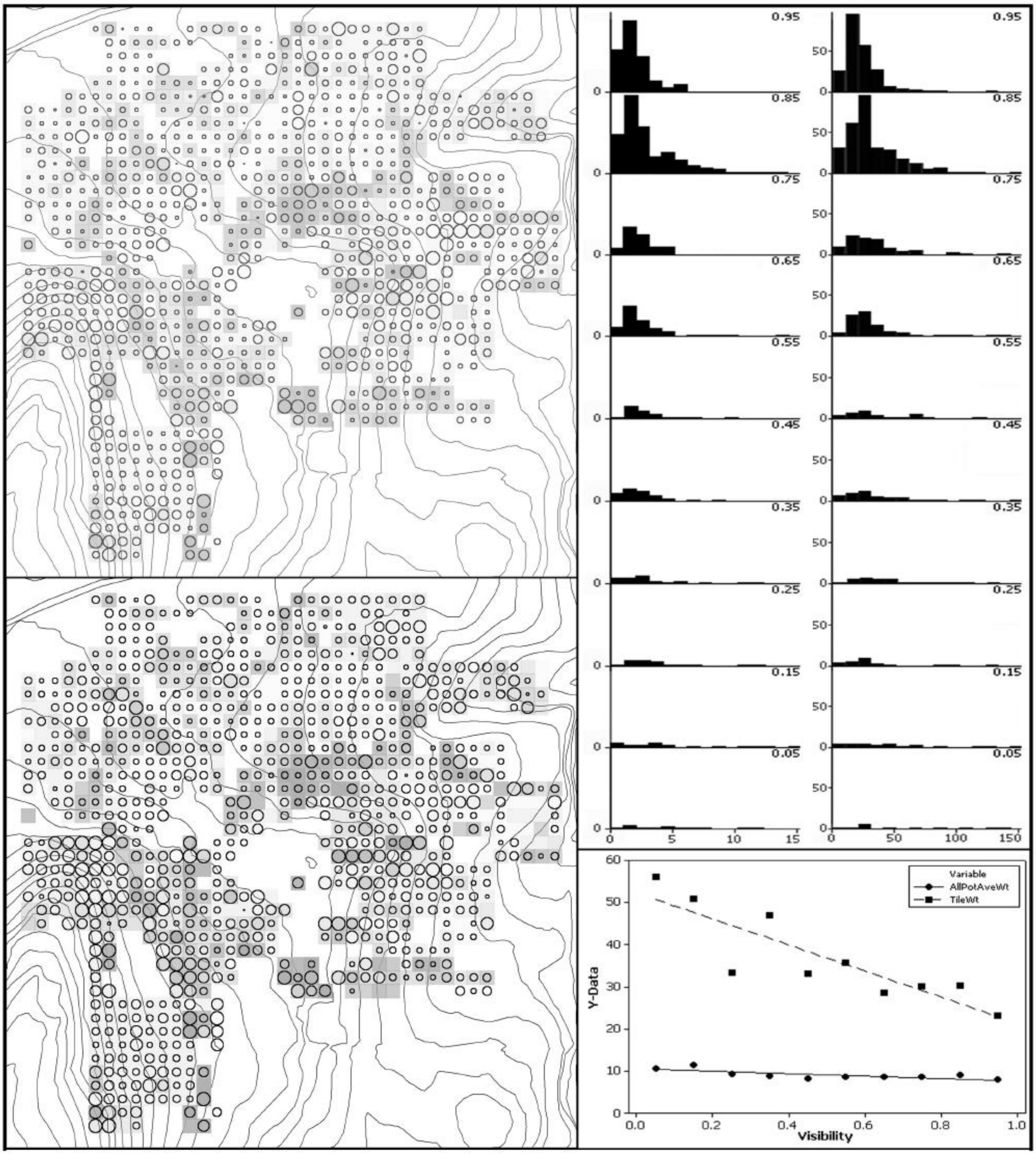

FIGURE 5.8: Core area, visibility and fragment size: A. all pottery; B. all tile; C. pottery and tile average fragment weight by visibility; D. regression of average weight on visibility, pottery and tile. *[Page 91]*

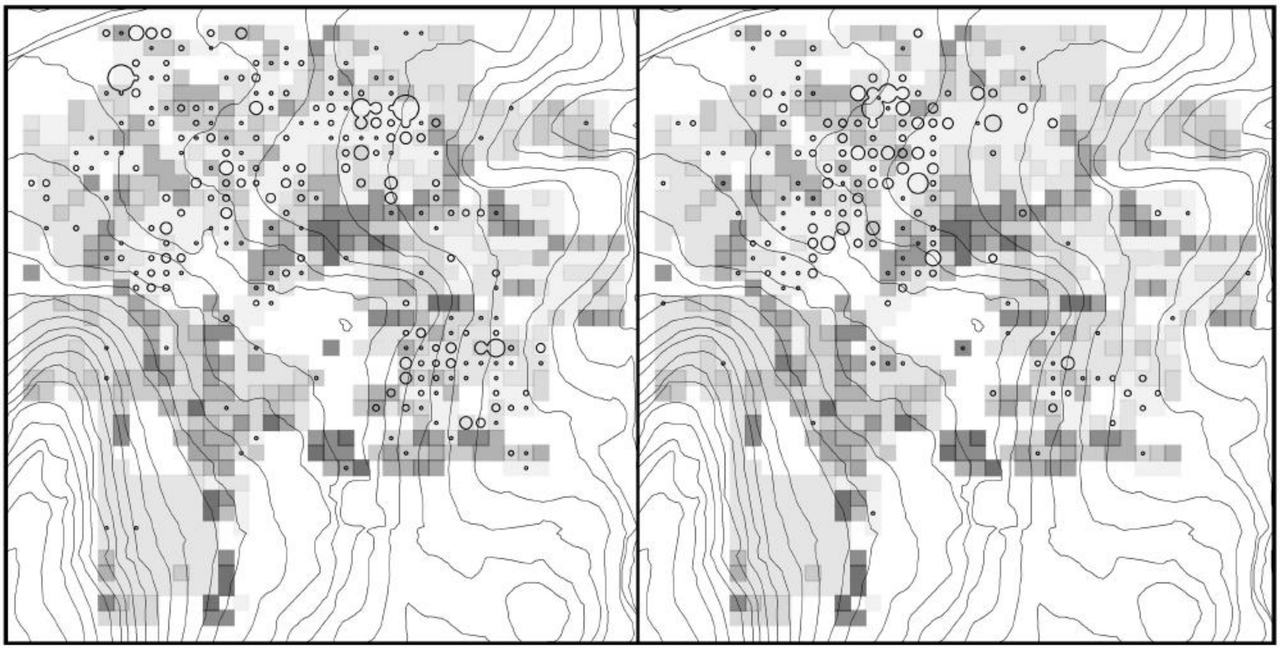

FIGURE 5.9: Core area, visibility and find recovery: A. stone tesserae; B. marble veneer fragments. *[Page 92]*

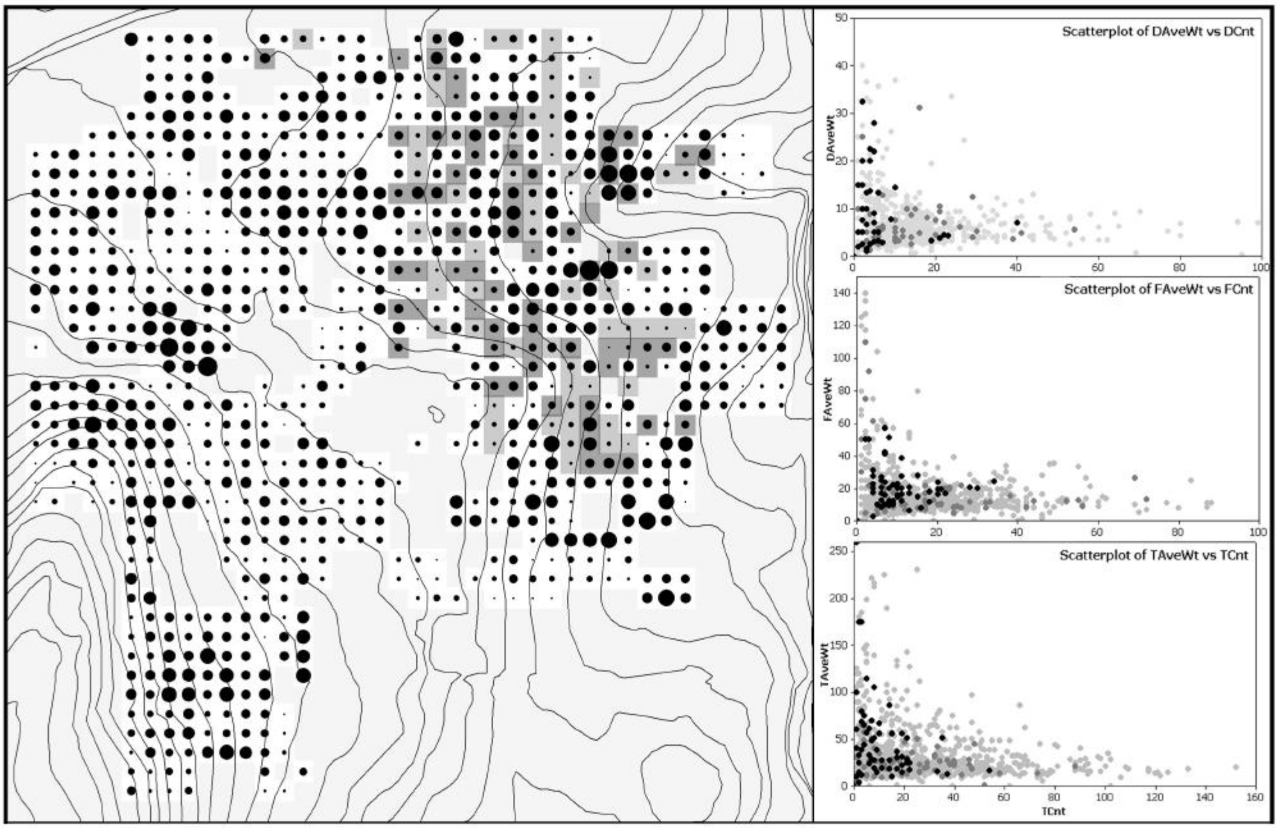

FIGURE 5.10: Core area, collector recovery bias: A. map of pottery recovery; B. detail of recovery by two collectors; C. decorated sherds, feature sherds and tile: counts by average weight. *[Page 94]*

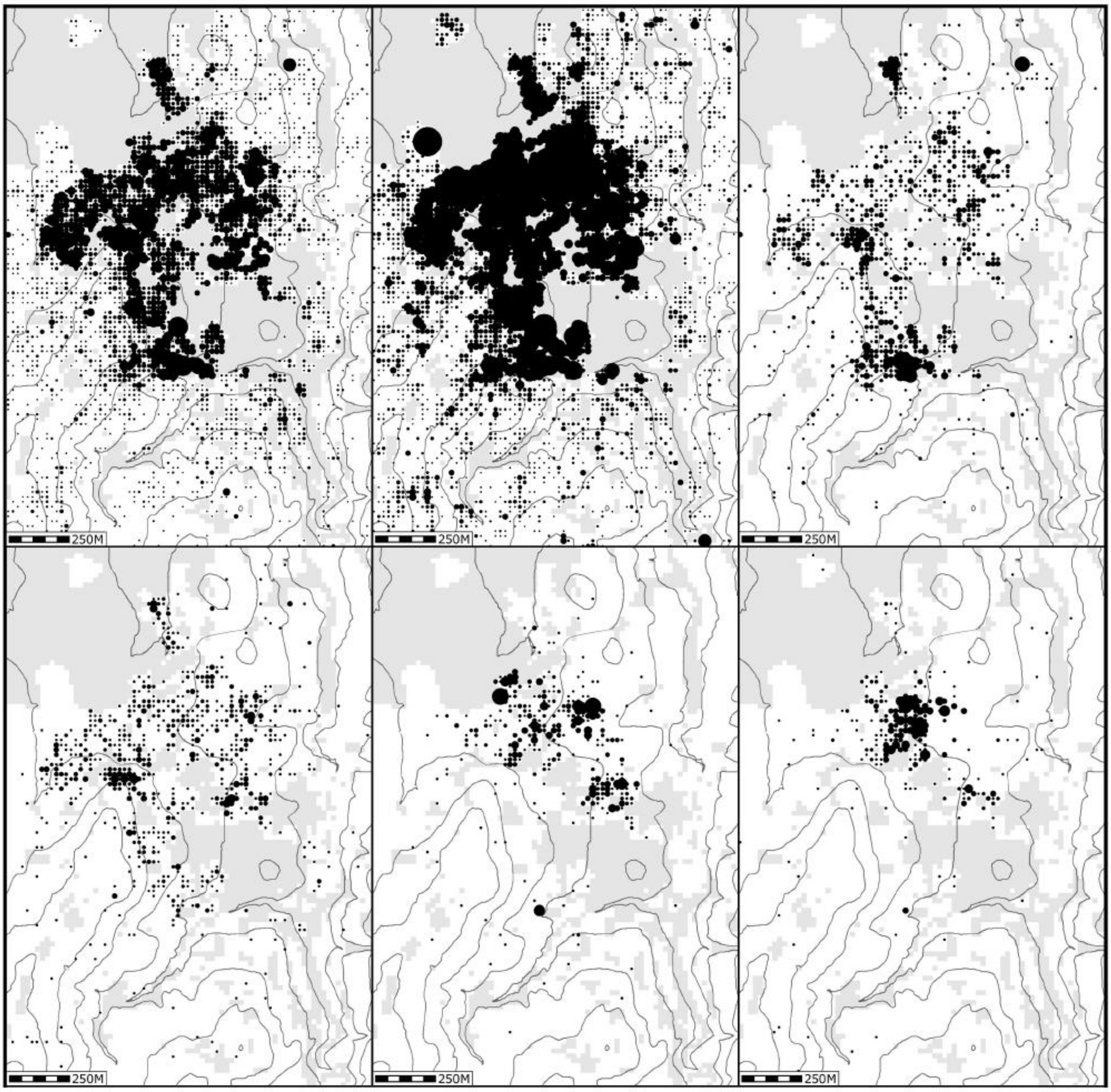

FIGURE 5.11: Roman distributions: A. all Roman pottery; B. tile; C. amphorae; D. Sigillata; E. stone tesserae; F. marble veneers. *[Page 95]*

	Counts		Densities		Average weights	
	Intensive	Transect	Intensive	Transect	Intensive	Transect
Units	325	288				
All pottery	7226	4324	2.22	0.38	10.7	11.6
Decorated sherds	517	125	0.16	0.01	6.6	11.9
Body sherds	5665	3208	1.74	0.28	7.3	9.2
Feature sherds	1027	991	0.32	0.09	13.5	18.9
Tile	1067	712	0.33	0.06	28.4	34.2

Table 5.1. Collection strategy biases. *[Page 86]*

Visibility	Units	All pottery				Tile	Prehistoric				Roman			
		All	Decorated	Body	Feature		All	Fine	Cooking	Coarse	All	Fine	Cooking	Coarse
90100%	224	168.4	14.5	134.8	19.1	38.3	4.70	0.94	0.36	0.93	10.50	1.70	1.97	4.62
80-90%	298	155.5	14.0	122.6	18.8	24.6	5.30	0.87	0.40	1.19	10.30	2.05	1.93	5.02
70-80%	98	118.3	11.0	91.8	15.5	22.3	3.40	0.48	0.27	0.87	8.80	1.56	1.63	4.42
60-70%	93	103.4	9.0	82.0	12.4	22.1	2.80	0.35	0.19	0.68	8.90	1.40	1.70	3.78
50-60%	36	74.3	5.0	60.8	8.5	16.9	1.60	0.25	0.11	0.50	4.70	0.78	0.81	2.14
40-50%	52	71.1	7.2	56.5	7.5	14.7	1.50	0.29	0.21	0.46	5.00	0.81	0.79	2.33
30-40%	35	63.7	6.8	49.0	7.9	12.3	2.30	0.63	0.17	0.57	5.40	0.83	1.00	2.11
20-30%	27	39.9	2.7	32.5	4.7	11.4	0.60	0.04	0.04	0.00	3.00	0.41	0.30	1.52
10-20%	27	42.0	3.2	33.6	5.3	9.7	1.30	0.11	0.11	0.70	2.80	0.56	0.44	1.30
0-10%	17	28.8	3.1	21.8	3.9	11.4	1.50	0.12	0.35	0.24	3.10	0.88	0.41	1.41

Table 5.2: Visibility biases: average sherd counts per collection unit. *[Page 89]*

Visibility	Units	All	Decorated	Body	Feature	Tile	Prehistoric	Roman
90-100%	224	7.9	6.5	7.4	13.1	23.2	11.1	3.1
80-90%	298	9.0	6.7	8.3	15.3	30.3	11.3	3.1
70-80%	98	8.6	6.0	7.8	15.1	30.2	12.0	3.1
60-70%	93	8.6	6.6	8.1	13.9	28.5	12.6	3.5
50-60%	36	8.7	6.5	8.2	14.0	35.8	14.1	3.6
40-50%	52	8.2	5.6	7.8	13.8	33.1	10.6	3.8
30-40%	35	8.9	7.4	8.1	14.6	47.0	11.9	2.6
20-30%	27	9.3	8.6	8.6	14.6	33.4	8.5	5.4
10-20%	27	11.5	8.4	9.7	25.5	50.9	21.4	3.9
0-10%	17	10.7	6.8	9.2	22.3	56.1	16.6	4.8

Table 5.3: Visibility biases: average weights. *[Page 89]*

Collector	Units	All pot		Decorated		Body		Feature		Tile		Prehistoric		Roman	
		Density	Ave. wt	Density	Ave. wt	Density	Ave. wt	Density	Ave. wt	Density	Ave. wt	Density	Ave. wt	Density	Ave. wt
A	45	19.23	8.70	2.00	6.73	14.70	7.78	2.54	15.57	2.71	39.59	1.03	12.45	1.36	3.98
B	167	17.80	7.34	1.50	5.04	14.36	6.67	1.94	11.13	3.36	18.70	0.46	8.53	1.14	2.81
C	66	15.67	6.89	1.10	6.66	12.80	7.01	1.78	13.35	2.25	23.28	0.26	9.92	0.87	2.67
D	76	14.85	9.14	0.94	7.31	12.34	8.01	1.57	14.13	3.95	28.15	0.21	9.43	1.13	3.07
E	33	13.68	7.89	1.04	6.24	1.13	7.50	1.35	12.29	2.85	34.08	0.37	12.55	0.86	4.34
F	55	13.55	7.30	0.89	5.15	11.09	6.61	1.57	12.76	2.36	23.90	0.23	10.10	0.87	2.26
G	36	11.45	8.51	0.88	8.70	9.31	7.71	1.26	14.27	2.12	45.76	0.39	15.25	0.84	3.58
H	44	10.42	12.59	1.17	8.36	7.65	11.95	1.60	18.82	2.03	38.26	0.48	14.23	0.83	3.68
I	35	10.31	9.05	0.88	6.82	8.03	8.39	1.40	14.25	3.17	25.21	0.40	14.71	0.76	2.76
J	96	9.83	9.15	1.12	6.00	7.44	8.47	1.28	14.80	2.14	28.11	0.34	12.21	0.74	3.55
K	30	9.35	8.24	1.15	5.19	7.04	7.46	1.16	13.47	1.18	29.91	0.60	9.89	0.58	3.62
L	46	9.30	9.01	1.06	5.92	7.28	8.60	0.96	14.32	3.55	24.28	0.20	15.45	0.61	4.47
M	34	8.39	7.75	0.88	6.98	6.48	6.99	1.03	12.66	1.48	44.21	0.35	11.65	0.53	3.49
N	62	4.85	14.03	0.44	7.55	3.47	11.60	0.95	21.36	1.05	35.03	0.13	20.14	0.39	3.12

Table 5.4: Collector biases: sherd densities and average weights. *[Page 93]*