CHAPTER 3

SETTLEMENT ARCHAEOLOGY OF MESOPOTAMIA

T.J. Wilkinson, Jason A. Ur, Carrie Hritz

Mesopotamia is well known as the place of origin of the early civilizations of Sumer, Akkad, Assyria and Babylonia. One of the main objectives of the MASS Project is to model the development of early urbanization by studying how the original settlements developed and sustained themselves, thus creating the foundations for the first towns and cities. The physical environments of southern and northern Mesopotamia are remarkably different. Whereas the arid plains south of Baghdad, in modern Iraq, are mainly irrigated by the twin rivers of the Euphrates and Tigris and their distributary channels, the rolling plains and intervening hills of northern Iraq and Syria are primarily regions of rain-fed cultivation. However, between about 2000 BC and 1000 AD, irrigation systems gradually spread through the north to transform parts of the region into irrigated landscapes. These contrasting environments have had a major impact on the development and history of settlement, and it is the aim of this chapter to summarize the settlement landscape of both northern and southern Mesopotamia specifically as they relate to the question of building settlement models.

Since cities develop as a consequence of social, cultural, religious and economic factors, they are difficult to study without resorting to elaborate metaphors or the language of complexity. For Southern Mesopotamia, Guillermo Algaze has presented a series of 'synergies' that might have led to the development of urban growth (Algaze 2005: 20-24; 2008: 124-26):

- a concentration of polities and associated peer-polity interactions
- a greater proportion of the population in urban centers, thereby allowing for divisions of labor and economies of scale, as well as efficiencies of transportation that result from larger concentrations of population
- increasing compactness of populations, which led to multiple interactions between people and associated increased information flow.

Algaze argues that when such increased numbers of people were brought together by an efficient transportation and communication network as part of a created landscape (in the sense of Cronon 1991) further synergies and growth resulted (Algaze 2008: 124). One flaw in this model is that it requires the existence of concentrations of populations in towns and cities for them to act as a catalyst for urbanization. In other words, the model presents the conditions for the perpetuation of urbanism, but does not provide for their emergence. It is therefore necessary to look earlier than the first towns, to the earlier concentrations of rural population that preceded urban development, if we are to discern the roots of cities. In contrast to earlier assumptions, it is in the rain-fed north of Mesopotamia that archaeological surveys are starting to recognize such foundations for urban development, as noted below.

In order to understand Algaze's 'synergistic cauldron' as well as the demographic foundations of cities, it is necessary to incorporate a large range of behaviors into computer simulations, as well as to use archaeological surveys to estimate long term settlement densities and the trajectories of city growth. This chapter sketches the main trends that are relevant from both northern and southern Mesopotamia in order to provide a foundation for the models that follow.

ARCHAEOLOGICAL SURVEY, SETTLEMENT PATTERNS AND THE FOUNDATIONS OF URBAN LIFE

A wide range of informative sources are available concerning early settlement in the Middle East. In addition to archaeological surveys (Fig. 3.1), data also comes from cuneiform texts, which supply crucial information from itineraries, tax records, lists of conquered territories, terse notes on administered territories, and a considerable amount of information on named towns and cities. Unfortunately, there is relatively little published about life in the countryside except when appropriate questions have been asked in the textual record, as is the case with a collection of some 15,000 tablets that supply a remarkable degree of detail about the rural landscape and settlement in the vicinity of Ur III Umma (Steinkeller 2007).

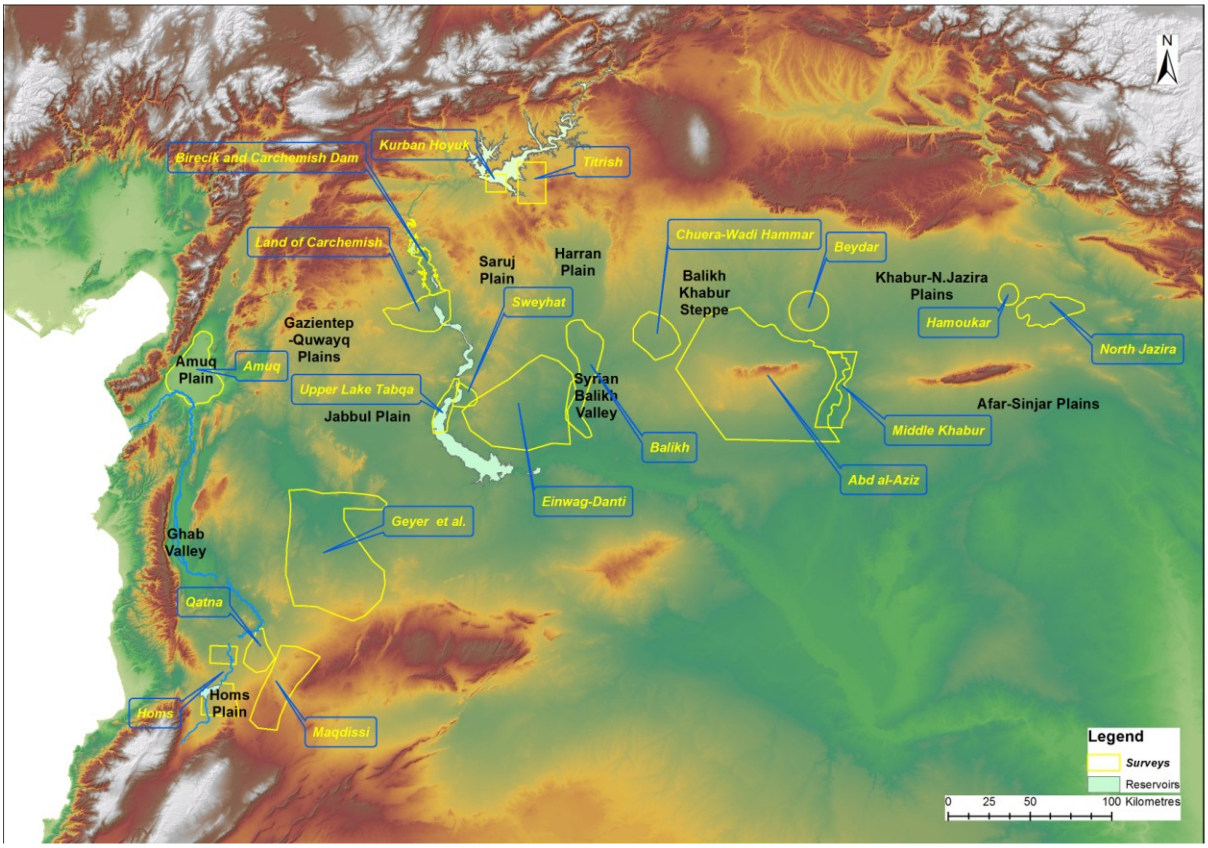


Fig. 3.1 Some of the main surveys conducted in northern Syria, southern Turkey and NW Iraq (compiled by N. Galiatsatos for the Fragile Crescent Project).

With regard to later periods, the Classical and Arab geographers, as well as Ottoman records, supply fascinating insights into settlement patterns of the Classical, Sasanian and Islamic periods (Le Strange 1906; Wheatley 2001), but are less forthcoming on the geography of early civilizations. Western travellers started to provide interesting insights into the region as early as the twelfth century AD, when Benjamin of Tudela sought evidence of Jewish communities in the Middle East. However, the real explosion of information did not start to emerge until the sixteenth century, when European travellers, building upon classical and biblical sources, made references to early cities, ancient canals and other features, especially along the Aleppo, Baghdad and Basra caravan routes (Ooghe 2007: 67-69). For example, in 1579 the Venetian merchant Gasparo Balbi described ruined cities and suggested an identification between Babylon and the Tower of Babel[1], and from that time on the flow of information increased rapidly (Ooghe 2007: 72).

[1] Although they may have been referring to Aqar Kuf, not Babylon.

By the nineteenth century, the record of early civilizations started to become the actual objective of early explorations, especially with the expeditions of, for example, Paolo Emelio Botta, Austin Henry Layard, and Henry Rawlinson from the 1840s onwards (Larsen 1994). Not only did these first Assyriologists undertake excavations, they also undertook general explorations that paved the way for later, more systematic investigations. Rather general archaeological reconnaissances were undertaken by Saare and Herzfeld as well as Von Oppenheim in the early twentieth century, by Robert Braidwood in the Amuq Plain of southern Turkey in the 1930s, and Max Mallowan in the Khabur and Balikh in the 1940s. However, a more analytical approach took shape in the 1950s, with the pioneering surveys of Thorkild Jacobsen and Robert McCormick Adams in the Diyala region east of Baghdad and the plains of southern Mesopotamia to the south, as discussed under southern Mesopotamia below (Adams 1965; Adams & Nissen 1972; Adams 1981). These projects essentially paved the way for many of the approaches undertaken in the regional studies of the 1980s and later.

Advances resulting from the application of remote sensing

In addition to surveys on the ground, an important source of information on early settlement came from the use of air photography and, since the late 1970s, satellite imagery (summarized in Fowler 2004, 2013). These started with the pioneering works of Aurel Stein, Kennedy & Riley (1990), Poidebard (1934) and others immediately following the first World War. Some of the most comprehensive records of the archaeological landscape was obtained by commercial surveys undertaken as part of agricultural development programmes of the 1950s and later. For the north, these are best exemplified by the studies of Van Liere and Lauffray (1954/1955), which demonstrated not only the pattern of Bronze Age settlement in the Khabur basin of northern Syria, but also remarkable radial patterns of route systems across the landscapes around the emergent Bronze Age early towns.

Unfortunately, the results of the aerial surveys were often inaccessible within agricultural ministries or were unavailable for contractual reasons; therefore their early promise was not always realized (although Adams and others were granted occasional access to these records). Consequently the use of satellite imagery such as the American Landsat and French SPOT programs promised to revolutionize our ability to map settlements and their economic landscapes over vast areas. These sources made it possible to detect some archaeological features thanks to their ability to record such features over a wide range of spectral wavelengths, but their low spectral resolution made individual sites and landscape details difficult to recognize.

This inability was redressed, however, by the release of CORONA satellite images for public use in 1995[2] (Fowler 2004; Kennedy 1998; Challis 2007; Ur 2013b; Fowler 2013) as well as by the development of high-resolution, commercial digital imagery such as Quickbird, GeoEye, Ikonos and SRTM (Parcak 2009; Hritz in press). The CORONA photographic images are powerful datasets because they offer moderately high resolution, broad geographical coverage and a good temporal range, with images available in different seasons. The images were taken from satellites during the 1960s and 1970s and were designed to monitor missile capability and other potential threats to the west. Fortunately for archaeologists, because the US government conceived a generous range of potential threats, large areas of Eurasia were covered by at least one (and frequently several) missions, so that we are now blessed with an unsurpassed record of archaeological landscapes from the Cold War era–all of which pre-date many of the destructive processes of urban and agricultural development of recent decades. This more recent imagery has proven useful in areas where landscape modifications are ongoing, such as the former wetlands in the delta (Hritz *et al.* 2013).

The Shuttle Radar Topography Mission (SRTM) has been particularly useful for the investigation of the Mesopotamian landscape because its high-resolution digital elevation models provide a sensitive rendering of the micro-relief of the land surface. This has been particularly effective in southern Iraq where the linear levees of ancient rivers and canals show up as remarkably distinct features (Fig. 3.2; see also Chapter 2; Hritz & Wilkinson 2006; Hritz 2010). Thanks to SRTM, together with the other forms of satellite imagery, it is now possible to assemble data on settlement patterns and landscape features (e.g., fields, canals etc) as well as on the broader networks of hydraulic features. In northern Mesopotamia, SRTM data has been used to recognize

[2] Although CORONA images were declassified in 1995, it was not until 1998 that they became publicly available.

mounded sites via semi-automated classificatory methods and to estimate site volume over a broad region (Menze, Ur, & Sherratt 2006; Menze & Ur 2012).

As a result of the surveys conducted since the 1950s, especially the most recent surveys conducted with the use of satellite imagery, we now have a much better idea of the patterns of settlement that shaped the development of early civilizations. These data sources for both the north and south now give a rather more precise idea of the pattern of settlement for key periods. Some degree of temporal resolution for these patterns has been possible because surface collection of ceramics from individual sites, site subdivisions and offsite areas have enabled the broad shifts, rises and falls of settlements to be charted over centuries. However, this resolution could still benefit from considerable improvement and ground verification, especially in the south. Unfortunately, these records are essentially static, and although there has been a considerable amount of discussion surrounding the processes of settlement development and urbanization, little real quantitative analysis has been undertaken concerning the dynamic processes of settlement development.

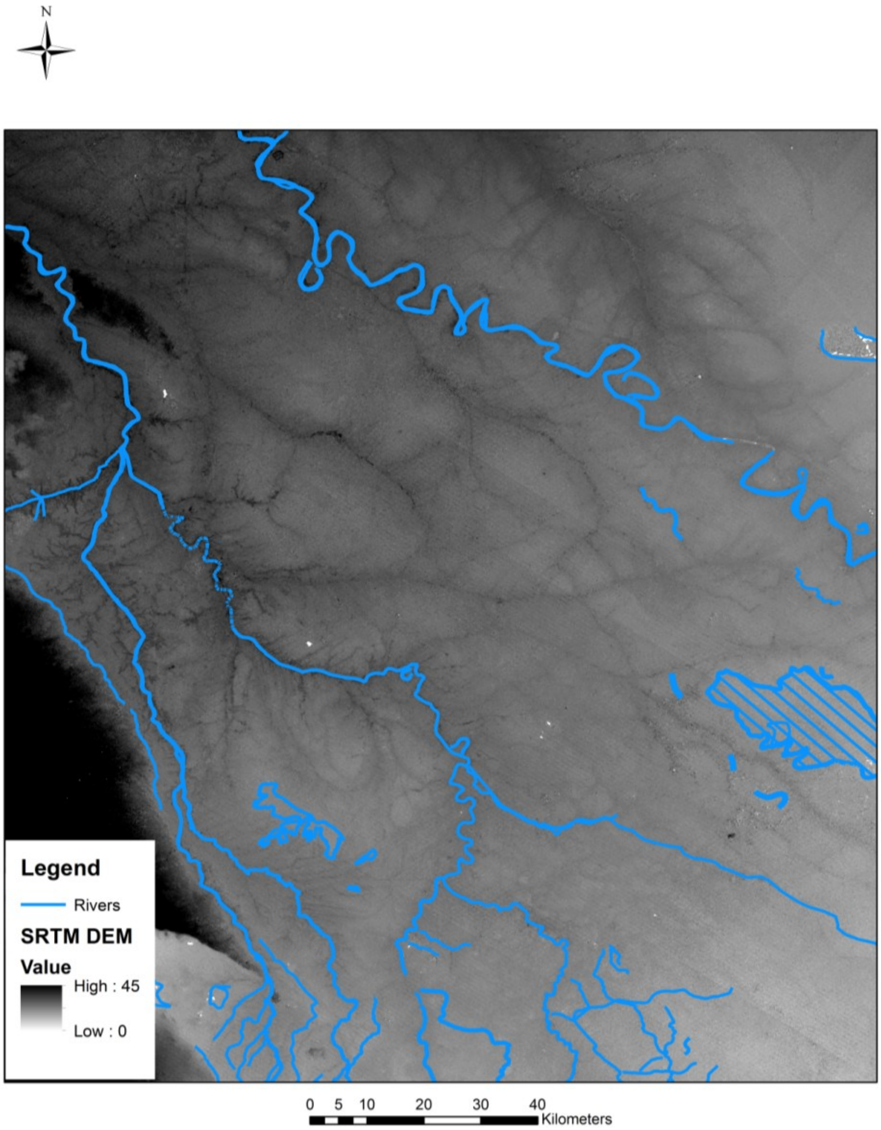


Fig. 3.2 SRTM image showing riverine levees around Lake Dalmaj in the central Mesopotamian plains (C. Hritz).

This chapter will therefore provide a broad perspective on the contrasting patterns of settlement between the north and south of Mesopotamia, and will set the stage for the processes of modeling that will be laid out later in the volume.

LONG-TERM SETTLEMENT

Northern or Upper Mesopotamia

Northern (Upper) Mesopotamia, described as the 'bread basket' of the Fertile Crescent (Weiss 1986), consists of a series of broad, fertile lowlands separated by uplands developed on limestone and basaltic rocks. Rainfall varies between ca. 500mm per annum in the north and 200mm on the desert margins (Chapter 2). Cereal crops can be grown in most years, and in the moister fringes tree crops and legumes provide a more diversified agricultural economy. Field evidence from archaeological surveys suggests that in the rain-fed lands of northern Syria and northern Iraq at least some of the preconditions for urbanization were present.

Although not as dense as during the third millennium BC, in contrast with southern Mesopotamia, settlement in the north was relatively dense during the sixth, fifth and fourth millennia BC (i.e., in the Halaf, Ubaid, and Late Chalcolithic periods). In fact many tells date back to these phases of prehistory. Surveys conducted over the last 25 years indicate that during the fourth millennium BC site densities in the Khabur basin and neighboring areas attained between 10 and 20 sites per 100km^2, equivalent perhaps to estimated population densities of 10-15 persons per km^2 (Wilkinson *et al.* submitted). Prehistoric settlement densities became lower towards the west–that is, along the Euphrates and its tributaries–although in favored fertile lowlands dense enclaves of prehistoric settlement also occurred, such as in the Amuq of southern Turkey and other parts of the Orontes Valley.

Developing social complexity took a variety of settlement forms in Upper Mesopotamia. Some of these forms proved to be durable, and others may have lasted only a few generations. Already by the late fifth millennium, communities were experimenting with new spatially large but low-density forms, such as 300ha Khirbat al-Fakhar/Hamoukar (Ur 2010b; Al Quntar, Khalidi & Ur 2011) and 55ha Tell Brak (Ur, Karsgaard & Oates 2007; Ur, Karsgaard & Oates 2011). Both sites featured core settled areas with smaller pockets of settlement around them and with unoccupied areas maintained between these pockets. In the case of Khirbat al-Fakhar, settlement growth was probably related to trade and specialized production in obsidian blades (Khalidi, Gratuze & Boucetta 2009), and was apparently short-lived.

By the fourth millennium BC a number of Late Chalcolithic sites took the form of massive tells that dominated the surrounding countryside (Lawrence 2012), examples being (from east to west) Kuyunjik (Nineveh), Tell al-Hawa, Tell Brak, Samsat, Oylum Höyük and perhaps Tell 'Imar al Sharki (Fig. 3.3). What distinguishes these bulky tells is not only their height, but their overall mass. In other words, their height appears to have been maintained over a relatively large area, implying that they were fairly stable configurations that maintained their size over relatively long periods. Although such mounds (which measured up to ca. 50-60ha), according to received wisdom, did not approach the spatial extent of equivalent sites in southern Mesopotamia (see below), some northern sites attained a considerable size. At Brak, settlement grew in density and extent to become a 130ha urban center with outlying smaller sites by LC 3-4, (Middle Northern Uruk) or the mid-fourth millennium BC (Ur, Karsgaard & Oates 2011: Fig. 3). A similar process may have occurred at nearby Tell al-Hawa (Ball, Tucker & Wilkinson 1989). These multiple discrete pockets of settlement formed communities clustered around major central mounds, which apparently gave way to settlements that had consolidated within walled cities by the mid-third millennium BC (Ur, Karsgaard & Oates 2007: 1188).

Recent research in Upper Mesopotamia suggests that the region supported trajectories of urban life parallel to those in southern Mesopotamia; the degree to which these processes were interconnected remains uncertain (Ur 2010a).

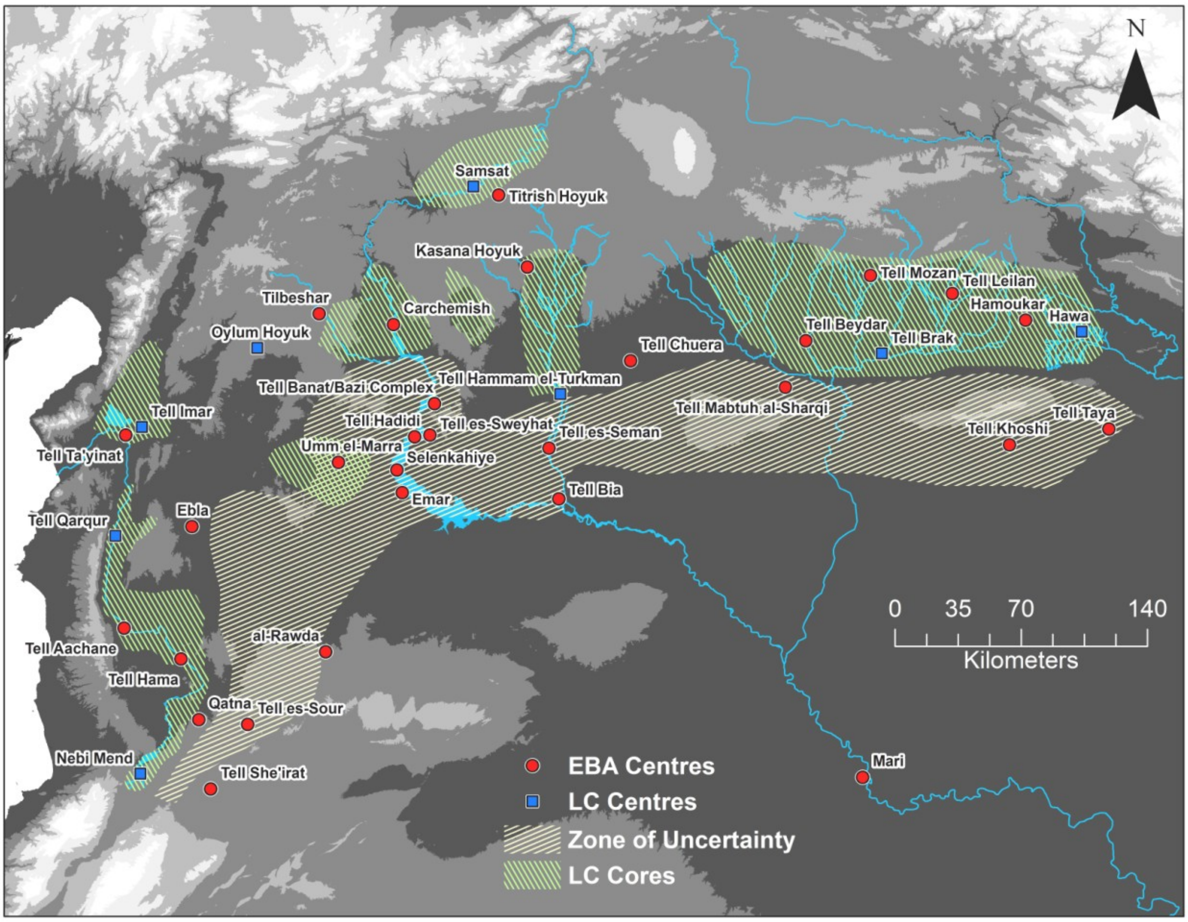
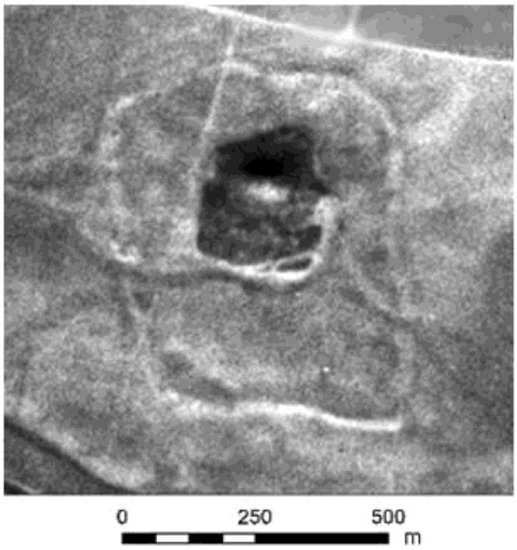


Fig. 3.3 Some major Late Chalcolithic and EBA settlements in Syria, southern Turkey and NW Iraq (by Dan Lawrence for the Fragile Crescent Project).

Although settlement hierarchies did exist in the fourth millennium BC, the walled cities of the third millennium were more clearly associated with both the development of a settlement hierarchy and with the creation of areas of open space in the landscape. Settlement hierarchies are particularly evident in the densely populated landscapes of the Khabur basin, where the deep and relatively fertile soils are associated with a dense scatter of tells distributed every few kilometres across the landscape (Wilkinson 2003: Fig. 6.18; Ur 2010b: maps 2 & 3; Deckers & Riehl 2008; Menze & Ur 2012). In the Khabur basin and neighboring areas, settlement hierarchies are evident around Tell al-Hawa (Wilkinson & Tucker 1995), Leilan (Stein 1994: 13) and Tell Beydar (Ur & Wilkinson 2008). The geographical evidence takes the form of a larger number of intermediate size settlements than is evident, for example, in more topographically constrained areas such as along the Middle Euphrates.

In addition, archaeological surveys indicate that the rural landscape itself became more differentiated into cultivated land use zones (around major centers) and occasional open spaces, the latter appearing to have developed in formerly more populated areas. Such open areas were associated with the development of pastoral lands, perhaps because the increase of intensive cultivation must have decreased the possibilities for grazing in the vicinity of the main tells (Wilkinson & Tucker 1995). The most conspicuous example of the creation of a pastoral zone occurs between Hamoukar and Tell al-Hawa and to the south, where an area of formerly dense Late Chalcolithic settlement was abandoned around the end of the fourth millennium BC to create a large area of open space ideal for use as pasture (Wilkinson & Tucker 1995).

Particularly noteworthy in Upper Mesopotamia was the development of so-called citadel cities, consisting of a central tell and surrounding walled area. These 'cup-and-saucer' configurations provide a stark contrast to the bulk of the Late Chalcolithic tells. Ranging in size from around 40ha (along the Euphrates in Syria) to a maximum of 100-120ha in the Khabur basin (e.g., Hamoukar and Mozan), many citadel cities show a rapid trajectory of growth and ultimate collapse which often took place over a few centuries (Fig. 3.4). Some of the smaller citadel cities of the mid-Euphrates region underwent this life-cycle particularly quickly. For example, Titriş Höyük (in Turkey) and Tell es-Sweyhat (in Syria), achieved their maximum size and then declined again within the space of a mere 200-300 years, perhaps fewer (Wilkinson *et al.* 2012: 175-76). Although it is not entirely clear why these sites underwent such 'boom and bust' cycles, it is likely that they were linked to the nature of the political economy that prevailed during the later third millennium. Such developments, either in the form of rapid growth in interregional trade (Klengel 1992; Algaze 1999) or high-risk sheep husbandry associated with textile production in growing states such as Ebla (Wilkinson *et al.* 2012), were relatively short-lived and were therefore associated with a phase of urbanization that was also of brief duration.



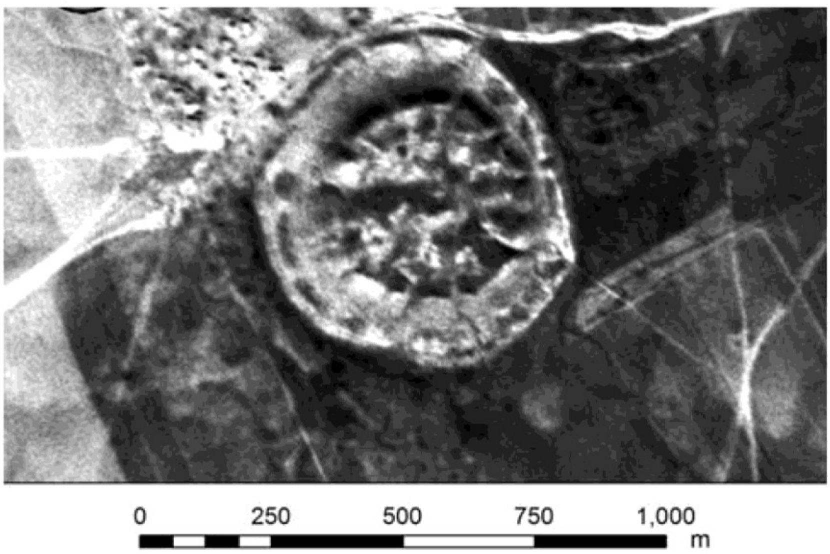


Fig. 3.4 Corona images of Early Bronze Age sites in northern Syria that show evidence of rapid expansion into a citadel city (both images are at roughly the same scale). Top: Tell es-Sweyhat; below: the Kranzhügel site of Abu Shakhat). (Stefan Smith; Corona images by courtesy of US Geological Survey).

Although distinctive settlement hierarchies were evident in the extensive fertile plains of the Khabur basin, the basins of southern Turkey and the moister parts of the rain-fed zone, in other areas the predominant settlement feature was the small tell. These prominent mounds, with areas measuring between one and three hectares, form alignments along river valleys and within minor basins. Many of these sites, despite their small area, boast extremely long histories of occupation; others might simply be small, short-lived, Bronze Age fortified farms or storage areas, perhaps equivalent to the second millennium BC *dimtu* settlements found to the east of the Tigris in northern Iraq (Kolinski 2002).[3] Significantly, in terms of modeling, the most common of these tells, which measure on average only one or two hectares, could only have housed 100-200 people or so. This situation fits within the range of size argued by Robin Dunbar (2003) as being the optimum size for social interaction.[4]

In other words, it appears that the most common settlement size in much of Upper Mesopotamia may accord with a spatial limit set by meaningful social interactions (see below). At the other extreme, a second upper limit on the size of settlement appears to have been set by the constraints of the environment, overland transport and the local economy. In this case, settlements did not grow beyond some 100-120ha, and perhaps were capable of housing some 10,000 or so people (Wilkinson 1994; Stein 2004). Further discussion of the development of the settlement landscape of Upper Mesopotamia is found in Chapter 4.

Southern Mesopotamia

In southern Mesopotamia the trajectory of early settlement growth is less clear. Urban life in the south built upon an earlier pattern of Ubaid settlement that extended back to at least 6000 BC (Huot 1996). The high groundwater levels and the anastomosing river systems must have created a verdant environment in the southern plains around Ur (Tell Muqayyar), Uruk (Warka) and Lagash (al-Hiba), especially given the proximity to the head of the Gulf which extended considerably farther inland during the fourth millennium BC than it does today. Processes of erosion, alluviation and deposition of irrigation sediments have probably obscured many of the earliest settlements, and generally the density and size of prehistoric settlements is unclear. It is therefore difficult to say with any confidence what settlement patterns were like during the Ubaid period in the northern alluvium.

Overall, visible settlement density during the Ubaid was higher in the south between Uruk and Ur (i.e., ancient Sumer) than it was further north in the alluvium (ancient Akkad). Adams considered this deficit of sites in the northern alluvium to perhaps be the result of a more pastoral way of life (Adams 1981: 59), whereas Pournelle (2003) interprets this as resulting from the greater attraction and use of marsh resources in the south for major settlement. However, the geoarchaeological evidence for increased sedimentation and masking of early sites in the north remains the most expedient interpretation (Wilkinson 2003: 80). Nevertheless, the presence of occasional larger settlements in the north, together with the clear evidence for the masking of sites by alluvial and irrigation sediments (see Chapter 2) suggests that a significant number of smaller Ubaid sites such as Ras al-Amiya (Stronach 1961) have been lost from view. Rather than providing a full history of settlement in the alluvial lowlands, we present two key stages: the fourth millennium BC phase of the emergence of cities and the period of city states between 2600 and 2100 BC, during which time a linear pattern of settlements becomes particularly evident. The latter period provides the context for the models of salinization presented in Chapter 13. In both cases, this review is based almost entirely on the fieldwork of Robert McCormick Adams (1965, 1981), Adams & Nissen (1972) and colleagues (Gibson 1972; Wright 1981). For other recent reviews, see Wilkinson (2000) and Ur (2013a).

The narrative of settlement evolution for the fourth millennium, which culminated in the unprecedented urban agglomeration at Uruk, is complicated by the lack of unequivocal chronological-type fossils; the main indicators of temporal development (clay sickles for Early Uruk and beveled rim bowls for Late Uruk) have yet to be

[3] Or, to the bad$_3$ settlements of the Ebla texts, Sebastien Rey, pers. comm., Oct 2012.

[4] The actual Dunbar number being around 150 people, as discussed below.

placed in a rigorously collected stratigraphic sequence. Nonetheless, Adams' own reconstruction sees early settlement expansion around Nippur in the center of the plain, followed by a shift to the south around Uruk at the end of the millennium (Adams 1981: 63-76; see also the reassessment in Pollock 2001). This shift was accompanied by the extraordinary growth of Uruk itself to 250ha (Finkbeiner 1991). Although Uruk is the best-understood early urban center, other large sites grew at the same time. None, however, have been subjected to intensive surface investigation, and other site-based studies have revealed considerable ambiguities; for example, Gibson (1992) considers the Ubaid and Uruk surface assemblage of Nippur to derive entirely from Parthian-era earthmoving.

Despite these ambiguities, fourth millennium settlements are remarkable for their more dispersed patterning, of the sort that came to define the subsequent millennia (Fig. 3.5). Nevertheless, some degree of linearity is evident at this time near Nippur and Uruk on both the original maps of Adams (1981: Figs. 12 and 13) and the re-analyzed versions by Pollock (1999: 56-57). A recent proposal interprets the dispersed non-linear patterning around, for example, Uruk as the result of settlement on 'bird's foot' deltas, a geomorphological characteristic of the marshy termini of riverine systems (Pournelle 2003). Shifting patterns of short-term sedentary occupation of a dynamic alluvial environment within ceramically-defined periods might also produce such a dispersed pattern. Both circumstances might have been in force simultaneously. In any case, the patterns show no sign of large distributary canal systems at the time of the earliest cities; these systems appear later, and are clearly the *result* of urban states, rather than the cause of them.

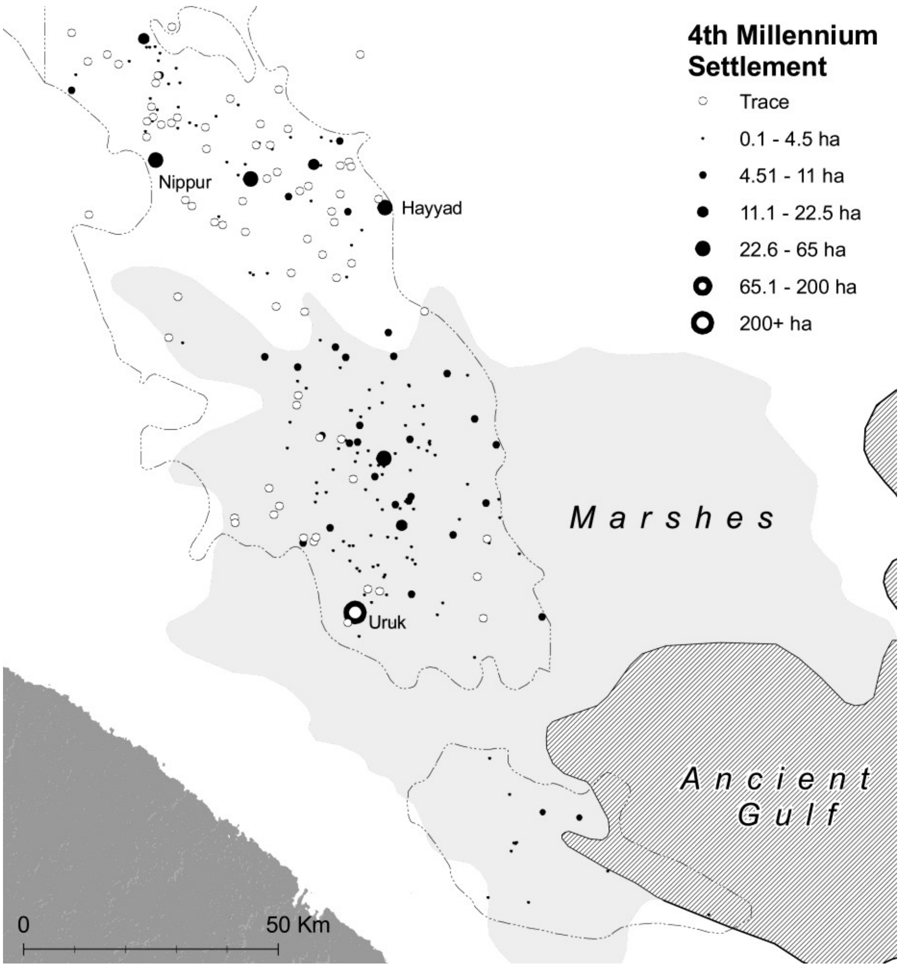


Fig. 3.5 Late fourth millennium BC (Late Uruk) settlement in southern Mesopotamia (J.A. Ur; based on Adams 1981; Algaze 2008; Wright 1981; Pournelle 2007).

The end of the fourth millennium marked the start of a half-millennium long phase of urban growth and settlement nucleation. In the early third millennium (Early Dynastic I period), Uruk itself continued to attract settlement and grew to at least 400ha, an area which included a monumental city wall (Finkbeiner 1991). This growth process almost certainly involved immigration, and its immediate hinterland was nearly depopulated. By the time of the so-called 'city-states' of the mid-third millennium, the countryside as a whole was largely vacant, with 80% of the plain's population living within settlements of urban scale (defined arbitrarily as 40ha or greater; see Adams 1981: 138). Settlement patterning was strikingly linear (Fig. 3.6), and it is clear that the courses of the rivers and other channels were the dominant factor in the settlement geography of the plain.

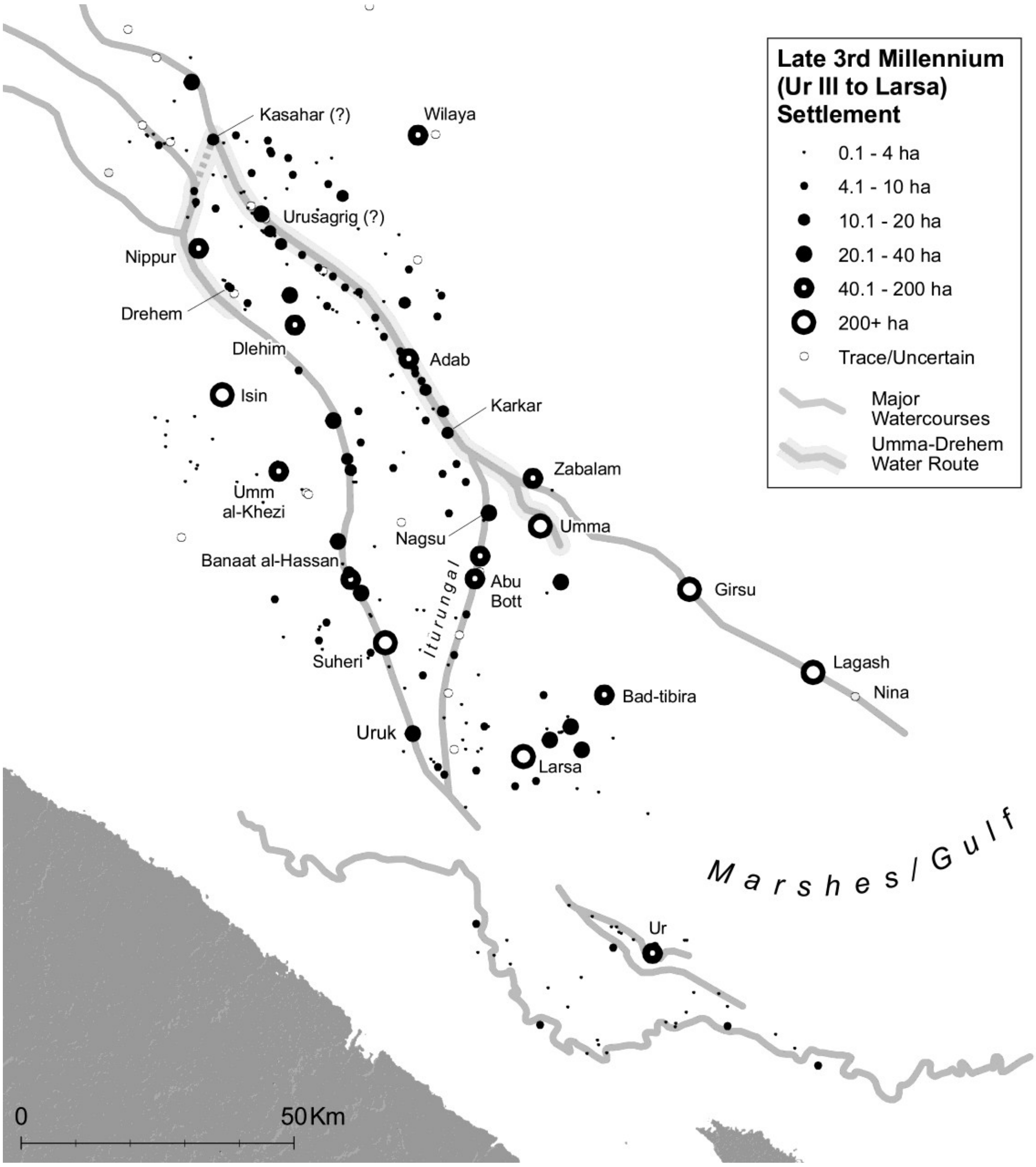


Fig. 3.6 Late third / early second millennium BC settlement in Southern Mesopotamia (J.A. Ur; based on Adams 1981; Wright 1981; Steinkeller 2001).

The major cities of this hyper-urbanized time often measured well in excess of one hundred hectares. In addition to those at Uruk, surveys at Kish, Lagash, and Fara confirm Adams' reconnaissance-based assessments (Gibson 1972; Martin 1983; Carter 1989-1990). Horizontal excavations at Early Dynastic cities in the Diyala region and at Abu Salabikh show that this spatial expansion was accompanied by high residential density alongside great palace and temple households (reviewed in Ur 2012). With some relatively brief deviations (see below), the major urban sites were the centers of small states that interacted as durable peer polities for the second half of the third millennium.

With the expansion of cuneiform writing to include royal inscriptions, letters, and various literary forms, an emic perspective on settlement can be discerned. The plain was roughly subdivided between a largely Semitic-speaking region to the northwest (Akkad) and a Sumerian region to the southeast (Sumer). Major cultural and political differences between these regions have been proposed (e.g., Steinkeller 1993), but it is unclear whether these differences extended to patterns of settlement and land use. Later historiographical sources like the Sumerian King List and other literary texts reveal unambiguously for the first time the deep significance of religious institutions in Mesopotamian cities: the gods literally lived within them. Far more than any economic function, it is the presence of the divine that accounts for the long settlement histories of many of these places (Adams 1981; Ur 2012). This emic perspective reveals one particular view of urbanism with serious ramifications for archaeological interpretations: the indigenous terminology for settlements (Sumerian *uru*, Akkadian *ālum*) has no spatial or demographic connotations; the same term designated city state capitals and small villages alike (Van de Mieroop 1997: 10). Archaeologists must recognize that our emphasis on settlement hierarchies would not have been meaningful to the ancient inhabitants of these places.

The end of the third millennium witnessed the consolidation of the plain into unified political entities that lasted for a century or more. Because the primary source for dating (evolving traditions of ceramic production) is entirely divorced from political dynamics, it is difficult to say what consequences these events had on patterns of settlement. The Akkadian period is a particular challenge (Nissen 1993). It appears, however, that these phases of political consolidation coincided with a reoccupation of the countryside, as the percentage of population living in rural settlements expanded under the Akkadian kings and grew still further under the Third Dynasty of Ur.

In the course of the second millennium BC, settlement patterning continued to show a decisive shift away from urbanism toward a more rural orientation; by the Kassite period, more people lived outside of cities than within them. Here we must be careful, however, and consider the shortcomings of the survey dataset. Early in the second millennium, political power had shifted west, outside of the survey regions of Adams and colleagues, and the Euphrates appears to have followed this move (Brinkman 1984; Hritz 2004). Hence this apparent ruralization process may be the result of the biases present in the places archaeologists have chosen to look. In an environment such as the plains of Sumer and Akkad, we must always be careful to consider such dynamism, both environmental and social, when interpreting the deceptively static archaeological record.

Settlement trends during initial urbanization (ca. 3500-2100 BC) can be summarized along two trajectories: overall population growth and alongside fluctuating urbanization (for graphic representations, see Ur 2013a: Figs. 7.9 and 7.10). If total settled hectares are used as a proxy for population (with appropriate caution; see Postgate 1994), the core of the plain between Nippur and Uruk witnessed more or less continuous growth from initial settlement through the Ur III and early Old Babylonian periods; nearly identical growth took place on the Diyala and Ur-Eridu plains. The spatial distribution of these populations was, however, more uneven. Relative urbanization, here defined as the percentage of the population living in settlements of 40ha or more, increased steadily until reaching a maximum of almost 80% at the end of the Early Dynastic period. With political consolidation under the dynasties of Akkad and Ur, this trend was reversed, and populations increasingly inhabited villages of less than ten hectares.

COMPARISON BETWEEN NORTH AND SOUTH MESOPOTAMIA

At the outset, we must point out that because many of the archaeological surveys carried out in southern Mesopotamia predate most of those conducted in the north, there are significant methodological differences between the two data sets, so that we are not comparing like with like (Fig. 3.7; Wilkinson 2000: 221-22; Ur 2013a: 132-36). One interpretation of the available data on settlement size is that in southern Mesopotamia the predecessor populations of the fifth and sixth millennia were relatively sparsely distributed, modest in size and of comparable complexity to those in the north (Fig. 3.8; Algaze 2005: 1-2). However, the density of fifth and sixth millennia BC sites in parts of the north was significantly higher than in the south, where around the sites of Tell al-Hawa, Hamoukar and Brak, Hassuna and Halaf sites occurred at a remarkable density (Wilkinson & Tucker 1995; Ur 2010b; Wright *et al*. 2006-07: 10). By the first half of the fourth millennium BC, at least one settlement (Brak) in the north was probably comparable in scale to contemporaneous Uruk sites in southern Mesopotamia (Algaze 2005: 18). Unfortunately problems with the pottery chronology make it difficult to make robust comparisons of site area. Bearing these chronological disparities in mind, it can be stated that Brak was relatively large (ca. 130ha) in the middle of the fourth millennium, and Uruk was even larger (ca. 250ha) by the end of the millennium. The degree to which their growth processes overlapped chronologically is unknown. However, by the Late Uruk period, the biggest settlement in the south (Uruk) had attained 250ha (Finkbeiner 1991), considerably larger than any contemporaneous site in the north, and a high proportion of the population appears to have been living in urban-scale settlements (Fig. 3.8; Adams 1981: 72-73). By the Early Dynastic period, cities in southern Mesopotamia had attained an unprecedented size. This is best exemplified by the city of Uruk, which covered some 400ha (Finkbeiner 1991) at a time when the contemporaneous sites in northern (Upper) Mesopotamia were experiencing a decline and rarely exceeded 40-50ha in size (Figs. 3.8 and 3.9).

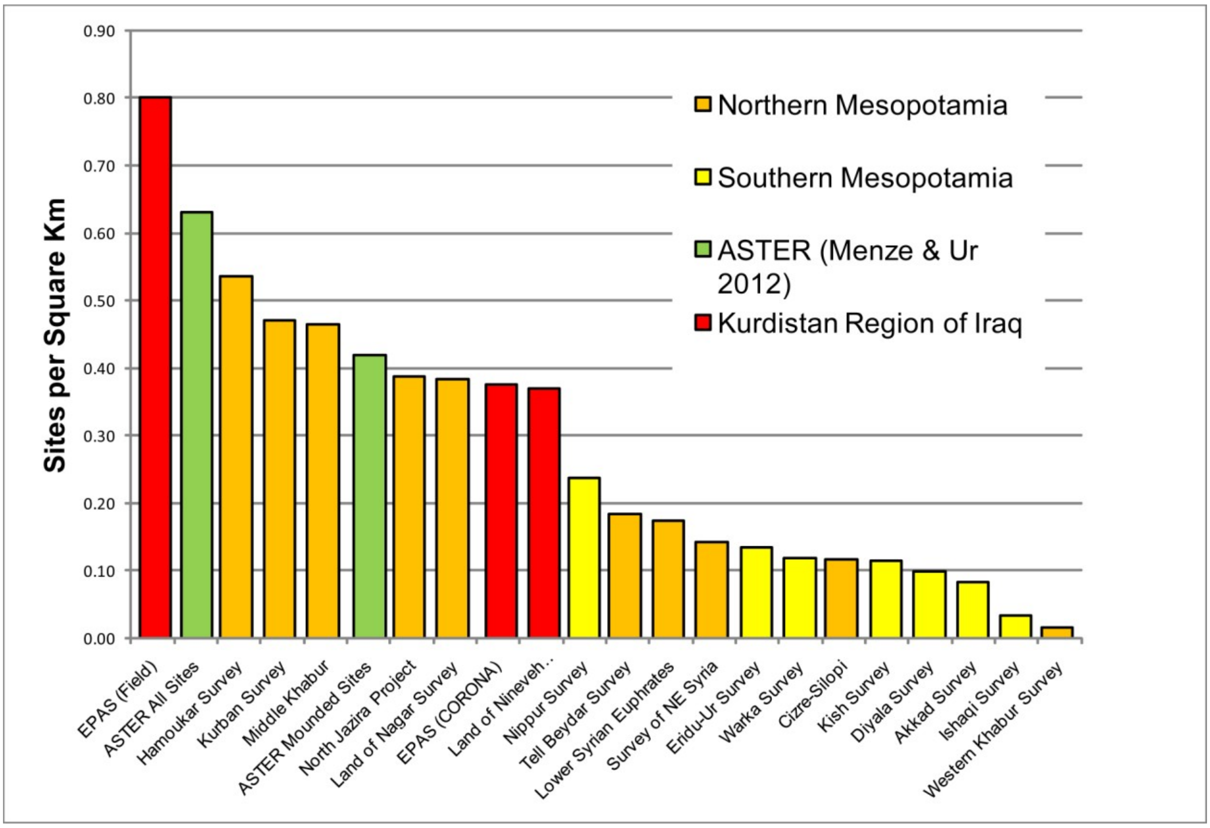


Fig. 3.7 Survey intensity of different regions and using various techniques. (J.A. Ur).

In order to attain the massive size that cities had reached by the late fourth and third millennia BC, growth rates in the south must have been very high–probably higher than can be accounted for by natural rates of increase alone (Adams 1981: 69). Certainly during the fourth millennium BC southern growth rates were higher than those in the north, where the relatively high predecessor populations combined with the modest scale of sites in the Late Chalcolithic indicate modest rates of growth. When the (admittedly very coarse) statistics are expressed in terms of estimated population densities together with the maximum size of the largest city (Figs. 3.8 and 3.9), the trajectory is quite clear: although occupying a region with apparently higher population densities, northern cities remained of relatively modest size. This broad statement must be tempered, however, by the observation that within particular enclaves, citadel cities showed very rapid cycles of explosive growth followed by decline and collapse.

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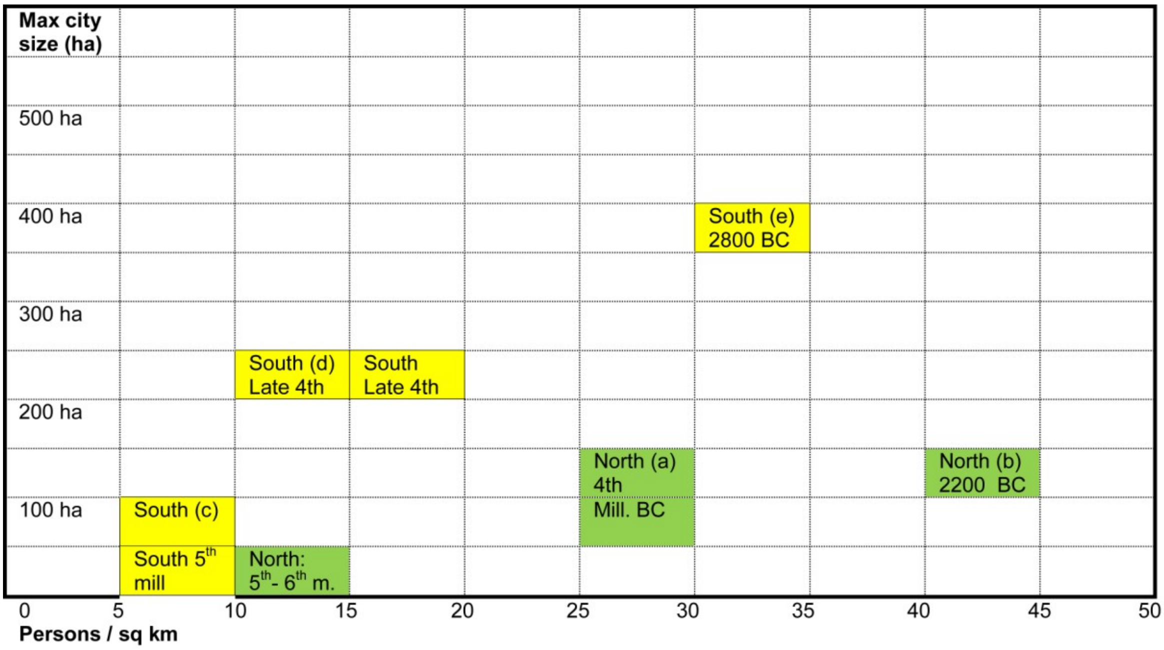

Fig. 3.8 Maximum city size versus population density (persons / sq km) for northern and southern Mesopotamia.

a) Maximum size of settlement at Brak and Hawa.

b) North: 2300-2100 BC allowing for the maximum site size in the north (100-150 ha).

c) South: maximum city size has been estimated by Pournelle for Uruk in the Ubaid period at ca. 106 ha (Pournelle 2003:188).

d) Uruk attains 250 ha in the Late Uruk (ca. 3100 BC); Population density estimated for the northern & southern enclaves of the Mesopotamian plains from Adams (1981).

e) Uruk attains a total area of ca. 400 ha in the Early Dynastic 1 (Finkbeiner 1991); the settlement population density is estimated for the northern and southern enclaves of the Mesopotamian plains from Adams (1981).

Population density is simply the aggregate settlement area for any period x 125 persons / ha for both northern and southern Mesopotamia. For northern Mesopotamia population densities have been estimated for the North Jazira (Tell al-Hawa) and Hamoukar survey areas (Wilkinson & Tucker 1995; Ur 2010). (Based on data compiled by Kristen Hopper).

Overall, however, the situation in the north differed from that in the south. Uruk and other southern cities experienced massive increases in their maximum size, despite their apparently relatively modest settlement density. At the deliberately coarse and approximate scale of Fig. 3.8, it is clear that while both systems started at roughly the same size and population density, the disparity between north and south widened over some three millennia. However, this statement must be tempered by the observation that by the second half of the third millennium BC (Early Dynastic III and later), both north and south had large nucleated centres, with those of the south being larger; however, here the difference is more of degree than kind. What makes comparison between the north and south at this time particularly difficult is that the rapid trajectories of growth and decline in the north meant that comparisons of city size only relate to a small chronological window (that is, the approximate point when the northern cities attained their maximum size).[5] Otherwise many settlements, which ultimately developed into citadel cities, were of modest size and certainly were smaller than their northern counterparts.

[5] Although southern Mesopotamian cities could have experienced similar boom-and-bust trajectories, the northern sites have benefited from more systematic excavations and surface collection which allow such cycles to be recognized.

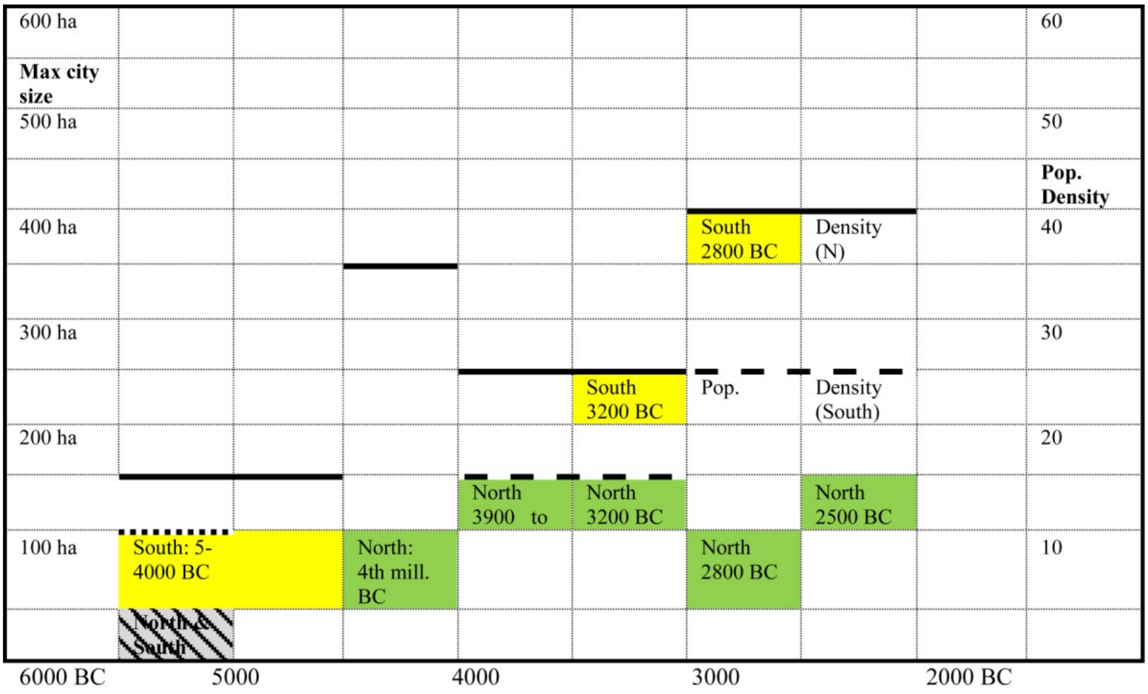

Fig. 3.9 Northern and southern Mesopotamia: maximum city size versus population density plotted according to chronology. Estimates for Uruk (Warka) from Pournelle 2003, fig. 78, at ca. 106 ha (Pournelle 2003:188). Eridu = 12 ha (ibid.: 193); Eridu is estimated at ca. 40 ha in the early Uruk. Solid line: pop density for northern Mesopotamia; broken or dotted line: population density for southern Mesopotamia. (Based on data compiled by Kristen Hopper).

In both southern Mesopotamia and parts of the north, such as the Khabur basin, urban growth appears to have entailed the enlargement of cities at the expense of the surrounding rural populations. In other words, small sites were abandoned and there was some degree of movement of population towards the growing centers, particularly the site of Uruk in the south (as described above). Nevertheless some northern cities, especially those located in marginal areas, appear to have developed in sparsely populated areas that lacked local populations to incorporate into their growing outer towns (Wilkinson *et al.* 2012). As mentioned above, in southern Mesopotamia immigration appears to have stemmed from declining or less rapidly growing areas such as the Nippur / Adab area or parts of southwestern Iran. In addition, a compelling case can be made for the sedentarization of nomadic groups during the fourth and third millennia BC, a process which particularly favored the growth of cities. This process may have, in part, contributed to the rapid growth of citadel cities in the more sparsely settled parts of northern (Upper) Mesopotamia. Unfortunately, field evidence for the presence of mobile or transhumant pastoralists in either the northern or southern survey areas remains frustratingly meager (Pollock 1999: 69-70).

In summary, by the later fourth and third millennia BC southern Mesopotamia had become dominated by cities that were significantly larger than those in the north, which had apparently stabilized at more modest levels.

Archaeological surveys demonstrate that both southern and northern Mesopotamia were densely occupied during the early civilizations of the late fourth and third millennia BC. However, because the statistics that deal with settled areas over specified periods are not necessarily of the highest accuracy, the data presented here must be treated with caution. Specifically, analyses of southern Mesopotamian settlement patterns must employ data from surveys that were conducted more than thirty years ago: the art of survey has become more intensive in recent years so that more efforts are now made to record smaller sites, as well as artefact scatters beyond the perimeter of the site, and to estimate missing sites and landscapes using geoarchaeology (Fig. 3.7). Furthermore, the ceramic sequences are now better known and more chronologically refined than those employed in the original surveys: a case which is particularly acute in the south, where many surveys were conducted when ceramic chronologies were less refined. The disparities in settlement or population density may therefore be partly explained by the fact that in the south the surveys of the 1950s, 1960s and 1970s experienced challenges in technique and chronological resolution and consequently recorded fewer sites than surveys in the north (Fig. 3.7). Furthermore, in southern Mesopotamia it is likely that many earlier settlements have been lost or obscured by alluvium, especially in the northern parts of the plain where alluvial sedimentation was greater (Wilkinson 2003: 76-81).

Although archaeological mounds form the basis of settlement in both the north (Upper Mesopotamia) and south (Lower Mesopotamia), their morphology varies considerably. When the maximum elevation of larger settlement mounds is plotted against total mound area (Fig. 3.10), southern sites occupy a distinctly lower sector of the graph than those in the north. Sites in irrigated southern Mesopotamia are evidently both lower and more extensive than the tells of the rain-fed north. Those in the north clearly form high and prominent mounds, although spatially rather restricted, whereas southern sites are much more sprawling and extensive, sometimes being partially aligned along canals or river channels. Even discounting the presence of ziggurats such as the 22m high ziggurat of Ur, which raises the profile of southern settlements somewhat, it is still evident that the settlement areas that surround them were more extensive than those of the north. These differences probably relate to a range of different processes, including the fact that northern sites are often more vegetated, especially on north-facing slopes, whereas southern sites usually suffer long-term deflation (Rosen 1986; Wilkinson 2003: 80). In addition, the southern settlements were frequently subdivided into two or even four sectors by canals and river channels, as was the case at Nippur and Abu Salabikh.

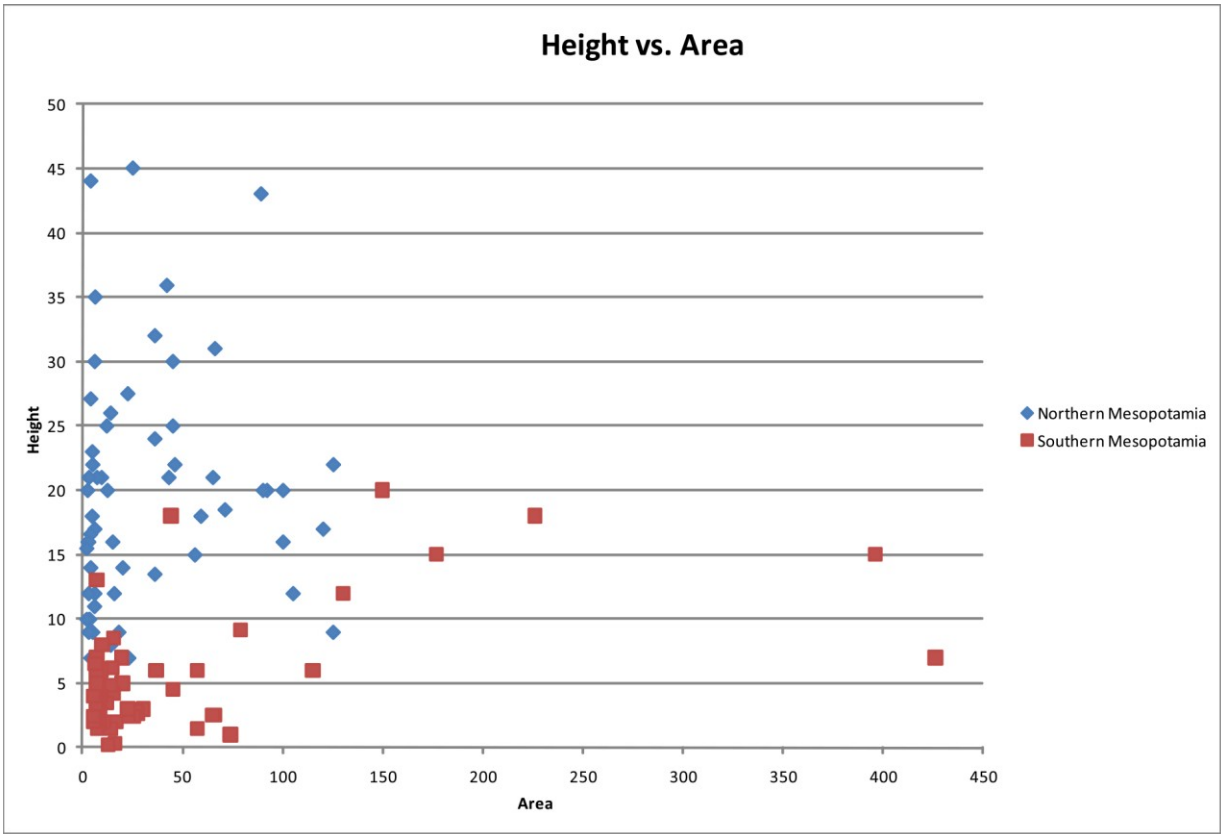

Fig. 3.10 Scatter graph comparing the area and height of a sample of archaeological sites in northern Mesopotamia (diamonds) and southern Mesopotamia (squares) for approximately the third millennium BC. (Compiled by Louise Rayne).

Since at least the nineteenth century AD southern Mesopotamia has been renowned for its impressive cities, which extended over areas of frequently more than 50ha. Such large sites, in turn, sat at the apex of a hierarchy of much less visible settlements, ranging from town-size settlements down to small village or hamlet-size communities of less than one hectare. Unfortunately it is usually difficult to interpret settlement hierarchies from the cuneiform sources; however, during his surveys, Robert McCormick Adams recognized the following size classes for sites of the third and second millennia BC (Table 3.1; Adams 1981: 136-41 and table 14).

Table 3.1. Estimations of settlement hierarchies for southern and northern Mesopotamia.

Southern Mesopotamia (from Adams 1981)	**Northern Mesopotamia** (modified from Wilkinson & Tucker 1995)
0.1-4.0ha	< 3.0ha
4.1-10ha	3.1-15ha
10.1-20ha	15.1-50ha
21.1-40ha	50.1-130ha
40.1-200ha	
> 200 ha.	

These six classes appear to fall into a twofold hierarchy of rural settlements: either less than seven hectares, or towns and cities greater than seven hectares (Pollock 1999: 68). At a more restricted scale, in the region of Umma, Ur III cuneiform texts allow settlement to be subdivided into a four-level hierarchy based on estimated populations: a) urban centers/cities (20,000-30,000 people), b) towns (5000), c) villages (600) and d) hamlets/small villages (50). In contrast, Adams' survey data suggests three levels, namely, urban centers (100-200ha), towns (7-30ha), and villages (2ha) (Steinkeller 2007: table 7). Overall, the hierarchies are remarkably similar except that the surveys appear to under-represent the record of hamlets/small villages by a significant amount.[6] This disparity is hardly surprising given that the earlier surveys by Adams were not intensive pedestrian surveys; therefore sites at the small end of the spectrum may well have been missed (see below). Moreover, settlement areas for specific periods may be less reliable because sites were not subdivided into smaller areas, with the result that occupied areas may only reflect the maximum size of any given site.

By way of comparison, in the northern Jazira in Iraq settlements of the mid/late third millennium BC fell into four discrete size classes (Table 3.1). They also formed a distinct spatial hierarchy, in this case focussed around the large settlement mound of Tell al-Hawa which occupied the apex (Wilkinson & Tucker 1995: Figs. 39 and 60).

In this northern hierarchy, the village-size sites which are relatively rare and quite small (< 2.5ha) form prominent small tells; there is a clear lack of the small, low sites that might be regarded as small villages or hamlets. As discussed below, this absence seems to be a significant feature in the pattern of settlement in parts of the Khabur basin and adjacent areas. In contrast, in the more sparsely populated areas adjacent to the Euphrates and parts of western Syria, small tells are the most frequent types of site (see above) and settlement hierarchies are more muted or even absent (Wilkinson *et al.* 2012).

In both the north and south certain functional classes of sites are less visible than the conspicuous mounds, and are therefore less readily discovered by archaeological surveys. This is particularly the case with settlements of pastoral nomads, who usually do not build houses, have few material possessions, and move frequently, with the

[6] That is the estimates are similar bearing in mind the range of assumed population densities of sites, namely between 100 and 200 persons per hectare.

result that they leave behind few remains to be discovered by archaeologists (Hole 1978; Cribb 1991; Rosen 1992; see Chapter 8).

When settlements of the mid to late third millennium BC are plotted to show the total size on the vertical axis and the rank order (largest, second largest etc) on the horizontal axis, the pre-eminence of southern cities is clear, although the situation changes as site size diminishes (Fig. 3.11). The rank-size curves for northern and southern Mesopotamia fall into three distinct sectors.

- For cities exceeding about 90ha in area, southern cities were considerably larger than those in the north, where sites attained an upper range of 100-120ha. Here, Mozan attained 120ha, and only the morphologically atypical site of Tell Taya exceeded this figure to attain an area of perhaps as much as 150ha (Reade 1982: 75).
- The overall range of sector 2 is from ca. 8ha to 80-90ha. From rank 12, at which point sites were in the range of 80-90ha, the northern sites overtook those in the south, so that the medium-sized settlements in the north (i.e., what might be the equivalent of small towns) were larger and more frequent than those in the south.
- Finally, below approximately 8-9ha, the southern sites again exceeded those in the north, showing that there were more smaller sites in the south than in the north. However, because of the predominance of small tells in more sparsely populated areas such as the Euphrates tributaries, this may be an artefact of the data base employed.

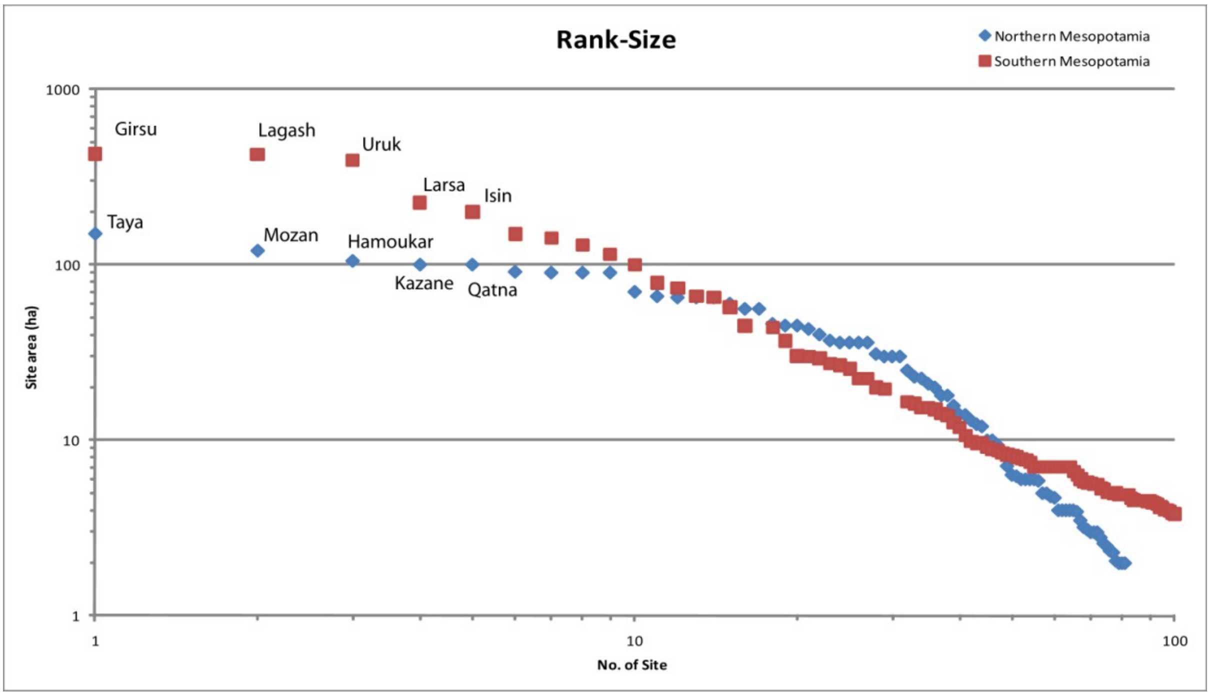

Fig. 3.11 Rank-size graph showing the contrasting rank and size of settlements in both southern and northern Mesopotamia; for discussion, see text. For clarity only the largest five sites for southern and northern Mesopotamia have been plotted (Compiled by Louise Rayne).

Although the spatial pre-eminence of southern cities is frequently stated, the gentler decline in the slope of the rank-size curve for northern sites (i.e., in sectors one and two) deserves comment. Overall, it appears that factors that drove settlement growth were less constrained for southern Mesopotamia than for the north: not only did settlements in the north not grow larger than around 100-120ha, but also there were more, and larger, 'town-size' settlements in the north than in the south.

As stated above, especially during late Early Dynastic times, southern Mesopotamia was not only dominated by large cities: a large proportion of the population also lived in such cities. On the other hand, the rain-fed north was a landscape dominated by small cities and towns. Moreover, the south was a landscape that apparently included more village size settlements (< 8-9ha) than was the case in the north. The latter point might be significant because surveys in the north have been more intensive than those in the south and have been successful at retrieving many smaller sites, but these do not include any dated to the third millennium. Despite the less intensive techniques used in southern Mesopotamia, and the problems of erosion–namely, masking by alluvial and irrigation sediments–surveys of the southern alluvium have succeeded in recording many more smaller third millennium BC sites than those in the north. That said, regional variations are important; hence in the Middle Euphrates and western Syria (specifically Homs), small sites less than 2ha dominate the landscape (Wilkinson *et al.* 2012: Fig. 12; Philip 2007). On the other hand, if surveys of the southern landscape have already recognized more small settlements, then it seems likely that an unknown number remain to be discovered. This would support the contention that the surveys of southern Mesopotamia may under-represent the smaller settlements (Steinkeller 2007). However, the interpretation of sites from textual evidence is not without its hazards. For example, although sites such as threshing floors are referred to in cuneiform texts, this does not necessarily mean that they were inhabited by a permanent population.[7] In summary, survey evidence suggests that not only was the south more urbanized during the later phases of the third millennium BC, it also had a larger component of its population living in village-sized communities. Nevertheless, regional variations may be crucial to the interpretation of settlement patterns.

If settlement is viewed not according to settlement size but in terms of the equivalent population that those settlements would house, it appears that during the phase of fourth millennium BC urbanization, settlement and perhaps population density was somewhat greater in northern Mesopotamia than in the south (Figs. 3.8 and 3.9). Although the figures can only be regarded as approximate, 'population' per square kilometre (equivalent to occupied ha per km^2) in the north was around 40-45 per km^2, but in the south fell between 10 and 20 per km^2, perhaps approaching 30-35 per km^2 in the mid-third millennium BC (equivalent to the late Early Dynastic period). These estimates, bearing in mind the above caveat regarding the estimation of population densities, imply that settlement and population densities may have been significantly higher in the north than in southern Mesopotamia. Therefore, if one accepts the model that urban centers are more likely to develop in areas of high population density (Boserup 1981: 63-75), it then follows that conditions favoring urban development may have been more propitious in the rain-fed north than in the irrigated south. Alternatively, in the south other factors such as the integrated system of rivers and channels may have made conditions ideal for the impressive growth of early cities. However, until additional intensive archaeological surveys have been conducted in southern Mesopotamia and the problems of alluvial sedimentation are better understood, such claims will be difficult to support.

Constraints on Settlement Size: North and South

Tells in Upper Mesopotamia, together with their surrounding mounds, did not grow much larger than approximately 100-120ha, an area capable of housing roughly 10,000 to 24,000 people or slightly more (Wilkinson 1994). This apparent limit may have been caused by the difficulty of transporting bulk goods such as cereals overland. As a result, cultivation was constrained to within 3-5km of the central site and, perhaps including the territories of some of the more prominent satellite communities (Wilkinson 1994). In addition there was probably significant competition between neighboring centers and their rulers for agricultural resources. As a result of these processes of constraint and competition, even favored settlements were unable to increase rapidly in size, and there was instead a tendency for settlement growth to have been balanced across a wider range of centers: hence the predominance of middle sized settlements or towns in Figure 3.11.

In contrast, southern Mesopotamian cities experienced fewer physical and environmental constraints. First, the availability of massive networks of canals and rivers made it relatively easy to transport products in bulk from

[7] In the rather different landscape of highland Yemen, ancient so-called Himyarite threshing floors occur in isolation within the fields or occasionally around the outside of settlements.

place to place to offset local deficits in production (Algaze 2005). Second, crop yields under irrigation were as much as 200% of those in the rain-fed north (see Chapters 4 & 5). Overall, southern Mesopotamian cities appear to have experienced processes of growth that were much more in keeping with modern cities, i.e., in which positive feedback prevails so that growth proceeds unhindered and the larger, more successful cities grow relatively unconstrained (Batty 2005: 24-25). Alternatively, according to Batty (2005: 356), 'cities persist until there is major transition–usually in terms of some technology affecting the cost of movement–that changes their state to one that is very different.' In the case of Mesopotamia, cities in the north and south existed under two very different transportation regimes: those in the north depended upon overland transport and those in the south benefited from the efficiencies of riverine water as well as ground transport, a point returned to in Chapter 15.

At the smaller end of the site-size spectrum, settlements of one to two hectares had populations that attained but did not exceed the optimum size for maintaining meaningful social relationships. This is based on the assumption that such tells were occupied predominantly by sedentary communities that achieved densities of around 100-200 persons per hectare, as is common in rural settlements in the Near East (Sumner 1979). Consequently, a one-hectare site could hold between 100 and 200 people and a two-hectare site 200 to 400. In other words, population sizes are unlikely to have exceeded 400 people, but more commonly would be about 100-200. This figure is significant because research on human group size as derived from evolutionary and organizational biology suggests that at populations greater than about 150 it is difficult to maintain functional social and organizational relationships (Dunbar 2003).[8] Above this ceiling, settlements might fission and form daughter communities, or people might migrate to growing centres. In a similar manner, residential neighbourhoods of major Mesopotamian cities are of roughly equivalent size to small Mesopotamian villages (one hectare) so that it is possible to maintain face-to-face communications (Stone 1995: 240; Smith 2003: 21).

While the constraints on larger settlements presented above differ between the north and the south, the social constraints as laid out by Dunbar would probably operate equally in both areas. This implies that, whereas city size might follow different trajectories in both north and south, the smaller sites *might* march to the same tune.

LANDSCAPES OF SETTLEMENT

The differences in settlement evolution between the southern plains of Sumer and Akkad and the plains of northern Mesopotamia are inextricably bound to their physical and cultural landscapes.

In the rain-fed north, the landscapes of Early Bronze Age settlement can be described as nodal. Here, simple tells, or tells with outer mounds and encircling walls, are dotted at intervals across the landscape and, where most clearly expressed, form the focal point of radial communications and roughly concentric agricultural systems. Landscape features consist of hollow way tracks, extensive scatters of pottery (termed *field scatters*), and pits for the extraction of mud bricks (see Chapter 4).

In contrast, by the mid-late third millennium, settlement in the south consisted of distinct alignments along main channels and canals. However, as pointed out above, such lineations do not seem to have been as pronounced during the Uruk period, when settlement appears to have been more widely distributed across the plain. Nevertheless, for the models used in the present volume, we are dealing with a landscape in which the main channels follow levee crests, lateral canals flow down the levee slopes, and settlements are aligned along the main channels, which presumably was also where palm gardens predominated. This rather orderly landscape is described in more detail in Chapter 4, and is used to provide the framework for modeling irrigation and its by-product salinization.

DEMOGRAPHIC CONTRASTS

One suggested precondition for urban development is that population must attain a sufficient density for cities to form (Boserup 1981: 63-75). If such were the case in Mesopotamia, there would probably be a direct correlation

[8] This theory continues to be debated (see for example Lyon et al. American Anthropologist 2011).

between population density (as estimated from the aggregate density of settlements per square kilometre) and the size that cities attained. When the data are plotted in tabular form (Fig. 3.8), preconditions for urbanization in the form of dense patterns of settlement appear to be better satisfied in the north, whereas cities developed more rapidly and became larger in southern Mesopotamia. From this it may be deduced that either prehistoric and early historic population densities in the south have been underestimated, or that the postulate of Boserup is flawed. On the other hand, the south not only accrued higher crop yields under irrigation, allowing for locally high population densities; the channel and canal systems themselves also attracted settlements, with the result that local concentrations of population may have been as high or even higher than in the north. Moreover, the use of channel systems for transport meant that, not only could bulk products be moved from city to city more efficiently, but also that the main settlements formed part of a network of communities that were more easily connected than those of the north.

In addition to the density of prevailing populations, population dynamics must also have been important in the rise of urbanization. Frequently civilizations are considered to unfold as cycles of settlement and population that rise and fall in roughly synchronous trajectories through time. Alternatively, archaeological surveys also indicate that there was a tendency for settlements to increase in some areas at the expense of other areas. This is evident in both northern and southern Mesopotamia, where there is compelling evidence to show that, during parts of the fourth and third millennia BC, in some areas settlements grew while others declined (Algaze 1999; Adams 1981; see also Pollock 1999).[9] Although the existence of such disparities is only suggestive, it appears likely that demography and associated settlement patterns were dynamic during the formative stages of urbanization: a process that fits with how urbanization frequently proceeds in the modern world, with larger cities growing at the expense of smaller settlements.

In terms of the internal dynamics of growth, it can be argued that in northern (Upper) Mesopotamia the initial phase of Late Chalcolithic urbanization was an emergent process (Chapter 1; Wilkinson *et al.* 2007b: 176; Ur 2010a: 413). Because such processes are ideal for modeling using agent-based approaches (Railsback & Grimm 2012: 10) the emergent approach was adopted by the MASS project. It is clear however that in northern Mesopotamia, because many third millennium cities grew and collapsed rapidly in response to a number of often unknown external factors, processes leading to emergence are probably more relevant to the development of fourth millennium cities.

In opposition to the dynamic processes that fuelled settlement growth, other factors held settlements in place. Not only were most Mesopotamian cities before the first millennium BC remarkably long-lived, but only under certain and perhaps dire circumstances were they abandoned and not resettled. Usually they were resettled, often as a matter of royal policy, because cities in both north and south were in places that were inherently significant. As noted above, a key contributory factor to the longevity of cities is the role of religion, and the sanctity of place (Wheatley 1971; Fox 1977) which resulted in cities such as Nippur, Eridu and Babylon remaining in the same location over millennia, despite there being considerable local fluctuations of population (Gibson 1992). This was also the case in the north, where cities such as Brak, Tell al-Hawa, Hamoukar, Mozan and Leilan, were occupied over some 3000 years or more. Nevertheless, areas that were either marginal for settlement or were deliberately colonized, such as the drier steppes of northern and central Syria, still experienced rather more short-lived episodes of city development (Hole & Kouchoukos 1995; Geyer *et al.* 2007; Lawrence 2012; Wilkinson *et al.* 2012). Significantly, the phase of maximum growth of such cities was usually brief. In contrast to cities of the fourth and third millennia BC, during the periods of the major territorial empires from ca. 1000 BC, new cities, especially royal capitals, were frequently founded and then abandoned.

In summary, and by reference to Figs. 3.8. and 3.9, conditions for settlement growth in southern Mesopotamia included a moderate population density as well as conditions that encouraged a rapid rise of population. These factors appear to have included a technology, namely irrigation, that permitted high crop yields and a well-

[9] Having said this, it is necessary to be cautious here, because in some case revisions of ceramic chronologies can change such conclusions.

connected and integrated network of canals and channels to mobilize the bulk staple products when required. It is now widely regarded that for modern cities, positive feedback processes enabled successful cities to become more successful, in part because more successful cities attract more people to live there (Pumain 2009: 242; 2012: 723-24; Bentley 2003: 17). As discussed in Chapters 11 and 15, this process of the rich getting richer (i.e., positive feedback) is fundamental to the development of scale-free networks; because cities–both ancient and modern–develop within social, religious and economic networks, then processes of positive feedback probably contribute to their growth (Bentley 2003: 17-23). Hence, the familiar rank-size curves of late historic and modern cities are usually linear (Gulden & Hammond 2012), and again suggest the operation of positive feedback processes. In contrast, ancient cities operated within a much more limiting environment, in which processes of growth were constrained by factors of food supply, social process or transport. Thus in the north the frictional effect of overland transport, as well as the high density of competing neighbors, dampened urban growth and constrained city size to roughly a quarter of that in the south.

MODELING SETTLEMENT

Cities first evolved in northern and southern Mesopotamia in the late fifth and fourth millennia BC, at a time before the appearance of written records. In this spirit the original proposal for the MASS Project assumed that cities of the fourth and third millennia BC emerged out of earlier village-size settlements such as the long-lived cities of Eridu (Safar *et al.* 1981) and Nippur (Gibson 1992). Although this book aims to capture the processes of growth of cities that eventually developed in the third millennium BC, it is the formative stages of the smaller fourth and third millennia BC settlements that are really being modeled. Moreover, the rural nature of southern Mesopotamia during many periods meant that these smaller settlements are not unusual, but rather represent a very common feature of Mesopotamian society throughout history.

The rapid processes of growth necessary for the development of the first cities in southern Mesopotamia were not simply a 'natural' growth based on the availability of natural resources or agricultural land. They also depended upon migration and economic exchange between communities, long-distance patterns of trade and exchange, the development and persistence of religious centers, integrated sheep and textile production, and the social requirements of communality that resulted in the advantages of urban living, as well as the role of cities as centers of power. The affect of such processes on urban growth in southern Mesopotamia are modeled in Chapter 14. Whereas exchange networks were seen to emerge out of the MASS simulations, it has also proved necessary to deliberately introduce specific processes relating to the use of power into the models (Chapter 14). The development of large cities also depended upon the growth of certain successful settlements, which grew at especially rapid rates, perhaps at the expense of less successful places or of outlying populations of mobile pastoralists. Such sedentary and/or mobile populations were probably occasionally sucked into the growing vortex of urbanization, as well as shed during phases of urban decline. Our initial models have been quite effective at showing how individual settlements grew in terms of their immediate subsistence needs, coped with problems such as the removal of labor or the sharing of plow teams, or exchanged with neighboring households; however, in order to model large scale population shifts from place to place, it is necessary that the models extend over large areas and multiple settlements. This scale of analysis has only been achieved by Altaweel's more generalized approach to simulations, which took place during the later phases of the MASS research (Chapter 14).

Our initial models build upon the early village stages of agricultural settlement, when small settlements of perhaps a few hundred people existed in both north and south. These depended predominantly upon the resources that were farmed within their immediate catchments. Such conditions cannot have been sufficient for urban development, but instead we anticipated that, as the social landscape became more complex, conditions would develop that were right for 'urban take-off'. The objective, therefore, was to see how such settlements might grow, as a result of both the farming strategies of different households (agents), and of the interactions between those households as they cooperated (or perhaps competed) for resources through time.

One assumption of our models has been that, rather than there being a single factor driving early urbanization, the plains of southern, and also perhaps northern, Mesopotamia provided the ideal combination of circumstances for cities to grow. The processes anticipated are along the lines expressed by Algaze, who employed the terms 'the synergistic caldron' and 'synergies of civilization'. In other words, the development of Mesopotamian civilization was dependent upon an ideal ecology that included various combinations of large areas of potential agricultural land, dense populations, and good riverine transport systems, as well as the potential to grow high crop yields via irrigation.

It is also significant that the present-day flat, desolate, and arid plains of southern Mesopotamia were probably more verdant than today during the periods leading up to urbanization, so that abundant fish, reeds, grazing, and wild animals were all available in abundance for hunting or gathering (Chapter 2). In the MASS modeling program, our approach has not been to bring all of these circumstances together in one vast set of interactions. Rather, we attempted to create at least part of the 'synergistic caldron' at a sufficient level of complexity, in order to allow additional levels of behavior to emerge which would then contribute to the further growth of settlement, and ultimately, perhaps, to the growth of urban-scale settlements. This selective process is particularly evident in the simulations of salinization generated by Altaweel in Chapter 13, which model part of the irrigation system as well as specific human choices. Nevertheless, it was the contrast in developmental trajectories of cities between the rain-fed north and the irrigated south that was intended to be central to our modeling. Although it has not been possible to undertake agent-based models of equivalent type and scale in both north and south, the MASS team has been able to model ancient societies and landscapes in both regions, and these models have drawn from a range of approaches: emergent, agent-based models; ecological models; and more generalized mathematical models (Chapters 11-14).

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